Frontiers in Oral and Maxillofacial Imaging, 2017

Editor-in-Chief: Li-Min Lin
Editors: Andy Y-T Teng, Yuk-Kwan Chen, Claudia Noffke, and Erich Raubenheimer

IADMFR/TAOMFR

International Congress Series – ISBN: 978-986-95957-0-4

Proceedings of 21st IADMFR/TAOMFR 2017 World Congress, Kaohsiung, Taiwan

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Published on: Dec. 27th, 2017; the 1st edition.
Published by: Taiwan Academy of Oral and Maxillofacial Radiology (TAOMFR)
Address: No.100, Shih- Chuan 1st Road, Kaohsiung City, 80708, Taiwan, R.O.C.
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The 21st International Congress of Dental and Maxillo-Facial Radiology

Photo Taken on April 27, 2017, Kaohsiung, Taiwan

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PREFACE AND INTRODUCTION

It has been my wish to compile a book of Proceedings with the key abstracts of papers and posters presented at the 2017 IADMFR academic meeting in Koahsiung. After months of communication with the delegates and editorial preparation of the abstracts submitted, I am presenting you with the final product.

The theme of the congress was arranged in three main topics: TMJ disorders, oral oncology and clinical diagnosis. We invited 42 prominent international speakers and received 236 papers (including one key note speech, 41 presentations on specialized topics, 91 oral presentations and 103 posters) from more than 400 attendees representing 34 countries. Importantly, without the sponsorship of several associations, organizations and companies, the high standard achieved would not have been possible.

The main goal of the proceedings was to provide an opportunity for the young researchers and those in the Asian continent, in particular, to nurture their skills for scientific writing in English. This will contribute towards the greater participation of researchers in our field in next generation of scientific achievements. The compendium of papers also serves as a directory of current active research themes pursued across the continents and will facilitate international cooperation, as the contact details of the main researcher is reflected in the title block of each paper. Several researchers also exploited the opportunity to acknowledge their funding agencies and the Proceedings also provide a reference for future grant applications and annual reports.

Over 100 authors (107 papers) responded enthusiastically to our invitation for submit their abstracts. The lower than expected response rate is probably the result of a lack of fluency in English (a factor the Proceedings aimed to address) and the belief that the material could not be published subsequent to the data appearing in printed form (the copy right issues). The last reason is unfounded as a full publication is significantly different from the abbreviated text presented in the Proceedings.

The outline of this book is straightforward: In the beginning we present a flow chart of the 21st IADMFR 2017 main committee structure, followed by the papers listed alphabetically according to the last names of the authors submitted.

In closing, I would like to thank my dear colleagues professors Andrew Teng and Yuk-Kuan Chen (members of the Academic Committee), and Ming-Gene Tu (Local General Secretary of IADMFR and President of TAOMFR). The editorial assistance of professors Claudia Noffke and Erich Raubenheimer from South Africa is also acknowledged. I wish to thank Professor Allan Farman for his eminent support in making this world congress and Proceedings possible.

Lastly, the harmonious international cooperation is a testimony to the common root of all mankind.

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Two radiological methods used for observing root canal morphology of maxillary teeth

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Introduction: Endodontic exploration by using conventional radiography did help when multiple angles were used. Today CBCT provides the opportunity to assess canal anatomy 3-dimensionally in a non-invasive manner. By using the CBCT the dentist can be prepared to identify variations in canal anatomy in order to clean them effectively. Our aim was to correlate the clinical findings with radiological images on the morphology of root canals for putting correct diagnoses and make a treatment planning in correlation with the anatomy.

Materials and methods: Our study included 20 patients diagnosed with different types of morphologies of root canals of the first maxillary premolar and first maxillary molar. After clinical examination we discovered a different morphology of some teeth than found on PA radiographs and we proceeded to performing CBCT on such cases.

Results: From 20 patients : 4 (2 molars- Figs. 1,2 and 2 premolars- Figs. 3,4) were diagnosed with different morphologies on PA radiographs, which can contribute to wrong clinical decisions, because the CBCT disproved the results. This compared with 16 patients examined with CBCT in whom the data achieved were decisive.

Conclusions: The MIP reconstruction in sagittal, coronal, axial, panoramic, cross section and oblique plane discovered different types of morphological root canal anatomy compared with PA radiographs. Evaluation with CBCT has a higher accuracy than PA radiographs.

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Figure 1: Control PA radiograph – iatrogenic perforation but no bleeding

Figure 2: CBCT 3D section – confirm the iatrogenic perforation and develop a morphological variation on MV root

Figure 3: PA radiograph – first maxillary premolar with 2 roots

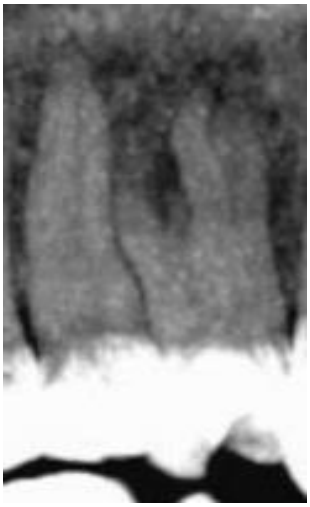

Figure 4: CBCT 3D section – first maxillary premolar with 3 roots

Next generation dental CBCT with 7 degrees of freedom

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Introduction: In the 1990s, high resolution limited cone beam computed tomography was invented.[1,2] A hybrid system with panoramic radiography and CBCT was developed in 2007. It is compact and very useful for general practice. However, the image quality of the hybrid system is lower than that of dedicated CBCT systems such as Accuitomo (J Morita MFG in Kyoto Japan).

The hybrid system needs to take the panoramic radiograph. Therefore, the main X-ray beam has to be set a few degrees off the horizontal plane. For that reason, the main X-ray beam cannot be perpendicular to the axis of the cylindrical Field of View (FOV), which is the ideal configuration for CBCT. In order to solve this problem, a next generation dental CBCT has been developed which is named Verview X800 (J. Morita MFG. Kyoto, Japan, Fig. 1). This developed new system has 7 independent degrees of freedom; X-Y position of the rotation center, rotation of the X-ray source and sensor through 360 degrees, up-down motion of the base of the rotational arm, up-down motion of the chin-rest for the patient, and width by height of the X-ray beam collimator. The system fits into the same space as the conventional system when this new system is taken by the CBCT image. The height of chin-rest is fixed. Then, the base of the rotational arm is moved to bring the horizontal beam to the center of the FOV. Thus, the main X-ray beam can be fixed in the ideal position as in dedicated CBCT systems. The study is aimed to show the image quality by new hybrid system.

Materials and methods: Two systems of CBCT images were compared. One of the images was taken traditional hybrid system as Veraview epocs 3Df (J Morita MFG) which X-ray main beam was set about 5 degrees off the horizontal. Another one was the new system as Veraview X800 which one was set horizontal. The equivalent human head phantom (Kyoto Kagaku Co. Kyoto, Japan) was taken both systems and compared the image quality.

Results: When the main beam was set horizontal as X800, that images were clearer than traditional hybrid system as 3Df. The radial artifact was reduced on new one (Fig. 2).

Conclusions: This next generation of the hybrid dental CBCT could be set the angle of main X-ray beam to horizontal from a few degrees off when CBCT was taken. It will be able to be used as a direct substitute for dedicated CBCT systems.

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Figure 1: Veraview X800

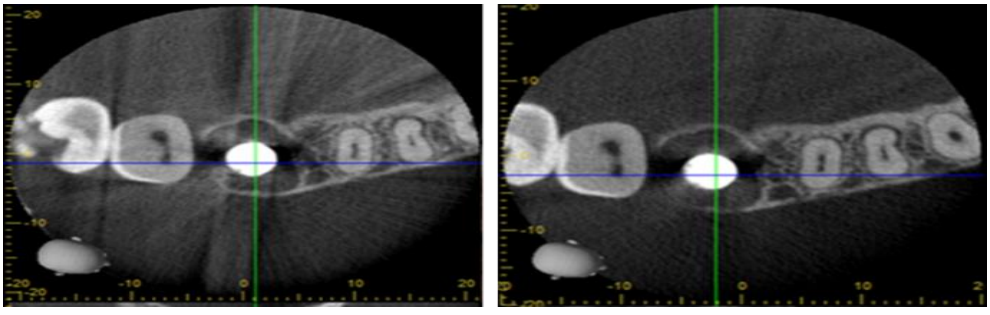

Figure 2: Comparison of the images

Observation of bone remodeling *in vivo* micro CT

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Introduction: I succeeded in developing a high resolution and limited area cone beam computed tomography (HLCBCT) for dentistry in 1997. These days, the equipment is commonly used in dental offices. However, there is still a problem of a lack of basic research on clinical applications. This is because in clinical applications we cannot determine the pathology and a lot of the number of CT scans because of radiation dose issues. Therefore, I developed *in vivo* micro CT for experimental animals in 2005.[1] As a result, it became possible to observe the continuation of the remodeling of the bone formation using the same experimental animals over a long period. This presentation will focus on bone remodeling, sclerosis, and peri-implantitis using HLCBCT and *in vivo* micro CT. It is thought that when inflammation occurs the bone develops sclerosis in order to defend against infection. So, sclerosis is a biological defense reaction. But after the treatment, the lamina dura and the periodontal ligament space become clearly visible and the alveolar bone becomes more radiolucent because the bone has remodeled to fresh bone. This phenomenon is observed in periapical disease as it is in peri-implantitis.

The study is aimed to show remodeling bone using *in vivo* micro CT.

Materials and methods: The Titanium implant was inserted into the tibia in the individual rat after drilling. The tibia of a region was taken by *in vivo* micro CT (R_mCT, Rigaku Co., Tokyo, Japan) at just post operation, after the 1st week, 2nd week and 5th week, continuously (Fig. 1).

Results: After 1st week, the newly bone was remodeling and looked like a cloud. After the 2nd week, the beam structure of bone was starting to appear. After the 5th week, the big beam structure of bone was visible. It was supporting the implant (Fig. 2).

Conclusion: *In vivo* micro CT was a very useful observation of remodeling bone continuously. This study showed that if there were many times of remodeling bone over and over, finally the thick beams were developed, and the implant was supported with the beams.[2]

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results in immediate peri-implant bone loss. Clin Exper Dent Res 2016;1: 65–72.

Figure 1: *In vivo* micro CT (RmCT)

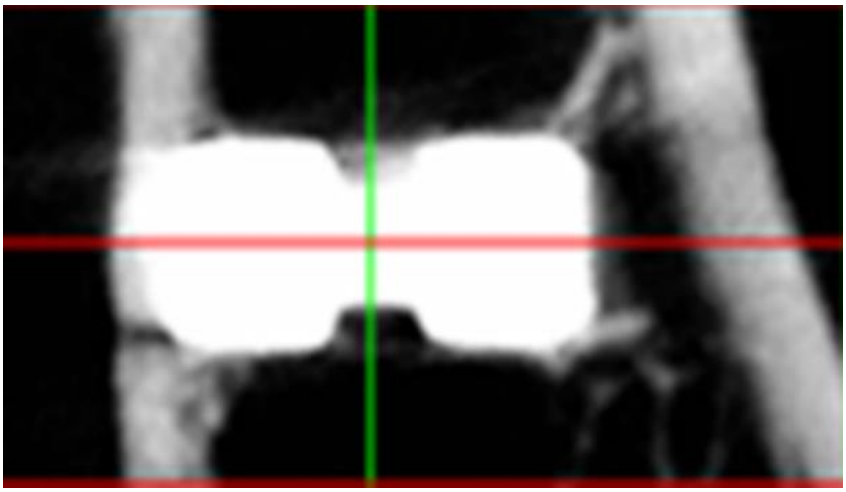

Figure 2: The thick beams structure (5th week)

Differential diagnosis of the lesions in the oral and maxillofacial region using CT and MRI

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Introduction: Among the modality of diagnosis, CT/MRI has proved to have excellent ability in demonstrating normal anatomy and pathologic processes in the oral and maxillofacial region. Whereas CT best depicts bone structures, MRI is superior to CT in evaluating soft tissues. The contents of bone lesions may also be better visualized on MRI. In this report, I will present the representative CT and MR images of lesions in the oral and maxillofacial region and discuss their imaging characteristics that provide important clues to differential diagnosis.

Materials and methods: The characteristic imaging features, especially in the MRI, were shown in the following lesions: cystic lesions in the jaw bone such as radicular cyst, dentigerous cyst, nasopalatine duct cyst, odontogenic keratocyst, simple bone cyst and aneurysmal bone cyst, and benign odontogenic tumors in the jaw bone such as ameloblastoma, adenomatoid odontogenic tumor (AOT), odontogenic myxoma/myxofibroma, and odontogenic fibroma.

Results: Among the radicular cyst, dentigerous cyst and nasopalatine duct cyst, we can differentiate them on the basis of signal intensity (SI) on T1WI. Radicular cysts, dentigerous cysts and nasopalatine duct cysts have different contents in the lesion. The dentigerous cyst includes higher density protein. The nasopalatine duct cyst includes abundant keratin and viscous fluid. Thus, the MRI may reflect the histopathological findings well. Characteristic findings of odontogenic keratocyst are that T1WI includes slight high SI area, T2WI low SI area. These reflect a large amount of keratin. The simple bone cyst shows that the uptake of the contrast agent in the cystic cavity gradually increases. The aneurysmal bone cyst demonstrates the characteristic feature showed a 'bubbly' appearance, on T2WI and created a 'honeycomb' like appearance in MRI. In the unicystic ameloblastoma, on CE-T1WI, only the surrounding area including the mural nodule and the thick wall shows well enhancement in the lesion. In comparison with odontogenic benign tumors, we confirmed that the DCE-MRI makes it possible to differentiate central odontogenic fibroma from the other odontogenic benign tumors such as ameloblastoma, AOT, odontogenic myxoma.

Conclusions: We could add additional information for differential diagnosis in the lesions of the jawbone using MRI.

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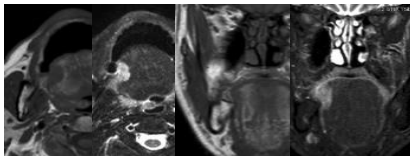
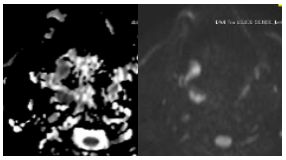
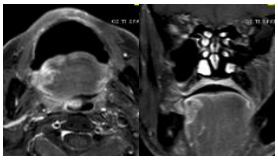
MRI protocol in Okayama University

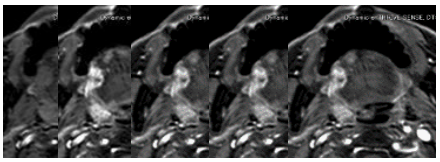
T1&T2WI (STIR) DWI CE-T1WI

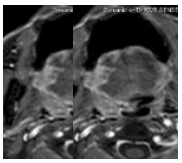


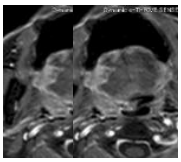




Dynamic MRI, 1st scan 2nd scan 3rd scan







1, 2, 3･･･ ･･ ･･･ ････ ･19, 20, 21 1, 2 1, 2 scans

Salivary diagnostics – A reflection of our experience

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Introduction: Saliva hosts most of the biomolecules that are circulating in our blood. A myriad of these salivary proteins could serve as biological markers for diagnosing and tracking the progression of various health conditions.[1] The advantages of using saliva as a diagnostic body fluid compared to blood are: sampling is non-invasive, rapid and allows multiple sample collections; collection process is painless and ideal for population based screening programs; there is minimal threat to the collector of contracting infectious agents, such as hepatitis and/or human immunodeficiency virus (HIV). This paper highlights the role of saliva and discusses our experience of salivary diagnostics in various oral and systemic conditions and in deoxyribose nucleic acid (DNA) isolation for human identification.

Material and methods: The studies were conducted on patients who reported to our institution between 2007 and 2016. The patients were grouped based on the presence of HIV infection, gastro-intestinal disorders, coronary artery disease, diabetes, potentially malignant disorders (PMDs) and for DNA isolation for human identification. Whole saliva was collected and analyzed for HIV antibodies, anti H. pylori IgG, lipid profile, glucose levels, interleukin-8 (IL-8) and lactate dehydrogenase (LDH) levels and for DNA isolation respectively.

Results and discussion: Positive predictive value was found to be 100%, 85.19% in HIV infection and gastro-intestinal disorders respectively. Significantly positive levels of salivary glucose in diabetics and salivary total cholesterol, triglyceride and low density lipoprotein levels in patients with acute myocardial infarction were found. Levels of IL-8 and LDH were statistically significant in patients with PMD. DNA was isolated on day 1 and day 7 at 0 ^{o}C and 7 ^{o}C. Highest yield was at 0 ^{o}C on day 1 followed by day 7 (Table 1).

Conclusion: Identification of minor components of saliva by using advanced techniques has led us to conclude that saliva can be used as an efficient tool for detection of several diseases. It would not be too optimistic for us to believe that in the near future human saliva would replace blood as a relevant diagnostic medium.

References

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Table 1

Salivary Diagnostics in Diabetes Mellitus

Comparison of Serum RNFPG and Salivary glucose levels in the study groups

	RNFPG* (mean) mg/dl	Un-stimulated salivary glucose (mean) mg/dl	r value	Stimulated salivary glucose (mean) mg/dl	r value
Control group	103.30	1.15	0.663	0.98	0.512
Controlled diabetes	169.23	2.04	0.847	1.88	0.830
Uncontrolled diabetes	290.00	3.99	0.704	3.61	0.636

p < 0.001 – statistically significant in all the three groups

*RNFPG – Random Non-fasting Plasma Glucose

Salivary Diagnostics in Acute Myocardial Infarction

Comparison of Serum and Salivary Total Cholesterol, Triglycerides and Low Density Lipoproteins

	Total cholesterol	Triglycerides	Low Density Lipoprotein
Group I Serum Saliva	151.01(± 23.67) 25.19 (± 3.8)	140.80 (± 24.7) 47.75 (± 9.71)	63.78 (± 15.47) 8.44 (± 3.17)
Group II Serum Saliva	207.35 (± 38.27) 42.07 (± 7.52)	273.70 (± 59.25) 98.64 (± 22.07)	103.23 (± 27.05) 12.77 (± 5.05)
Group III Serum Saliva	215.07 (± 54.9) 44.72 (± 11.31)	290.40 (± 190.09) 106.33 (± 70.86)	136.87 (± 44.57) 18.60 (± 6.78)

p value – 0.001- highly statistically significant

Salivary Diagnostics in HIV Infection

Test	Serum					
Saliva	Reactive	Non-Reactive				
Reactive	39	0	Sensitivity	Specificity	PPV*	NPV*
Non-Reactive	1	40	0.9750	1.0000	1.0000 (100%)	0.9756 (97.56%)
Total	40	40				

The **sensitivity** of saliva test was found to be 97.50% and the **specificity** was found to be 100%. The probability of the patients having HIV is 100 % when the test is positive. PPV- Positive predictive value, NPV- Negative predictive value

Salivary Diagnostics in Detection of anti H-Pylori Antibodies

Test	Histopathology			Sensitivity	Specificity	PPV*	NPV*
ELISA	Positive	Negative	Total				
Positive	23	4	27				
Negative	6	7	13	0.7931	0.6364	0.8519 (85.19%)	0.5385
Total	29	11	40				

The **sensitivity** of saliva test was found to be **79.31 %** and the **specificity** was found to be **63.64%.** The probability of the patients having H. pylori infection is 85.19 % when the test is positive. PPV- Positive predictive value, NPV- Negative predictive value

Salivary Diagnostics in DNA Isolation

Nature of genomic DNA

Storage time	1 Day			7 days		
Storage temperature	RT*	0 ^{0}C	-7 ^{0}C	RT*	0^{0}C	-7 ^{0}C
Quantity (µg/250ml)	9.24	8.64	6.66	8.88	7.83	6.24
Quality at Å 260/280	1.82	1.80	1.83	1.81	1.82	1.76

Comparison of the quality of DNA stored for 1 day and 7 days at three temperatures

Quality Å 260/280	Storage period		P value
	1 day	7 days	
Room temperature	1.82	1.81	0.0696
0 ^{0}C	1.80	1.82	0.001
-7 ^{0}C	1.83	1.76	0.0001

Retrospective study of CT scans. Report of a case of calsifying myositis of the medial pterygoid

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Introduction and objectives: The deposition of calcium salts, if in soft tissues, occurs in a disorganized fashion.When calcification of the musculature occurs after a history of trauma, is called traumatic ossificans myositis. The purpose of this study was to observe calcifications in soft tissues related to the maxilla and the mandible through panoramic radiographs and/or multislice CT scans.

Material and methods: Data was gathered through the retrospective analysis of patients, with panoramic radiographs and multislice CT scans obtained from November 2014 to November 2016. The following machines were used in this study: the Rotograph Plus, Italy, for X-ray and the Somatom Sensation 64 Tomograph, by Siemens, Germany, for the CT scans.

Results and dscussion: 2,444 panoramic radiographies were observed and analyzed and only in two patients, calcifications were observed overlapping the mandibular ramus and body, and CT scans showed extensive calcifications of the submandibular gland. One patient had a large focus of heterotopic ossification identified within the lower fibers of the right medial pterygoid muscle, in close contact and neoarticulated with the mandibular ramus of this side, close to the mandibular angle. Inferiorly, the ossification extended to the hyoid bone; posteriorly, it crossed the right submandibular gland; medially, it reached the posterior belly of the digastric muscle; and, in its more medial aspect, led to an extrinsic bulging upon the lateral wall of the nasopharynx.

Conclusion: The diagnostic sensitivity and the levels of specificity with multislice CT scans are as high as or higher than those obtained with panoramic radiography and other methods of diagnosis. Multislice CT is the preferred latent image modality for the diagnosis of heterotopic calcifications of muscular tissues and salivary calculi.

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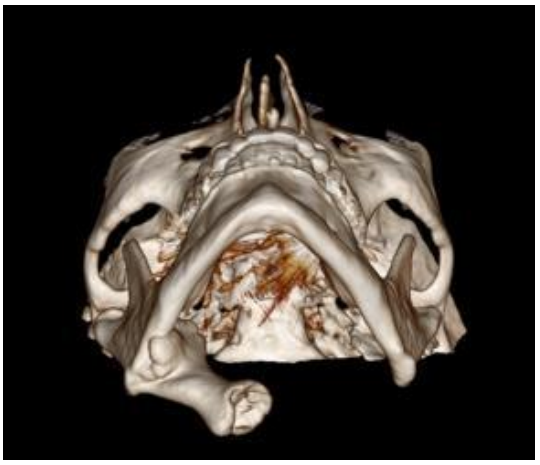

Figure 1: 3D calcification, inferior view of the mandible

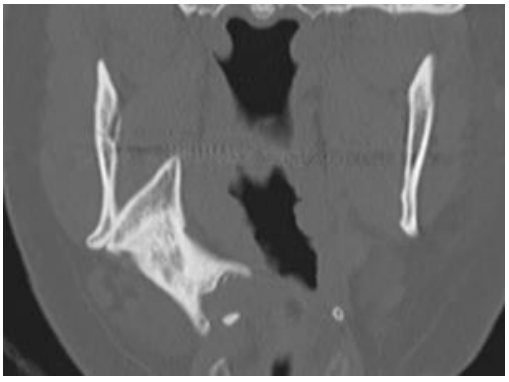

Figure 2: Coronal section showing the calcification join with the angle of the right mandible

Figure 3: CT examination of a 48-year-old patient by myositis of the medial pterygoid

C-arm: A new diagnostic imaging modality for evaluating dynamic changes in TMJ

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Introduction: Radiological investigations are of paramount importance in the diagnostic assessment of a patient with TMD. The limitations of conventional radiography and various TMJ projections to evaluate the soft tissue components of TMJ have been replaced with advanced imaging techniques like USG, CT, MRI, CBCT and Nuclide Imaging. Within a span of 30 years the technological advances in imaging has gained rapid momentum expanding the arena for diagnosing the TMJ disorders. The insight into the latest procedure guided imaging like C-arm into various medical specialities and its extension into dentistry cannot be undermined. Application of C-arm technology to study the dynamics of TMJ is unique of its kind as this is the only modality where TMJ can be studied in motion and provides an excellent insight into the biomechanics of the most unique joint in the body.

TMJ imaging has been broadly classified into non-invasive and invasive modalities. Non-invasive modalities include CT, MRI, USG, CBCT, and other conventional method and TMJ projections. Invasive modalities includes arthrography, arthroscopy.

C-arm comprises a generator (X-ray source) and an image intensifier or flat-panel detector, which was discovered by Ziehm in 2006. An innovative imaging technique composed of flat panel detectors it generates 2D CT like images and finds it wide application in RCT, implant imaging and in trauma assessment.

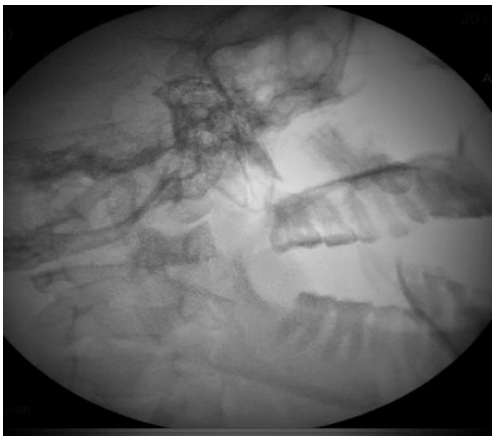
Objective: The basic objective of the study to evaluate the efficacy of c arm in measuring the range of dynamic movement.

Methdology: C arm with a specification of 14 kHz, 1.9 kW, 40–120 kV, 8.0–250 mA with a fluoroscopy rate of one image per second. With a sample size of 22 and equal division of control and sample size included patients with complaints of persistent TMJ pain. Patient were positioned supine with head tilted at 30° from the mid sagittal plane and forming an angle of 10° upwards & FH plane being perpendicular to the floor. The Interincisal distance for each sample was measured (mesio-incisal angle of upper central incisor to the mesio-incisal angle of lower central incisor) and condylar distance (most superior point of articular eminence to most superior aspect of convexity of condyle).

Result: The age distribution shows (GRAPH 1) that 20–30 years age group in the

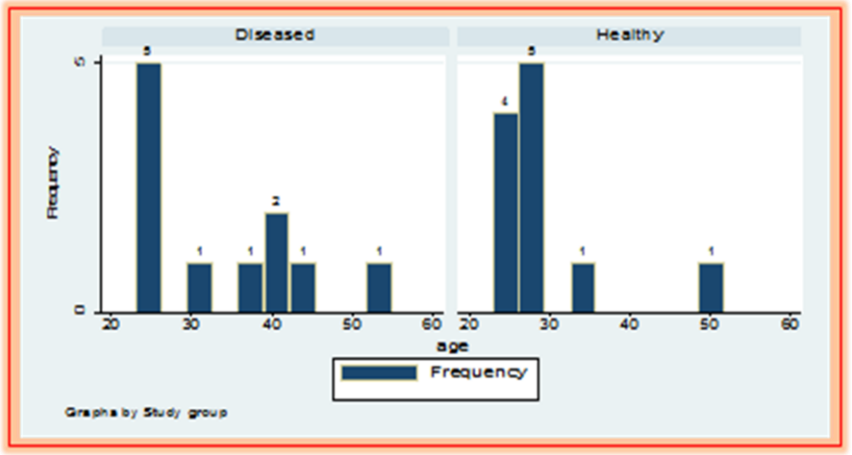
present study are affected most which can be explained as the study sample is very small and larger symptomatic cases need to be included. Maximum cases (GRAPH 2) are in the range of 10–15mm of condylar distance in diseased group and in healthy group as well. So one important finding that evolves is that there should be other parameters determining the TMJ symptoms or coexisting factors along with the present variable. There is uniform distribution of data from 35–65 mm; so, the interincisal distance (GRAPH 3) determining any TMJ disorder is ambiguous.

Conclusion: The programming of C arm in dental use mostly in TMJ helps in evaluation with respect to adjusting the image clarity, contrast, sharpness and preventing the overlapping of the adjacent structures. This machine has been widely used in gastroenterology, neurology and orthopaedics but no considerable work has been done in the field of TMJ in order to see the dynamic movement. So, it can be considered in near future for further in depth research in TMJ dynamics.

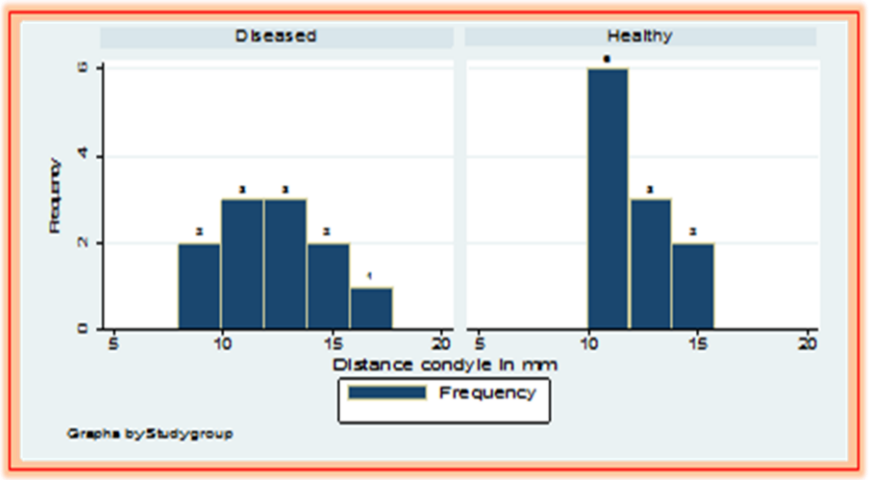


Sectional Image of C-arm (normal TMJ)

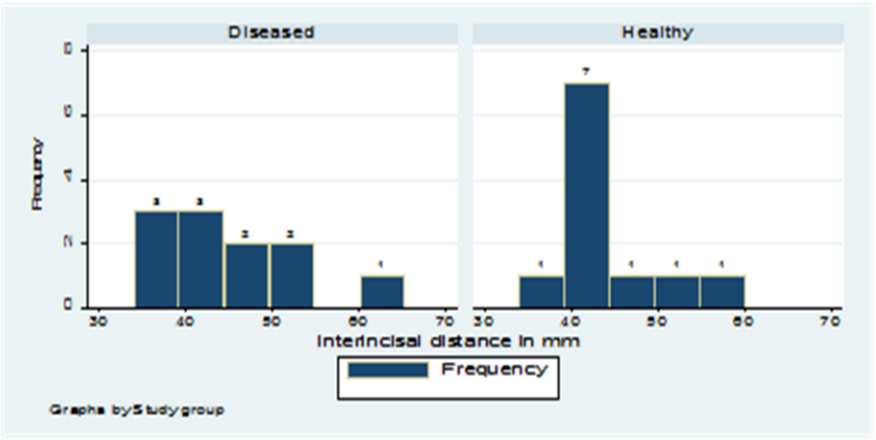
GRAPH 1



GRAPH 2 Maximum cases are in the range of 10–15 mm of condylar distance in diseased group and in healthy group as well



GRAPH 3 As the graph is more or less symmetric in case group i.e. there is uniform distribution of data from 35–65 mm so the Interincisal distance determining any TMJ disorder is ambiguous



High resolution cone beam tomography of the temporomandibular joint

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Introduction: Oral and maxillofacial imaging diagnostic capability has dramatically grown since the introduction of cone beam Computed Tomography (CBCT). This radiological modality has allowed obtaining high quality volumetric images of the maxillofacial region with low radiation dose and at reasonable costs. Since the introduction in the market of the first Cone Beam units less than two decades ago, we witnessed the introduction of hundreds of models and trademarks of machines using this technology but with great differences in the quality of the images they procure. Subtle osseous morphologic changes in the temporomandibular joint (TMJ) can only be detected in sufficiently high spatial resolution CBCT images. The current presentation focuses on imaging diagnosis of the TMJ through high resolution CBCT images.

Objectives: To discuss the following topics:

- Principles for generating high resolution images in cone beam.
- CBCT imaging settings to obtain the best possible diagnostic TMJ images.
- Anatomy of ATM in CBCT.
- Anatomic Variations of ATM observed in CBCT.
- Degenerative morphological changes of TMJ in CBCT, description and sequence of the imaginologic signs.
- TMJ positional and dynamics changes observed in CBCT.
- Prevalent pathology of the TMJ.
- Ongoing investigations that relate the anatomy of TMJ predisposing to certain diseases.

Conclusions: CBCT performed with high resolution and limited field of view (FOV) allows us to successfully apply this technology in the study and diagnostic of the TMJ. The diagnostic capability of the high resolution CBCT images makes it feasible to detect subtle changes in the anatomy of the bony components of the TMJ as well as changes in the cortical and cancellous bone structure.

He uses CBCT in TMJ is having a major impact as a primary diagnostic tool, because of its accessibility, low cost, high resolution and lower radiation doses. CBCT imaging parameters like voxel size, slice thickness, number of frames, kV, and mA has to be carefully selected, to obtain the best diagnostic images possible. A diagnostic protocol is presented to lead a consistent written TMJ CBCT report that includes morphological and positional changes of the TMJ in maximal occlusal intercuspation, open mouth and different jaw excursions.

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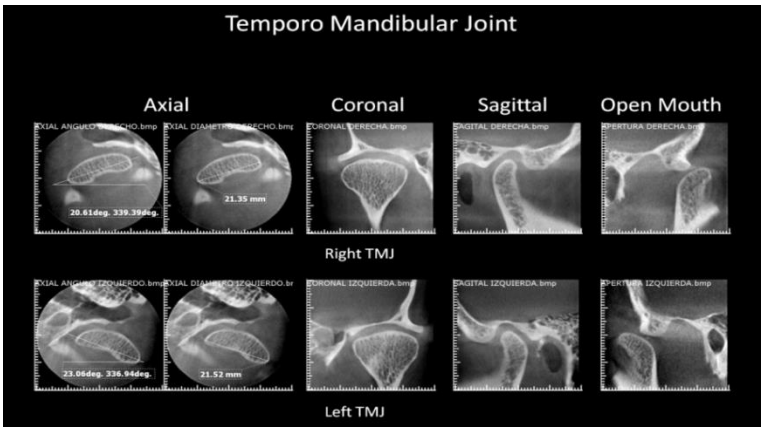

Figure 1: Typical high resolution CBCT study of a healthy TMJ

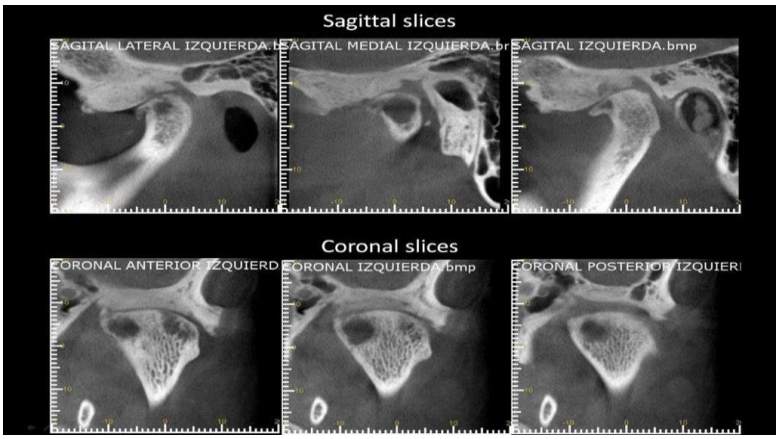

Figure 2: Coronal and sagittal high resolution CBCT slices showing erosions and flattening of the articular surfaces, loss of the interarticular space, subcortical sclerosis, osteophyte formation, osteolysis and subchondral cyst formation

Measurement of dose perception and radiation risk of radiographs by teachers and students of dentistry

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Introduction: All types of radiographs have become an essential tool in the world of dentistry. However, there are some studies that have been raising the concern from practitioners and patients about the potential risks associated to ionizing radiation exposure of these tests.[1]

Objective: To analyze and compare the perception of radiation dose and risk of cancer of maxillofacial radiological exams by academics and students of dentistry at the Universidad del Desarrollo, Santiago, Chile.

Material and method: A cross-sectional analytical study was carried out during the months of August to October 2016. The sample consisted of teachers and students of the 5th and the 6th year of dentistry. Radiology teachers and specialists were excluded from the study. The participants answered an online survey designed for the measurement of the perception of radiation doses and the cancer risk associated with each radiographic examination commonly used in dentistry. All the data collected were submitted to statistical analysis, which included averages, variance and Mann Whitney U Test.

Results: The average values obtained, for students and teachers, of doses perception and cancer risk associated with dental X-ray exams, were in all cases higher (overestimated) than the real values obtained from multiple studies, except for the cone beam CT (medium and large field of view) and CT scan, where the perception on radiation doses was lower than the real values (Figs. 1,2). In general, the answers between these two groups did not have significant differences.

Conclusion: Students and teachers of dentistry in Universidad del Desarrollo, overestimate the amount of ionizing radiation and cancer risk associated with dental radiographic exams. The need to use new education strategies in terms of ionizing radiation doses and potential risks associated with each radiographic exam is evidenced in order to reduce apprehensions and fears, thus obtaining the maximum benefit of the important tool that radiology constitutes.

References

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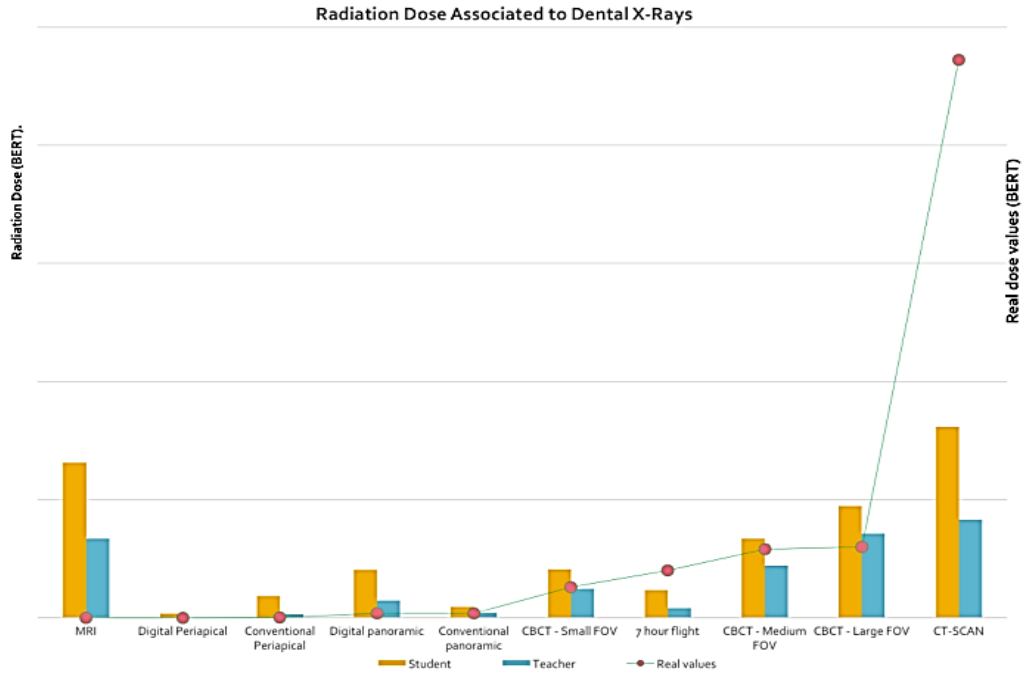

Figure 1: Radiation dose associated to dental X-ray

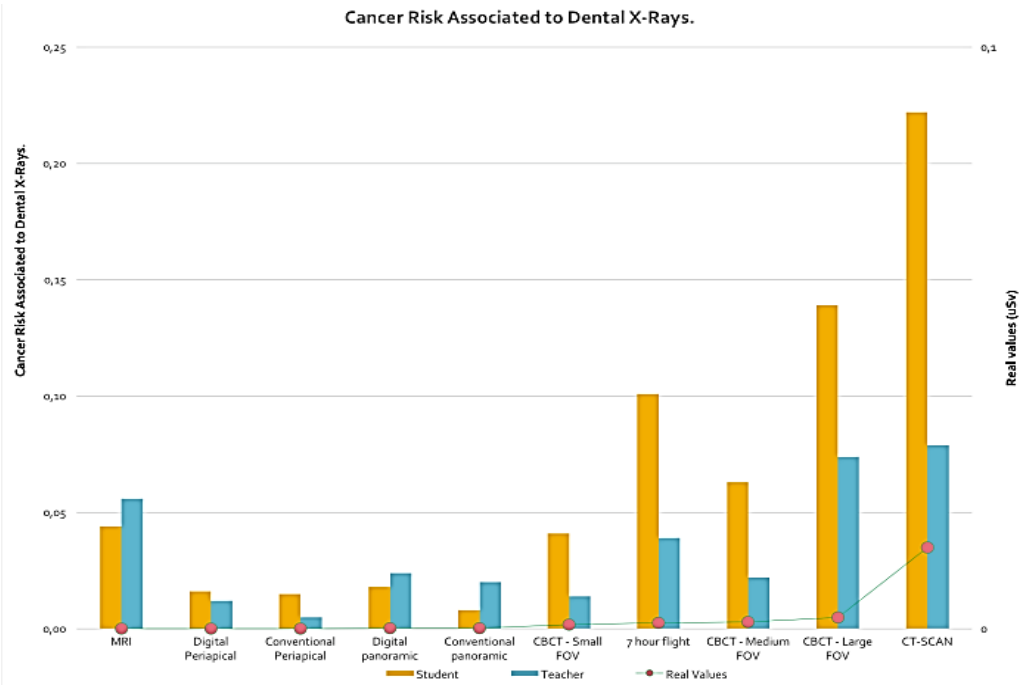

Figure 2: Cancer risk associated to dental X-ray

Gubernaculum dentis: A report of 31 cases

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Introduction: Gubernaculum dentis (GD) is a rare vestigial anatomic structure, composed by the gubernacular tract (GT), which is a bony pathway in alveolar bone that enables communication between the dental follicle and the alveolar crest. Its content is the gubernacular cord.[1] It acts as an eruption pathway rather than a stimulus for eruption. During the eruptive phase, the successor tooth moves in an axial direction towards the oral cavity and the gubernacular tract, which can be seen on radiographs, is widened by local osteoclastic activity.[2] GD is barely described in the radiology literature, leading to omissions, errors or diagnostic confusion with normal anatomic structures.

Objectives: To describe the imaging characteristics- and elaborate on the differential diagnosis of the GD.

Material and methods: GD visualization was retrospectively analyzed using CBCT, panoramic and periapical radiographs from January 2015 to October 2016. Thirty one cases of GD were observed in 16 patients.

Results: Out of the 31 cases that were studied, 14 were canines in the process of eruption or impacted, one deciduous molar, two supernumeraries, six premolars, two incisors accompanied by odontomas, one compound odontoma, and five third molars. In all cases the radiographic images presented similar characteristics. In only one case radiographic signs of cystic or tumoral pathology were observed.

Conclusion: The GD should be described on radiographs as Gubernacular Tract. It is visualized as a radiolucent canal, with cortical, parallel and generally rectilinear borders, which diameter and length varies in all cases. It extends from the pericoronal space of an unerupted or impacted tooth or an odontoma to the corresponding zone at the alveolar crest (Fig. 1). It is always bilateral, unless the contralateral counterpart has erupted or does not exist (Fig. 2). It must be differentiated from bone trabeculae, medullary spaces, neurovascular bundles, fistula tracts and the nasopalatine canal. It is a normal structure which is seen in all cases with erupting teeth and is not related to pathology.

References

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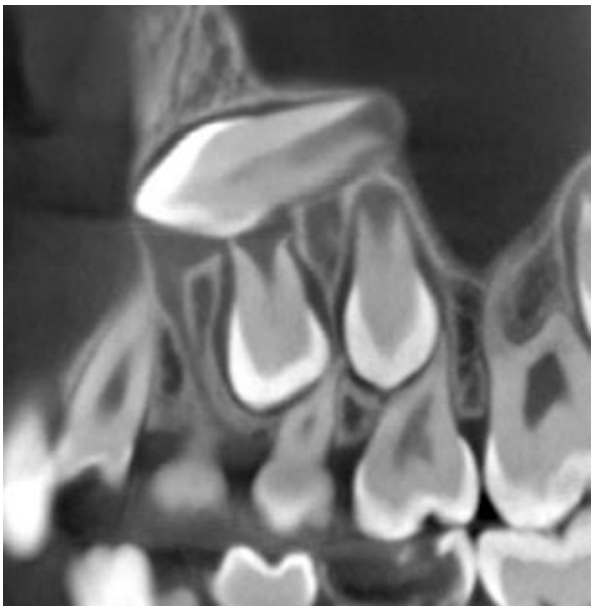

Figure 1: Gubernaculum dentis in tooth 23

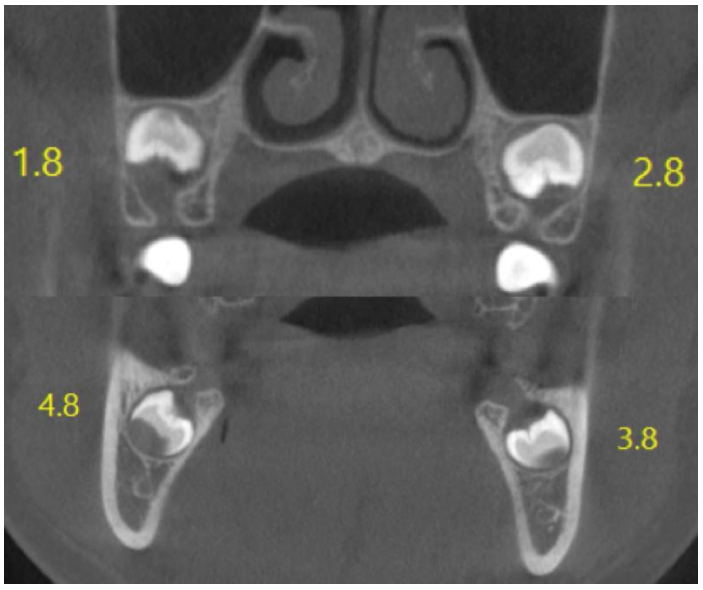

Figure 2: Gubernaculum dentis in third molars bilaterally

Puzzles to ponder: cases from my collection

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Introduction: This presentation is designed to show through selected cases the process one experienced dentomaxillofacial radiologist uses to analyze radiographic images and to develop a differential diagnosis for various types of lesions that present in the jaws. The emphasis will be on the thought process itself, not specifically on the actual diagnoses.

Materials and methods: A series of five cases is presented, all with CBCT images in various planes, along with pertinent history and clinical findings. Description of the lesions is made, with reference to the following features: location, shape, density, size, border, number, effect on bone and effect on teeth.[1] The features of interest of each case are summarized and then a differential diagnosis is presented and discussed. A diagnostic aid available on the Internet, ORAD III, Oral Radiographic Differential Diagnosis,[2] is demonstrated and discussed.

Results: Cases presented include a small multilocular lesion in the angle of the mandible in an 11 years old male, with differential diagnosis of desmoplastic fibroma or vascular lesion; a low density lesion with permeative margins located inferior to the mandibular canal in a 39 years old male, with diagnosis of Langerhans histiocytosis; a similar appearing lesion in the third molar region in a 17 years old female, with diagnosis of simple bone cyst; an expansile multilocular lesion filling the ramus in a 15 years old male, with diagnosis of ameloblastoma; and an ill-defined low density area around a premolar in a 36 years old female, with a diagnosis of non-specific inflammation. ORAD was applied in all of the cases, with mixed usefulness and accuracy.

Conclusions: When faced with an unknown entity on images, the radiologist should try to identify the significant features, both clinical and imaging, and then try to find reasonable possibilities that fit all the features. Use of diagnostic aids, such as textbooks or computer programs, such as ORAD, may be helpful. However, since ORAD incorporates information provided by the user about patient demographics and lesion characteristics into a statistical algorithm to develop a differential diagnosis, the helpfulness of the diagnosis list generated will depend on the accuracy of the data input and the degree to which the lesion matches the information in the program database. Another source of help for difficult cases is other professional colleagues.

References

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ORAL Radiology ORADI

Oral Radiographic Differential Diagnosis
© 1995 Stuart C. White, DDS, PhD
Scripting © 2015 by **William L. Scheding**
Illustrations by **Brad deCaussin**
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Please send comments to:
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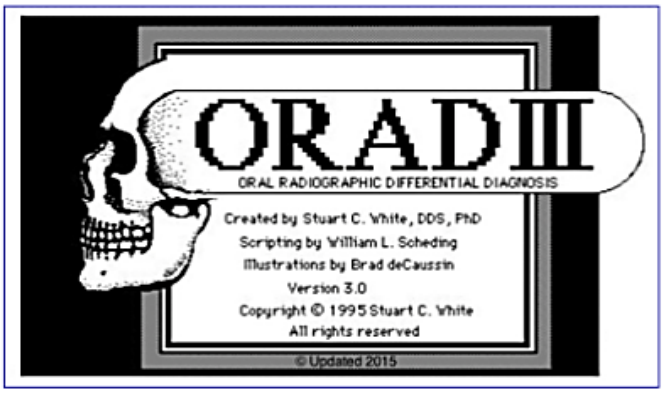
Los Angeles, CA 90095-1668
USA

ORAD for the web & ORADMobile:
Wm.L.Scheding



The purpose of this program is to assist in generating a differential diagnosis for radiographic lesions of the jaws.
It will evaluate information you provide and compare it to data the most common lesions manifested in the maxilla or mandible.

This program is intended to serve as an aid to the clinician. It is NOT a substitute for professional judgment.

Touch here or on the image above to start ORAD.

Touch here for introductory comments about ORAD.

ORAL Radiology ORADI

Patient Characteristics

CLINICAL FEATURES

- What is the sex of your patient? Male
- What is the race of your patient? Nonblack
- What is the age of your patient? 26 - 50
- Does your patient have pain or paresthesia? No pain

RADIOGRAPHIC FEATURES

Location

- Which jaw contains the lesion? Mandible only
- The lesion center is in what region ? Molar region
- The relationship of the lesion to teeth is: Not tooth associated
- Please estimate the number of lesions: One
- What is the maximum size of the lesion? Less than 2 cm
- Where is the origin of the lesion? Central

Periphery

- The borders of the lesion are: Corticated
- The loculation of the lesion is: Unilocular

Internal Structure

- The contents of the lesions are: Radiolucent
- Does the lesion contain one or more teeth ? No

Effects on Surrounding Structures

- Does the lesion expand the bony cortex? No
- Does the lesion cause root resorption ? No
- Does the lesion cause tooth displacement or impaction? No

Shall we consider prevalence? Yes

Touch Differential when finished to formulate a radiographic differential. Touch Reset to reset the form.

Clinico-pathological conference

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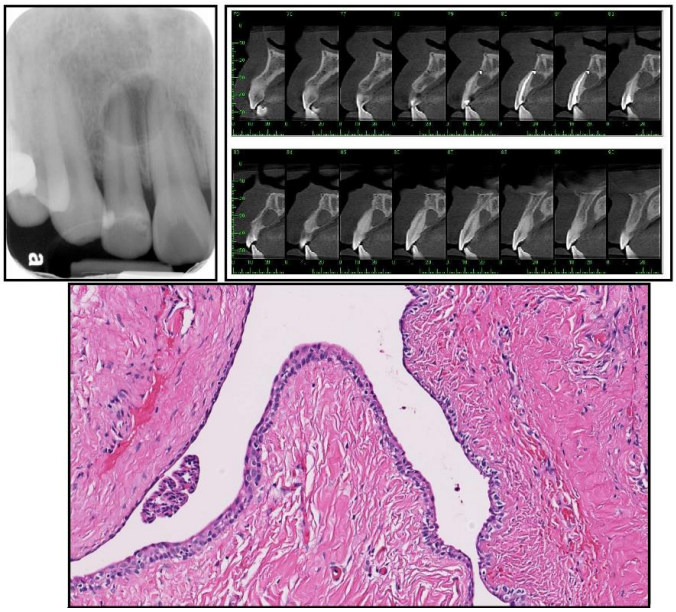
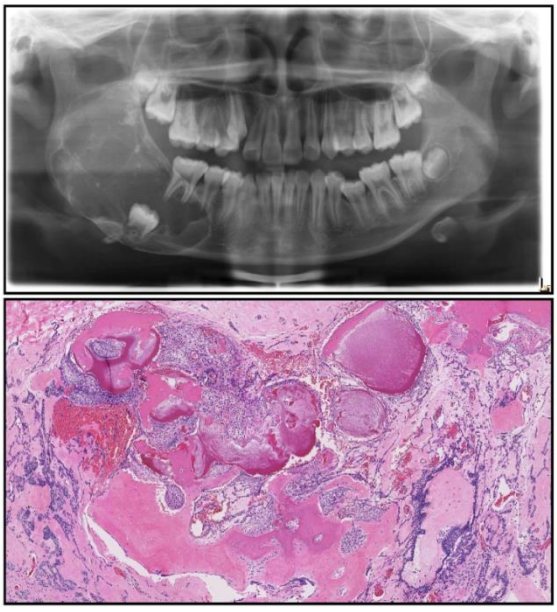
Case 1: Case 1 was a 37-year-old male patient complained of chewing pain of the right upper lateral incisor recently. The tooth had negative response to both electronic pulp and cold tests. Radiographically, it showed a well-defined, corticated, unilocular radiolucent lesion in tooth 11 and 12 apical region. However, intact lamina dura and the radiolucency connected to the nasopalatine duct in periapical and CBCT images were identified. Microscopically, it showed a non-inflamed cyst lined by double cuboidal cells to non-keratinized squamous epithelium with medium sized nerve bundles and blood vessels in fibrous cyst wall. A lateral nasopalatine duct cyst was diagnosed.

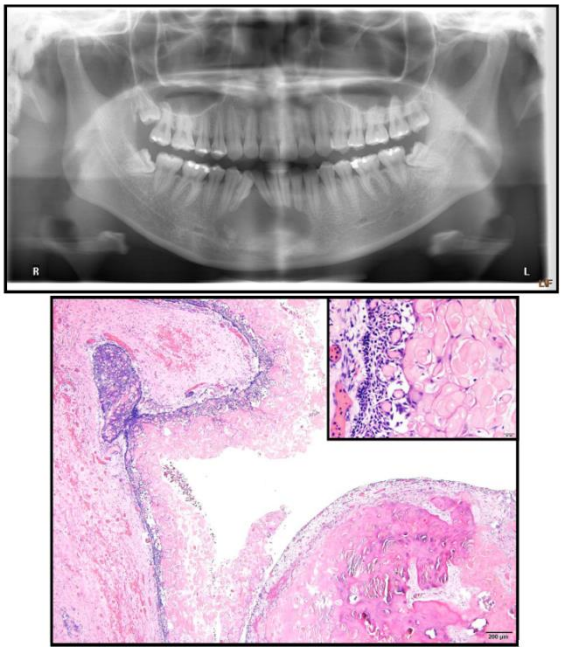


Case 2: Case 2 was a 39-year-old male patient complained of a swelling in the right mandible for 4 months. Both buccal and lingual bone expansion and tooth mobility were noted. Radiographically, it showed a large, well-defined, mixed radiolucent and radiopaque lesion involved right mandibular central incisor to second molar region with buccal and lingual plate expansion and perforation and root resorption. The lesion was resected after biopsy and the specimen was diagnosed as desmoplastic type ameloblastoma with multiple compressed ameloblastic nests infiltrating in between residual bone trabeculae. Focal characteristic reverse polarity and basal vacuolation of the peripheral ameloblastic cells were also evident.

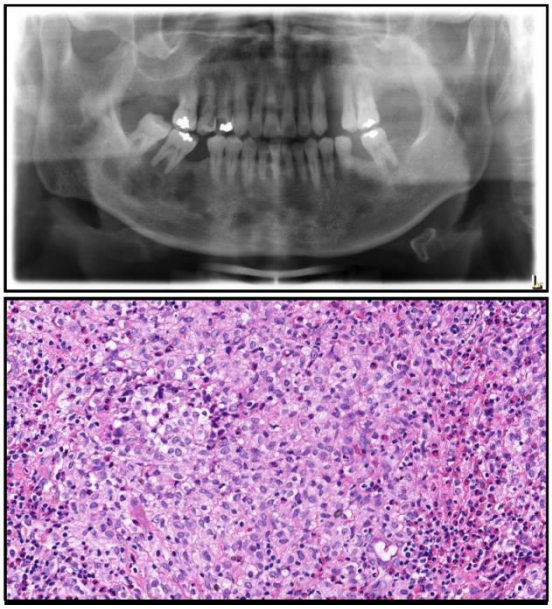
Case 3: Case 3 was an 11-year-old girl complained of a swelling in the right mandible for more than one year. Radiographically, it showed a large multilocular radiolucent lesion with scattered radiopaque materials dispersed and associated with an impacted molar in right posterior mandible. Prominent bone expansion and thinning of the cortical bone were noted. Enucleation of the lesion was performed and the specimen was diagnosed as an ameloblastic fibro-odontoma with strands or small islands of ameloblastic nests and some irregular shaped tooth structures in a loose cellular primitive stroma.



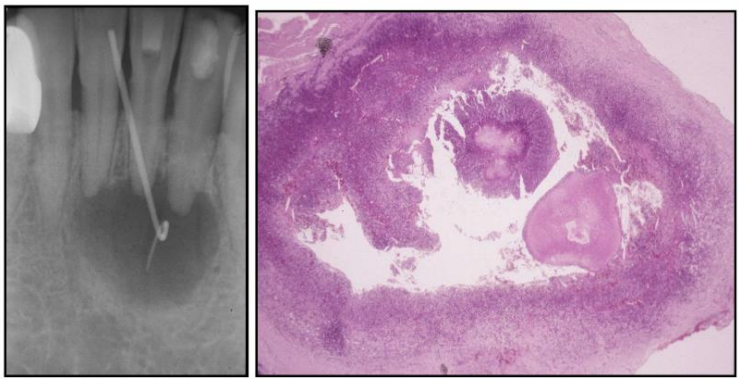
Case 4: Case 4 was a 20-year-old female complained of a swelling in the anterior mandible for 6 months. The swelling was slow-growing. No symptom was noted. Radiographically, it showed a unilocular, well-defined radiolucent lesion with a radiopaque material present inside. Root resorption and divergence were noted. Enucleation was performed and the specimen was diagnosed as calcifying odontogenic cyst with odontoma.



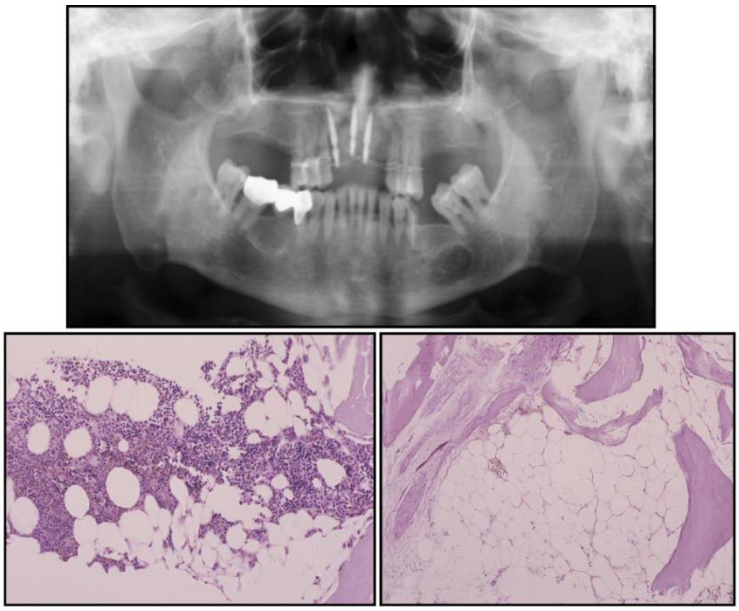
Case 5: Case 5 was a 45-year-old male patient suffered from tooth mobility and was referred from a local dental clinic for treatment of abnormal panoramic x-ray findings. The patient had immune thrombocytopenia purpura 15 years ago. Radiographically, it showed multiple, illdefined radiolucent lesions in the mandible. Due to heavy calculus deposition and gingival inflammation, periodontal treatment was first performed. However, the lesions became more extensive after treatment. Biopsies were performed and the specimens were diagnosed as a Langerhans cell histiocytosis by characteristic coffee bean nuclei and nuclear grooving and abundant eosinophils infiltrate.



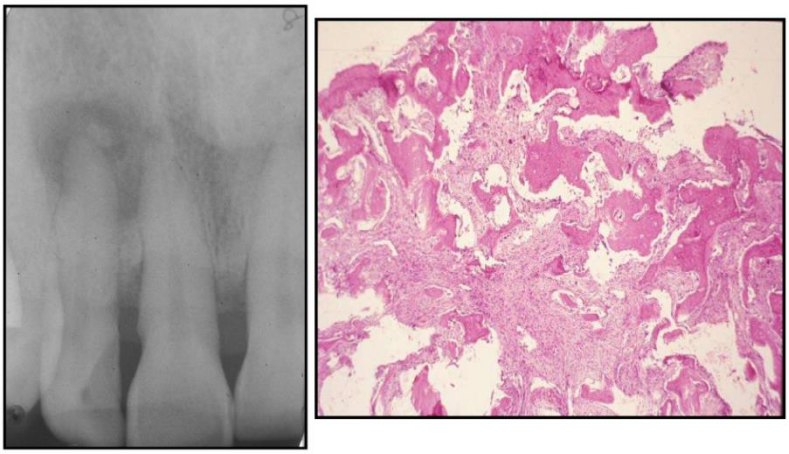
Case 6: Case 6 was a 35-year-old female patient complained of a swelling at the attached gingiva of tooth 31 with pus discharge. Radiographically, it showed a periapical radiolucent lesion at the periapical area of teeth 31 and 32, which did not heal after regular endodontic treatment. Enucleation of the lesion was performed and the specimen was diagnosed as a radicular cyst with actinomycosis based on the microscopic finding of inflamed cystic wall and sulfur granules (colonies of actinomycotic organisms) in the cystic lumen.



Case 7: Case 7 was a 52-year-old patient referred from local dental clinic for evaluation and treatment of two radiolucent lesions in the mandible. Radiographically, it showed two radiolucent lesions at the edentulous areas of the right and left mandibular first molar regions. The two lesions were diagnosed as focal osteoporotic bone marrow defects due to the microscopic finding of hematopoietic and fatty marrow tissues in the two lesions.

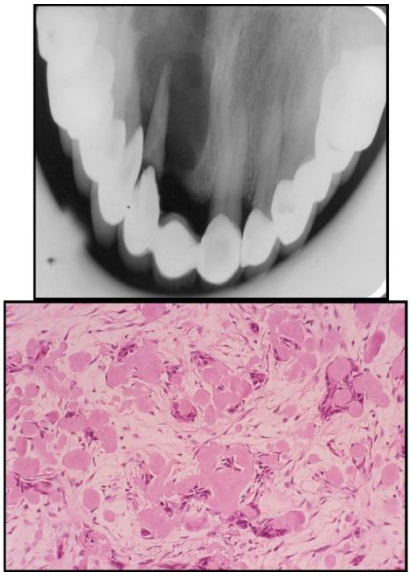


Case 8: Case 8 was a 52-year-old patient who was found to have a radiolucent and radiopaque lesion in the periapical area of the right upper lateral incisor. Radiographically, it showed a mixed radiolucent and radiopaque lesion at the periapical area of the right upper lateral incisor, which was misdiagnosed as a radicular cyst with pulp necrosis of the associated tooth. Endodontic treatment of the associated tooth was performed but the periapical lesion did not response to the treatment. Enucleation of the lesions was performed and the lesion was proved to be periapical cementoosseous dysplasia. Moreover, the lesion healed with formation of new normal bone after surgical treatment.

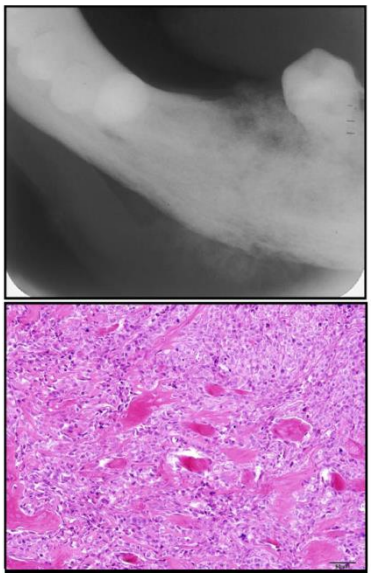


Case 9: Case 9 was a 52-year-old woman referred from a local dentist for evaluation of a radiolucent lesion at the right anterior region of the maxilla. Radiographically, it showed a radiolucent lesion at the right anterior region of the maxilla, which was enucleated under the clinical diagnosis of a large radicular cyst.

However, the final histopathological diagnosis was a noncalcifying Pindborg tumor based on the microscopic finding of foci of amyloid materials and a few Langerhans cells in the nests of odontogenic epithelium in a loose myxomatous stroma.



Case 10: Case 10 was a 35-year-old male patient who found a gradually enlarging swelling at the left lower posterior region of the mandible for 3 months. Radiographically, it showed an ill-defined mixed radiolucent and radiopaque lesion with vague sunray pattern. Total excision of the mass was performed and the specimen was proved as an osteogenic sarcoma by the microscopic finding of many small areas of osteoid materials and a sheet of pleomorphic and hyperchromatic osteoblast-like cells.



Teaching of dentomaxillofacial radiology – the current scenario and beyond

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Introduction: The concept of teaching envelopes a large boundary-less territory in the life of both student and teacher. Teachers help immensely in the creation of the students own image. Teaching used to be concept based; however nowadays it has become more competitive based, and so is the case in teaching dentistry or dentomaxillofacial radiology as well.

Brief history: Although it was Edmund C Kells, who actually took the first dental diagnostic radiograph in the United States of America, we remember and salute the work of Roentgen. It was Howard Raper, who first established a dental radiography course, practiced dental radiography as a specialty and subsequently wrote several books on this topic.

In India dental radiology was included in the curriculum in 1959, and the first two years Masters program in dental radiology began in Bombay University. By the year, the Government Dental College, Bangalore, which is one of the first dental colleges in India.

Discussion and current trends: However, over the recent years the changeover to digital radiography from conventional radiography has made Radiology to be practiced as a distinct specialty. The United States of America, United Kingdom and Europe have organized competency based education systems. They are based on solid principles and concepts given in the form of domains (Table 1) with each having a specific level and inclusion, knowledge and skill levels. Moving further, there are improvisations based on the needs of society and the profession. Programs, such as distance learning by the Kings College in London came into being in Europe. The European Academy of Dentomaxillofacial Radiology (DMFR) began a special training program to help students become independent specialists in DMFR fellowship programs, having both practical and didactic sessions. Several universities began combined programs so as to enable graduates to pursue a clinical career in private practice and an academic career in teaching or research.

Challenges and future: One of the main challenges is formation of a suitable curriculum and one should not make it too departmentalized, nor having to continue with redundant concepts or make it too rigid, neither allows it to be modified based on individual whims and fancies. Apart from the curriculum, the teaching - learning methods need to suit the requirements of society, the student and the university. There are several limits to the current educational system e.g. inadequate integration of basic theory in clinical practices: insufficient integration

of technology and lack of uniformity. A major concern is to move from *an exam centric* system to a more *learner centric orientation*, include pre-patient care clinical training. Use blended learning methods, case based learning and even probably add a radiology clerkship and definitely make use of advanced learning methods. Apart from curriculum and teaching learning methods, the assessment is a very important aspect and has to be relooked at.

Conclusion: DMFR education needs a new curriculum. There is a need for a universal or uniformly structured curriculum and course design which should enable graduates to practice independently, act as a specialist and encourage exposure to scientific needs and research and new teaching learning methods with exchange of knowledge.

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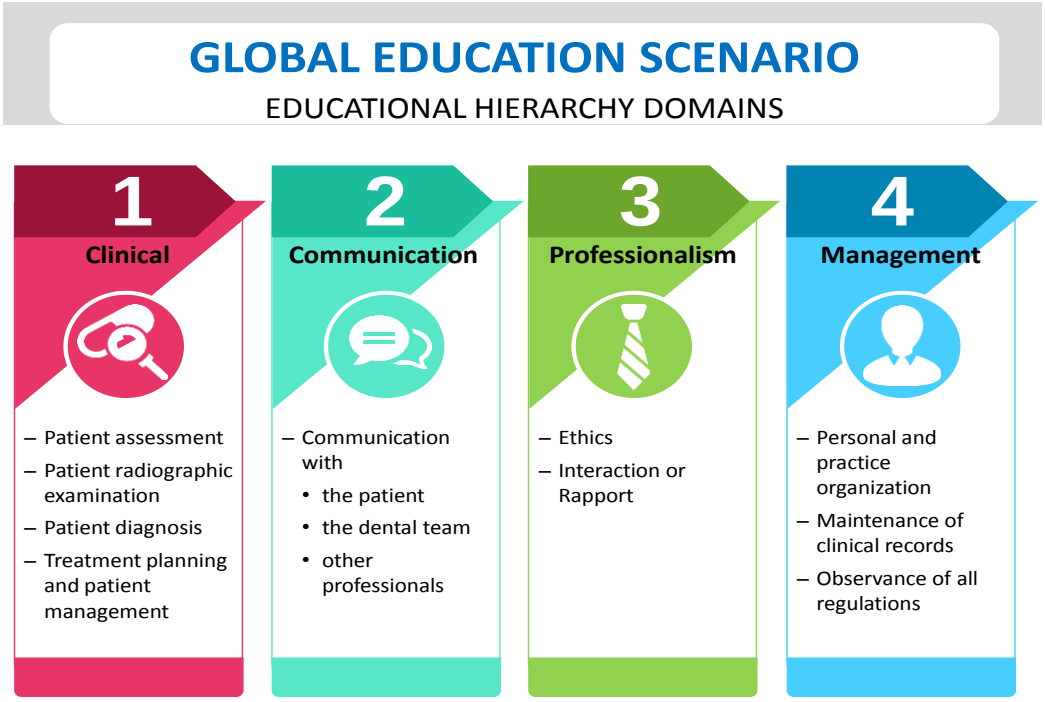
Table 1

CURRICULUM DISEASES	
Curriculosclerosis	Hardening of the categories: too much departmentalization
Carcinoma of the curriculum	Uncontrolled growth of one section; unrelated to objectives of the course
Curriculitis	Too much meddling with the curriculum based on individual whims and fancies
Curricular obesity	Continuing without deletion of redundant portions
Curricular ossification	Too much rigidity in curriculum; disregard for changing trends in education and disease pattern

Table 2


GLOBAL EDUCATION SCENARIO
EDUCATIONAL HIERARCHY DOMAINS
1
Clinical
– Patient assessment
– Patient radiographic examination
– Patient diagnosis
– Treatment planning and patient management
2
Communication
– Communication with
• the patient
• the dental team
• other professionals
3
Professionalism
– Ethics
– Interaction or Rapport
4
Management
– Personal and practice organization
– Maintenance of clinical records
– Observance of all regulations

Ectopic third molar in the sigmoid notch: Report of a case

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Clinical: A 37-year-old woman visited our outpatient department of oral and maxillofacial surgery due to pain in the upper right face for 1 to 2 weeks. The extra-oral examination revealed right facial swelling with pain. Erythematous surface, local heat or fluctuation is absent. The intra-oral examination showed no sign or symptom related to upper and lowers right teeth. No obvious pathologic change was identified.

Radiology: A panoramic study was taken (Fig. 1) and it revealed an inverted impacted right mandibular third molar located in the right sigmoid notch. The ectopic tooth was surrounded by a well- defined, unilocular radiolucent lesion with non-corticated border. The radiolucent lesion continued to extend to the retromolar trigone and forming a well-defined, less radiolucent, tunnel-like image, resembling an abnormal eruption pathway. Cone beam computed tomography was also taken (Fig. 2) and showed an inverted ectopic tooth locating in right sigmoid notch with crown facing toward lateral side. The surrounded cystic lesion caused cortex perforation of sigmoid notch and retromolar trigone. Increased bone density around the tunnel-like lesion was noted and an inflammatory condition was suspected.

Pathology: Surgical management, including odontectomy and cyst enucleation, via intra-oral approach was performed. The histopathological report showed an infected odontogenic keratocyst.

Discussion: The cystic lesion might play an important role for migration of the ectopic mandibular third molar in our case. Cone beam computed tomography can provide a three-dimensional image and more information can be obtained for preoperative evaluation and surgical planning of treatment for an ectopic third molar.

Figure 1: Pre-operation panoramic image of an ectopic right mandibular third molar locating in right sigmoid notch, surrounded by a tunnel-like radiolucent lesion

Figure 2: Pre-operation cone beam CT revealing cortex perforation of retromolar trigone

Analyses of aerodynamic characteristics of the oropharynx applying CBCT: obstructive sleep apnea patients versus control subjects

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Objectives: To determine the most relevant aerodynamic characteristic of the upper airway related to the collapse of the upper airway in obstructive sleep apnea (OSA) patients; and to determine the correlation between the most relevant aerodynamic characteristic(s) of the upper airway and anatomical characteristics of the upper airway in OSA patients.

Methods: 31 mild to moderate OSA patients (mean ± SD age = 43.5 ± 9.7 years) and 13 control subjects (mean ± SD age = 48.5 ± 16.2 years) were included in this prospective study. The diagnosis of OSA patients was based on an overnight polysomnographic recording. To exclude the presence of OSA in the control subjects, they filled out a validated questionnaire to determine the risk of OSA. NewTom 5G cone beam computed tomography (CBCT) scans were obtained from both OSA patients and control subjects. Computational models of the upper airway were reconstructed based on CBCT images. The aerodynamic characteristics of the upper airway were calculated based on these computational models. Pearson correlation analysis was used to analyse the correlation between the most relevant aerodynamic characteristic(s) and anatomical characteristics of the upper airway in OSA patients.

Results: Compared with controls, the airway resistance during expiration (Rex) of the OSA patients was significantly higher ($P = 0.04$). There was a significant negative correlation between Rex and the minimum cross-sectional area (CSAmin) of the upper airway ($r = -0.41$, $P = 0.02$), and between Rex and the volume of the upper airway ($r = 0.48$, $P = 0.01$) in OSA patients.

Conclusions: Within the limitations of this study, we concluded that the most relevant aerodynamic characteristic of the upper airway in the collapse of the upper airway in OSA patients is Rex. Therefore, the repetitive collapse of the upper airway in OSA patients may be explained by a high Rex, which is related to the CSAmin of the upper airway and to the volume of the upper airway.

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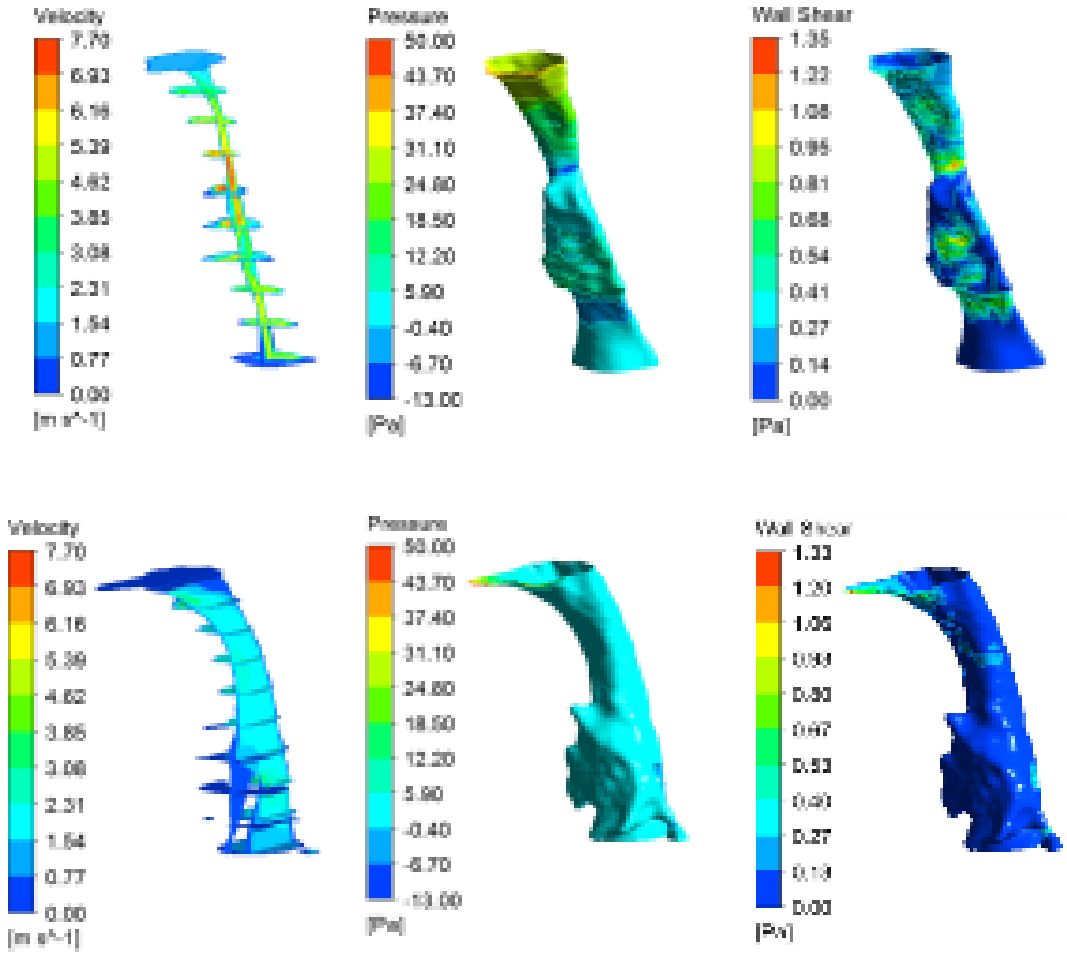

Figure 1: Contours of the velocity (m/s), wall shear stress (pa), and wall static pressure of a typical OSA patient (A) and control subject (B) during expiration. Scale: Red = higher value of the aerodynamic characteristics of the upper airway; blue = lower value of the aerodynamic characteristics of the upper airway

Calcifying epithelial odontogenic tumor

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Clinical: A 47-year-old man was referred to our hospital for the evaluation of a hard swelling in the left face that he noted 3 years ago. He had a past history of surgical excision of a mass on the left posterior mandible turned out to be CEOT 10 years ago. Intraoral examination revealed that the left mandibular molars were missed and the oral mucosa was swollen and bitten by antagonistic teeth.

Radiology: Panoramic radiography and CT images showed large radiolucent/ radiopaque mixed lesion involving whole left mandible. This severe expansile lesion showed honeycomb calcification with cancellous and cortical bone resorption (Fig. 1,2).

Pathology: Histopathological examinations revealed polyhedral epithelial cell islands, amyloid-like material and concentric calcifications (Liesegang rings) dispersed in a fibrous stroma.

Final diagnosis: A final diagnosis of CEOT was made:

Discussion: The radiographic appearance of CEOT is variable and depends on the stage of development. It ranges from unilocular pericoronal radiolucency, pericoronal radiolucency with irregular calcific flecks, mixed radiopaque-radiolucent lesion, driven-snow appearance to an entirely radiopaque mass.

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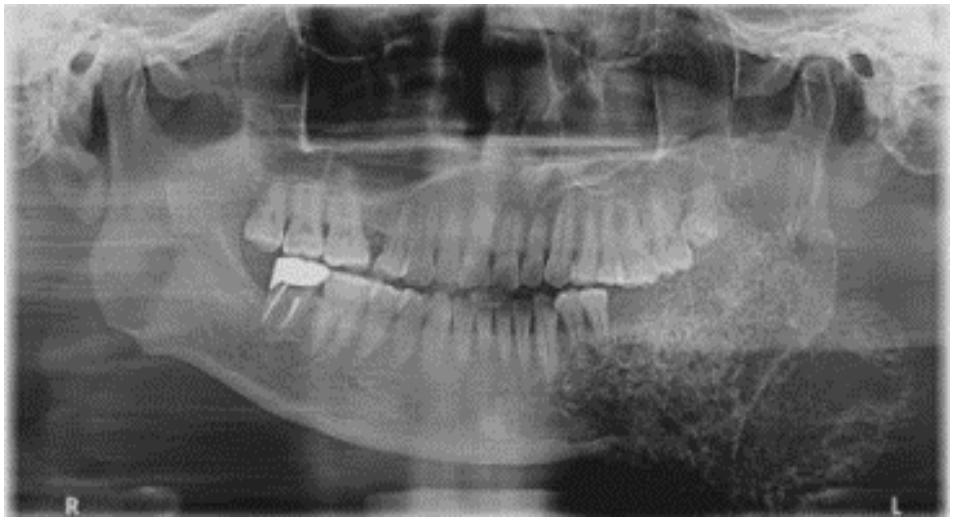

Figure 1: A panoramic radiography showing a large expansile trabeculated radiolucent-radiopaque lesion with cortical expansion and perforation

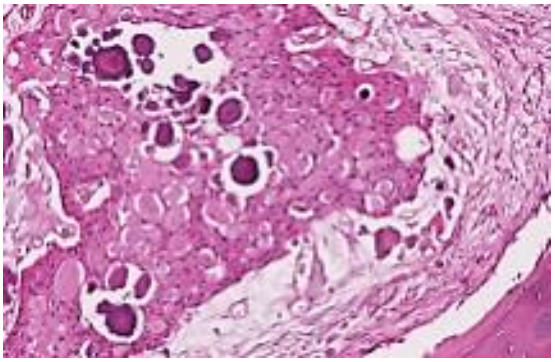

Figure 2: Histopathologic examinations showing a typical CEOT findings of polyhedral epithelial cells with intercellular bridges, amyloid-like materials and Liesegang ring

A case of osteochondroma with a vestige of cortical contour at the mandibular condyle

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Introduction: Osteochondroma (OC) is the most common benign tumor of bone and usually affects long bones and defined as a cartilage-capped bony protrusion on the external surface of bone. OC is rare in the TMJ region. We report here a case of OS with a vestige of previous cortical contour at the base of the tumor mass.

Clinical: A 33-year-old female presented because of the pain at both TMJ areas after trauma at the mandibular symphyseal area.

Radiology: Bony overgrowth was noted at the antero-superior portion of left mandibular condyle on panoramic and cone beam computed tomography (CBCT). A vestige of previous cortical contour was also noted at the tumor base on the CBCT. Based on the radiographic finding, the diagnosis of OC of left TMJ was made. Two years later, she revisited because of the sound and pain at the Lt. TMJ. Bony change was not detected on both panoramic and CBCT images. The vestige of previous cortical contour was confirmed later by surgical removal.

Discussion: A vestige of cortical contour on the radiograph can be clue to the diagnosis of OC.

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Figure 1: Cropped panoramic image shows bony overgrowth at the anterior and superior portion of the left condylar head

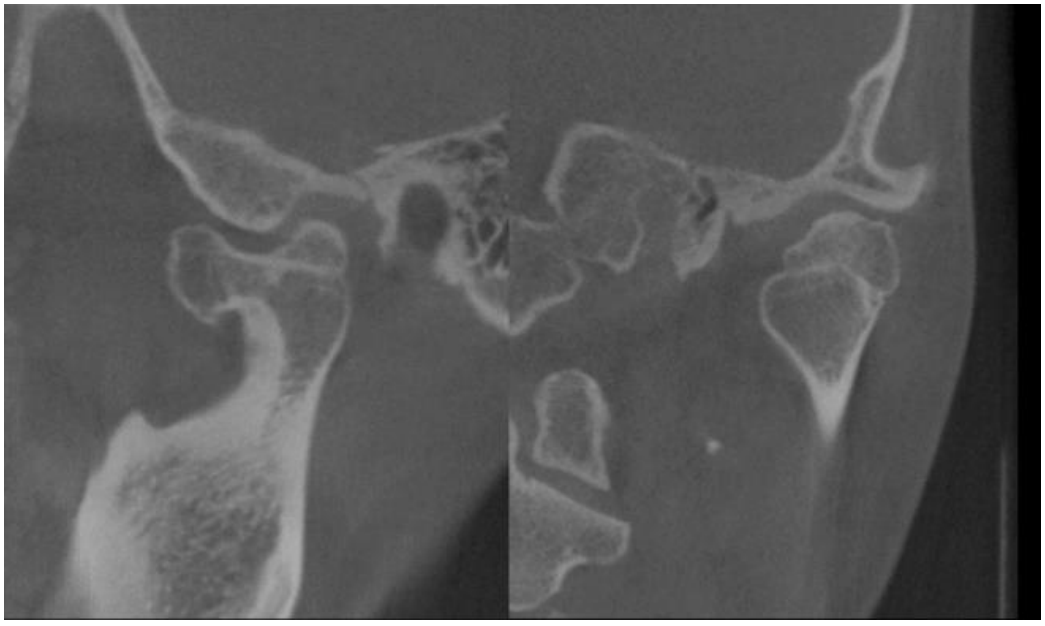

Figure 2: Sagittal and coronal images of CBCT. A vestige of previous cortical contour is noted at the tumor base on the CBCT

Diagnostic imaging of infection of the jawbone

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Introduction: The jaw bones are more frequently affected than other skeletal bones by infection and trauma. Recently, there has been an increase in bisphosphonate (BP)-related infections in patients who are treated for osteoporosis and metastatic carcinomas. The purpose of this presentation was to investigate the imaging characteristics of osteomyelitis and to compare the imaging characteristics of BP-related and non-related osteomyelitis.

Materials and methods: We examined the clinical records and imaging of 366 patients (242 females and 124 males) who visited the Seoul National University Dental Hospital over the past 2 years. They were diagnosed with osteomyelitis after clinical, radiological, and histopathologic examinations. The age range was 10 to 91 years, with an average age of 66.7 years.

Results: 364 panoramic radiographs, 317 MDCT, and 30 CBCT were included in the study. On panoramic radiographs, the mixed bone pattern was the most common, followed by the osteolytic bone pattern. In 31 cases, there were no changes visible in the panoramic radiographs. Sequestra were found in 150 cases and periosteal new bone formation in 26 cases. On CT's, trabecular defects, cortical defects and sclerosis were frequently found. Sequestra were found in 198 cases and periosteal new bone in 99 cases. On CT images, about 70% showed soft tissue changes. On panoramic images, sequestra, periosteal new bone and extraction sockets were observed more frequently in BP treated patients. As expected, the mandibular cortical index was also significantly lower in BP treated patients. On CT images, sequestra and periosteal new bone were observed more frequently in BP treated patients. However, the location and the type of periosteal new bone were not significantly different between the two groups. The size and features of sequestra were not significantly different between the two groups. As Fatterpekar et al. (2011) proposed, expansile lytic lesions were highly suggestive of BP-related osteomyelitis.

Conclusions: The age of occurrence of osteomyelitis is increasing. The incidence of osteomyelitis of the jaws in females is increasing. About half of the patients had a history of BP medication associated with osteoporosis or cancer. Sequestra and periosteal new bone formation were not as clearly defined on panoramic radiographs compared to CT. There was little difference in the CT findings between osteomyelitis related to BP's and those not related to BP's except for sequestra- and periosteal new bone formation.

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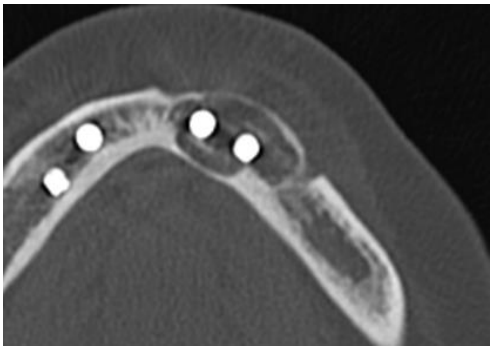

Figure 1 a

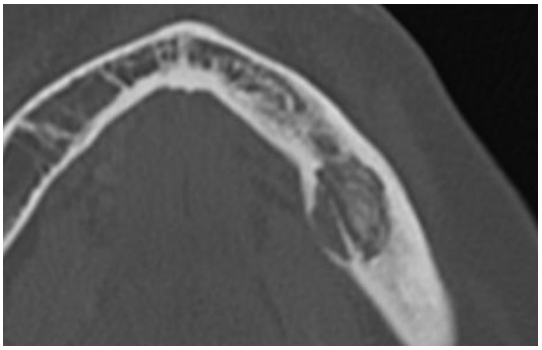

Figure 1 b

Figures 1a and b: Cropped occlusal radiograph of BP-related osteomyelitis. Note the expansile labial (a) and lingual (b) cortex of the lesion

Promoting factors for bone graft osseointegration, in maxillary sinus augmentation, in osteoporotic subjects

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Introduction: Graft resorption, absence of osseointegration, or delayed healing is complications frequently encountered in osteoporotic patients who suffered bone augmentation. The purpose of this study is to evaluate, for the first time, radiologically, histologically and mechanically the factors that promote bone osseointegration, in maxillary sinus augmentation (MSA), in osteoporotic subjects (OS).The objectives are to identify the factors that promote the osteogenic potential of the bone graft and to assess these factors in dynamic.

Material and methods: 20 subjects were divided into 4 groups: control group (healthy patients) – bovine xenograft; I (OS) – bovine xenograft; II (OS) - platelet rich fibrin and autologous bone addition to the xenograft; III (OS + bisphosphonates) – bovine xenograft. MSA was performed on each subject. After 3 months, maxillary cone-beam computer tomography (CBCT) was performed and bone core was be harvested from the maxillary sinus and the biopsy will be taken from the alveolar crest. The bone core will was sent for histopathologic and imunohistochemic examination, and micro-indentation tests. After one month, another biopsy was taken following the same protocol.

Results: The results from the mechanical tests, the CBCT analysis, the histological and the immunohistochemical analysis were correlated. The results from the CBCT analysis are not consistent with the micro-indentation tests and with the histologic evaluation.

Conclusions: Understanding the mechanisms of the osseointegration process brings valuable knowledge to this domain. Identifying the factors that promote osseointegration, in osteoporotic patients will improve the life quality of these patients.

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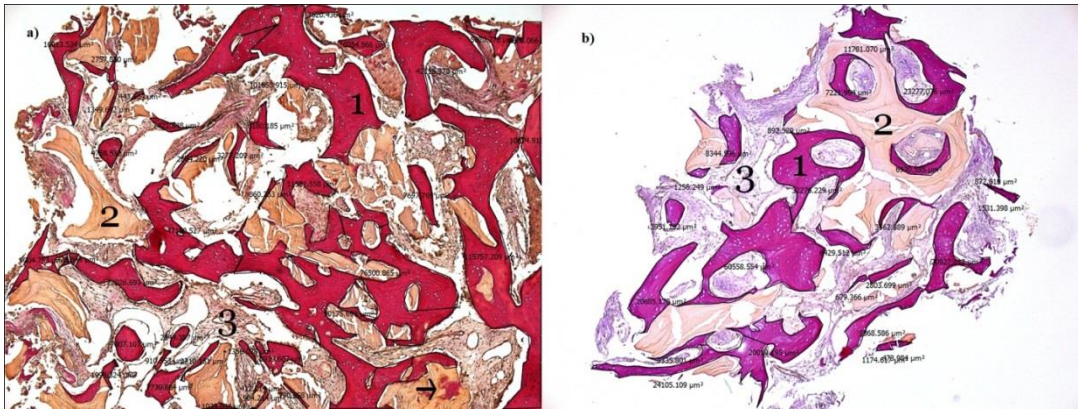

Figure 1: Specimens retrieved at 6 months postoperatively, 50 × magnification. Van Gieson staining. (1 - newly formed bone 2 - xenograft particles, 3 - fibrous tissue (stromal area)); (a) Group II, (b) Group I

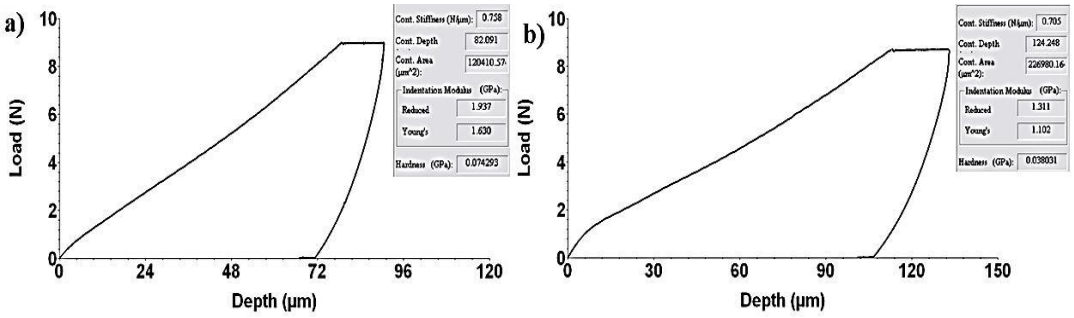

Figure 2: Micro-indentation tests. The highest resulting curve and the smallest force displacement can be seen for after platelet rich fibrin and autologous bone addition to the xenograft (a); (b) Group I

The use of CBCT scans in dental medicine

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Introduction: Periapical and combined periodontal-endodontic lesions of the maxillary teeth can lead to various impairments of the maxillary sinus. Studies have reported that 10–12% of maxillary sinusitis is of odontogenic origin.[1] The aim of our research is to assess the thickness of the maxillary sinus mucosa, the type of the periapical lesions and bone resorption using CBCT.

Material and methods: This study was conducted using a selection of cases that underwent CBCT in Iasi, Romania. The evaluation of the maxillary sinus membrane thickness was performed in axial, coronal and sagittal images. The mucosal thickness was measured between the maximum thickness point of the maxillary sinus floor and the apexes of all present teeth; was present where the value was > 1 mm; and was classified according to Duygu et al.[2] It was made also a distribution according to PAI system (periapical index scoring). The measurements were made in the paraxial plane, using a ruler feature of the software; two measurements were carried out for each tooth using the method of Duygu et al.[2] The assessment of the relationship between the premolars and molars, and the inferior wall of the maxillary sinus was performed according to a modified classifications used by Duygu et al,[2] named the Kwak classification.

Results: Out of the 149 analyzed teeth, 61.74% correlated with a normal sinus mucosa, with no signs of maxillary sinusitis, which belongs to the Class 1–2 category. 14.76% teeth presented with a thickened mucosa with values between 2–4 mm (Fig. 1), 18.79% had a thickened mucosa with values between 4–10 mm and 4.69% showed a thickened mucosa with values > 10 mm (Fig. 2), corresponding to classes 3,4,5. Our study showed that there were statistically significant differences in bone resorption between males and females only in respect of the buccal surface of the upper first molar. Males presented with statistically significantly higher values than females. We also found a case where there were big differences in terms of bone resorption for the buccal surface of the third molar which is more common in men.

Conclusion: CBCT examination is an important step in the evolution of dental imaging that has great potential in preoperative planning and is an indispensable diagnostic alternative when 3D images are needed.

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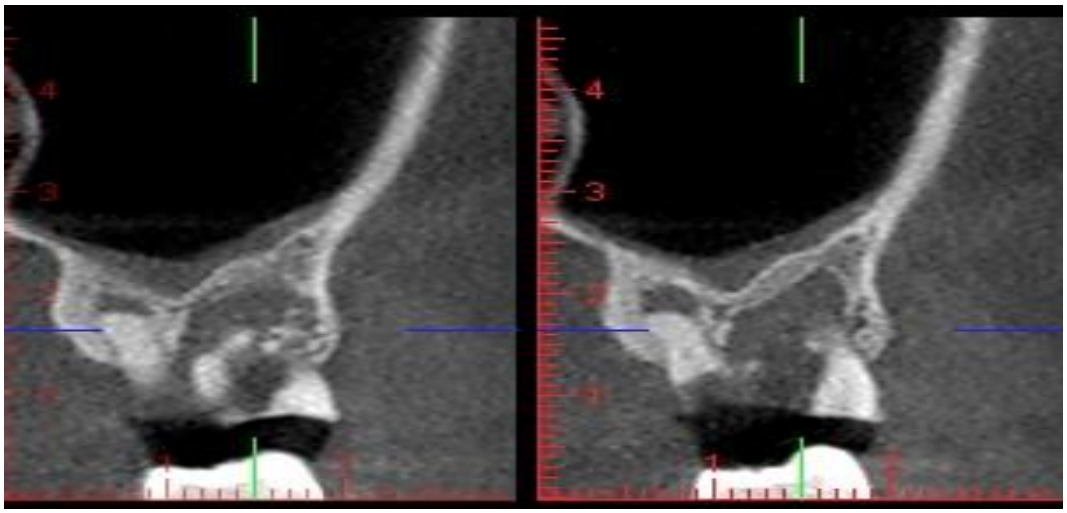

Figure 1: CBCT paraxial view with thickened mucosa with values between 2-4 mm and vestibular/palatinal bone resorption

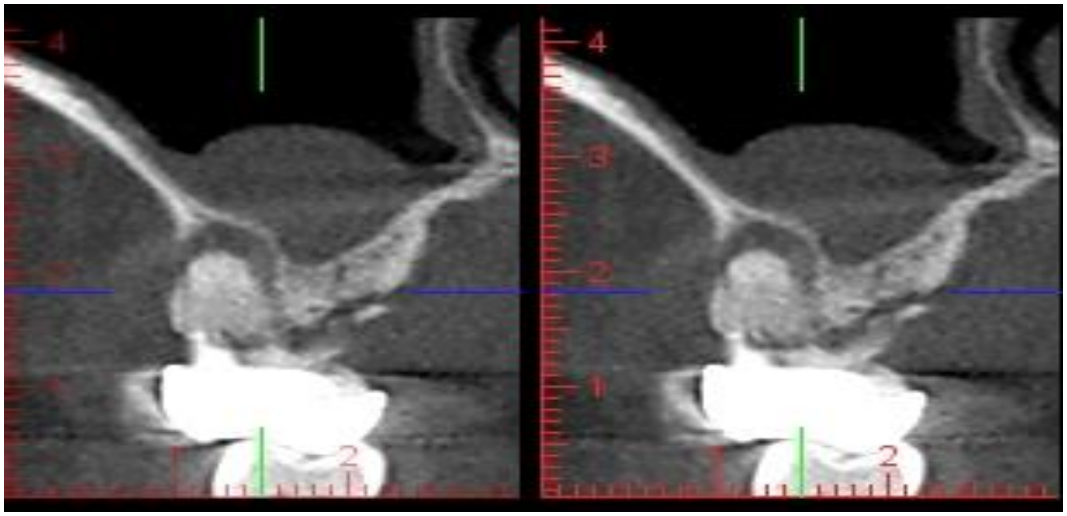

Figure 2: CBCT paraxial view with thickened mucosa with values between 10-12 mm with periodontal-endodontic lesions and the close contact of the 16 with the maxillary sinus

Teleradiology service with the requested medical fee in Japan

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Introduction: There are medical fee points of the National Health Insurance system in Japan. This system almost covers medical and dental costs for Japanese citizen. However, patients have to pay the full fee in cash about a part of the medical and dental costs. Teleradiology service always has been provided by paying the full fee in cash on dentistry. Teleradiology was introduced into the points on dentistry for the first time 4 years ago around. We started a teleradiology service from 2 years ago and it is the first teleradiology service with the requested the medical fee points in Japan.

Materials and methods: For the teleradiology system, our departmental PC was linked to the PC in the dental clinic via the internet. The teleradiology application was installed on both the PCs. Clinic doctor was able to request approximately 105 US$ for the basic point. In addition, medical fee points for teleradiology are approximately 17 US$. Therefore, a clinic doctor can be requested 1,350 points, approximately 122 US$ totally to the Ministry. We charge from dental clinic about 28 US$/case for the radiographic finding fee.

Results: A contract has already been formed with 20 dental clinics for this service. The number of case is from 10 to 20 cases/month. Many cases were chronic apical periodontitis, impacted wisdom tooth, marginal periodontitis...etc. for Diagnostic radiology.

We have some problems about teleradiology system for dental hospital side.

1. The reporting system does not work with DICOM viewer, that is, when we will start the reporting system in teleradiology system, the DICOM viewer is not started at the same time automatically.
2. Sometime inadequate FOV images are sent to us. For example, tooth fracture case is 8 × 8 FOV images, or target tooth deviate from FOV, etc. In such cases, we suggest about adequate FOV to clinic doctor and resending the image date.

Conclusions: we started a teleradiology service with the requested medical fee points. In future, we will solve the problem and further develop this service.

Acknowledgements: This study was supported by the Sato Found on Nihon University School of Dentistry (2015).

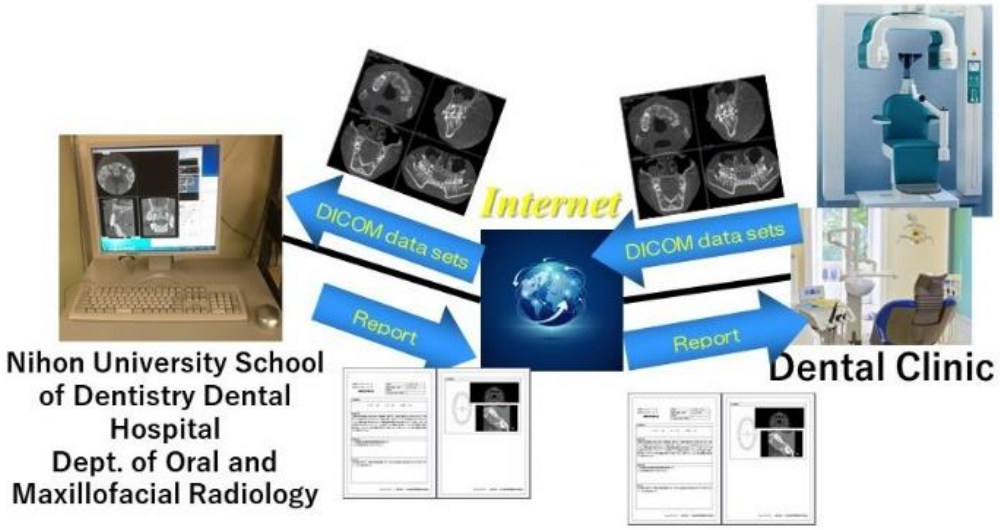

Figure 1: Connection diagram for the teleradiology and data flow

Usefulness of signal intensity correction filter in MR imaging of the oral region

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Introduction and objectives: In MR imaging, the surface coil is used to improve the resolution, whereas the image uniformity is declined. Therefore, signal intensity correction filters, such as geometric and calibration filters, were developed to improve uniformity. This study aimed to evaluate the usefulness of signal intensity correction filters in MR imaging of the oral region.

Material and methods: A copper sulfate filled phantom was scanned by 1.5 T MR imaging scanner equipped with either an 8-channel neurovascular array (8-ch NV) coil, or a brain coil using spin echo (SE) and gradient echo (GRE) sequences. Then, original images were filtered by two types of the signal intensity correction filters, SCIC, as a geometric filter, and PURE, as a calibration filter. To evaluate the uniformity of the images, the 17-point method by NEMA was adopted and NUI (non-uniformity index) was calculated. The NUI was statistically compared among the original images, which were filtered by SCIC, and PURE.

Results and discussion: Axial images with SE showed that maximum NUI in the original images, filtered by SCIC and PURE, were 31.0, 8.8, and 6.5, respectively, with 8-ch NV coil. Virtually, all NUI's in the original images were significantly higher than those in the images filtered by SCIC and PURE. Coronal and sagittal images displayed an improvement of the uniformity with SCIC more than with the PURE. There were no remarkable differences, neither between SE images and GRE images, nor between two coils about the signal uniformity. Some lesions arisen in the oral region are located peripherally to the imaged area. For those cases, the signal intensity correction would be necessary to make an accurate diagnosis.

Conclusion: Since the original MR image was found to be non-uniform, applying the signal intensity correction filter was important and could be indispensable in the oral region.

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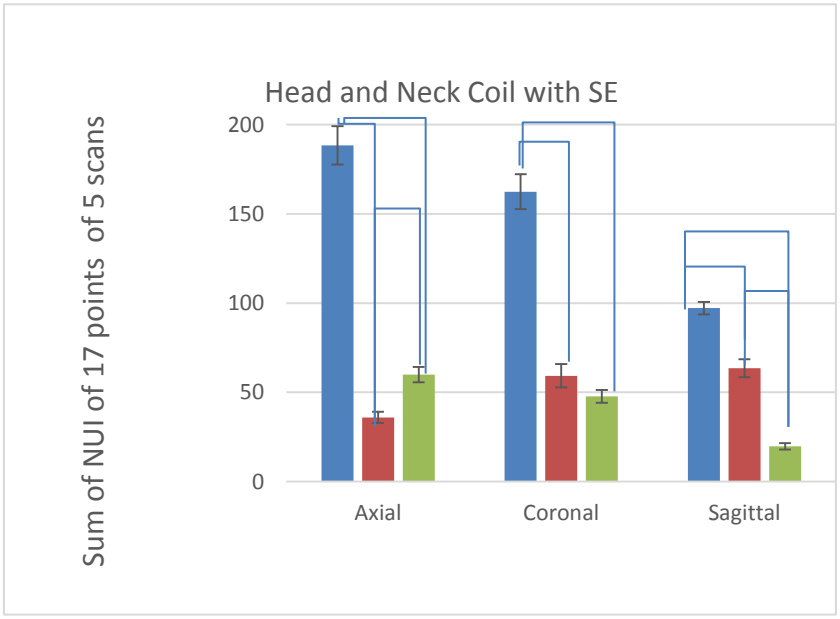
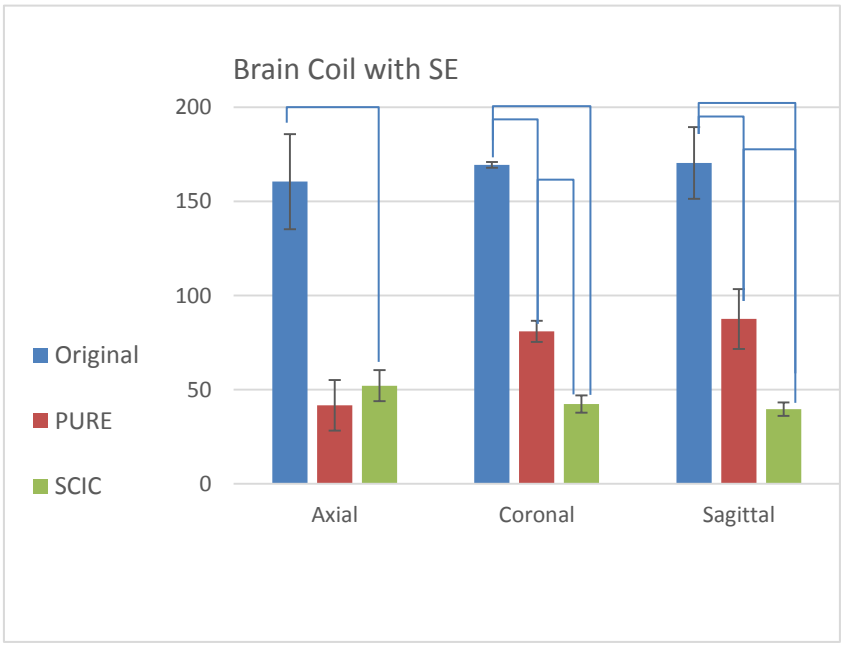

Head and Neck Coil with SE
Sum of NUI of 17 points of 5 scans
200
150
100
50
0
Axial
Coronal
Sagittal


Brain Coil with SE
200
150
100
50
0
Original
PURE
SCIC
Axial
Coronal
Sagittal

Effect of rapid maxillary expansion on upper airway volume applying cone beam computed tomography

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Introduction: Rapid Maxillary Expansion (RME) is an effective dento-facial orthopedic treatment procedure routinely used in young patients to increase the transverse dimensions of the maxillary arch.[1] Several studies have shown that RME is a significant improvement of nasal breathing even for the children with obstructive sleep apnea (OSA). However, the volumetric changes of upper airway have shown conflicting results. Various radiological measurement methods of upper airway dimensions have been used, such as cephalometric radiographs, cone beam computed tomography (CBCT), CT (computed tomography) and MRI (magnetic resonance imaging).[2] CBCT allows segmentation and visualization of the upper airway in three dimensions with reduced radiation dose compared with conventional CT and lower costs than MRI. Several studies have confirmed that CBCT is a reliable method for calculating the volume of upper airway. The present study aimed to evaluate the volumetric changes of the nasopharynx and total upper airway after RME applying CBCT imaging.

Objectives and methods: Twenty subjects, 12 boys and 8 girls with a mean age of 14.25 ± 5.58 who had received RME treatment were included in the present study. For each patient 2 CBCT scans (3D eXam; KaVo, Biberach an der Riss, Germany) were taken at 120 kvp and 5 mA, one before the start of RME and one at least 3-months after retention period. Linear measurements were performed on CBCT image. Furthermore volumetric measurements of upper airway were obtained in terms of the volumes of nasopharynx and total upper airway using Dolphin software (Fig. 1). The width of maxilla was assessed between the first molars on the upper jaw at six levels: the mesio-buccal apex, buccal alveolar crest, most prominent point of the crown, buccal cusp tip, the palatal apex and palatal alveolar crest. To analyze the volumetric variables of NP and total upper airway after RME Paired t-test was applied. Pearson's correlation coefficient was used to evaluate the correlation between the volumetric changes of NP and total airway.

Results: Linear measurements of maxillary width showed statistically significant increase after RME treatment ($p < 0.05$). With respect to the changes of upper airway volume, a tendency of increased nasopharynx ($p = 0.10$) and total upper airway ($p = 0.09$) was observed after RME. The volumetric changes of nasopharynx and total upper airway exhibited a significant correlation ($p = 0.97$).

Conclusions: Our results confirmed that RME could broaden the maxillary width. No statistically significant changes were found with respect to the volume of

nasopharynx, and total upper airway after RME therapy. The change of nasopharyngeal volume was significantly correlated to the total upper airway volume after RME.

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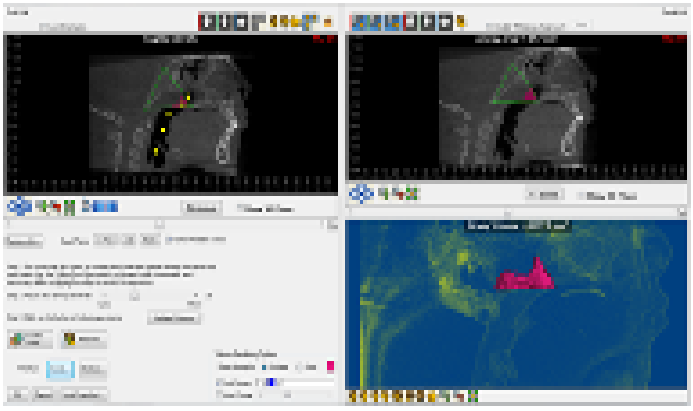
A



B

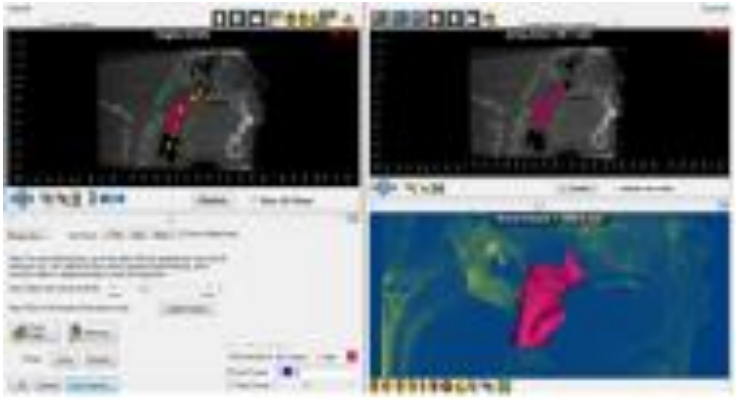


Figure 1: Volumetric measurements of upper airway: A, Nasopharynx; B, Total upper airway

Lessons learned from CBCT reports – CBCT use by Israeli general dentists

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Introduction: Cone-beam computerized tomography (CBCT) has been introduced to the maxillofacial imaging field in the last decade and has been used for various indications including implants, bone pathology, impacted teeth, TMJ as well as salivary gland and airway. Several guidelines have been published for its appropriate use,[1,2] which all relate to the mandatory reporting of the whole scan volume. Thus, dentists choosing to use CBCT, should be acquainted with special training in order to technically review and interpret the whole CBCT volume.[1] The aim of this study was to examine the knowledge and training of Israeli dentists on CBCT use and interpretation.

Methods and materials: Anonymous questionnaires were presented to dentists during 5 congresses throughout 2014. The questionnaires included: demographic data pertaining to the dentist's field of work, duration of practice, questions regarding CBCT use, specific education, requested output from the imaging centre (cross sectional images or DICOM files), as well as the possible fabrication of a radiographic report by either the referring doctor or by a specialist who is knowledgeable in the field of maxillofacial radiology.

Results: 252 anonymous questionnaires were collected. Most (70%) dentists were males, graduating in Israel (56%), in an average age of 48.5 ± 12 years, with 20 ± 12 years of dental experience. CBCT was used by 90% of them, mostly for implant planning (76%) and third molar extractions (42%). Other indications (including endodontics or orthodontics) were usually referred by the relevant specialists. Only 36.6% received CBCT training and were found to be younger (46 years as opposed to 50) with less experience (18 years as opposed to 21). Most (77.2%) reported reviewing the whole scan volume, though only 56.3% requested the DICOM files from the imaging centre. The majority (75.4%) referred for consultation. However, only 28.2% referred for radiographic interpretation, though the majority believed that they were responsible for the whole data set in the scan and that they could be sued.

Conclusions: The use of CBCT technology is widely used in Israel; however, most dentists have not received specific CBCT training. The main factors found to be associated with use and training, were seniority, academic institution and specialization. Furthermore, it seems that most dentists are not familiar with the

need for reviewing the whole CBCT volume and they are content with viewing the cross-sectional images. The main use of the DICOM files seems to be for third-party software, such as implants surgical guidance and not for viewing the whole volume. There is a great need for CBCT education, especially for post-graduate dentists – who graduated dental school prior to CBCT introduction to the dento maxillofacial field, as well as need for professionals who can provide the needed radiographic reports for all CBCT scans produced in Israel.

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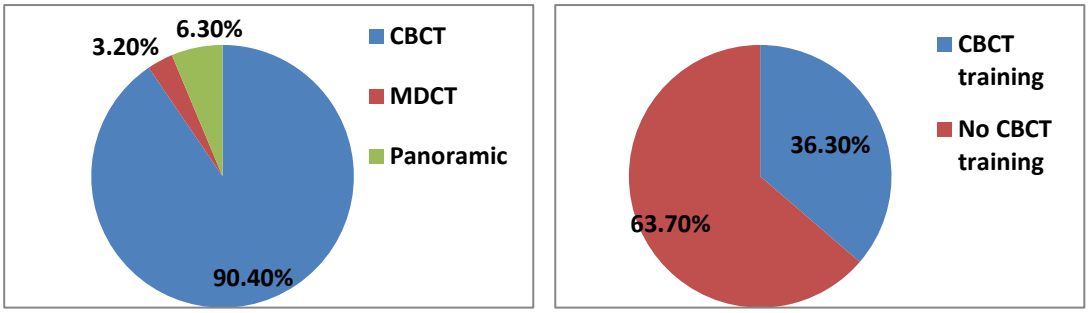

(A) **(B)**

Figure 1: Use of CBCT by Israeli dentists (A) Use of advanced imaging (CBCT, MDCT and Panoramic imaging); (B) CBCT specific training as reported by the dentists

Table 1: CBCT requested output, interpretation and referral pattern

		Number	% of TOTAL
CBCT output	Cross sectional images	158	75.2%
	DICOM files	111	56.3%
Requested output form	Printed file	150	70.1%
	Disc	139	65.3%
	On line	116	54.2%
CBCT reviewing	Dentist examines all information	159	77.2%
	Refer to radiographic interpretation	57	28.2%
	Refer to consultation	157	75.4%

Morphology and mineral density of enamel pearls

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Introduction and objectives: Enamel pearls are sometimes seen on the root surfaces of molar teeth.[1] Although this abnormality is relatively common, the histological and radiological characteristics of enamel pearls have not been studied in detail.[2] Therefore, we used micro-computed tomography to study extracted teeth bearing enamel pearls on their root surfaces, with particular focus on the mineral density of the enamel in these pearls.

Material and methods: We used a ScanXmate-RB090SS (ComScanTechno, Tokyo, Japan) micro-CT system. Thirteen extracted teeth with enamel pearls were scanned at X-ray settings of 90 kV and 90 µA. The CT value resolution of the reconstructed image was 16 bits, with voxel size of 70 µm. The mineral density was calculated based on the CT value of a set of reference materials designed to measure bone mineral density (BMD). The size of the enamel pearls and the BMD of the enamel and dentin in various sectional images of these teeth were measured (Fig. 1).

Results and discussion: The diameters of enamel pearls were from 0.3–2.8 mm (average: 0.9 mm). Eight enamel pearls also contained dentin, whereas dentin was absent in five pearls. The average BMD value of the enamel pearls (15 g/cm^3) was higher than that of enamel in the tooth crown (14 g/cm^3). There was no significant correlation between the diameter of enamel pearl and its BMD. The BMD of dentin in enamel pearls and in other parts of the tooth were almost identical.

Conclusion: We conclude that this type of mineral density analysis may be useful in studying the etiology of tooth malformations, and that micro-CT is useful for measuring mineral density in small tooth structures.

Conclusion: We conclude that this type of mineral density analysis may be useful in studying the etiology of tooth malformations, and that micro-CT is useful for measuring mineral density in small tooth structures.

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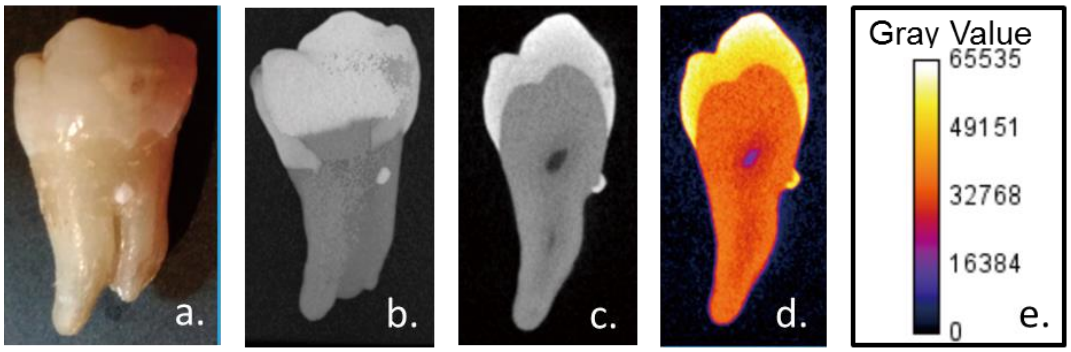

Figure 1: Extracted tooth with enamel pearl (a. picture, b. volume rendering, c. CT image, d. colour tables, e. colour table of gray value)

Large dentigerous cyst of mandible: a case report

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Clinical: A 38-year-old male patient was referred to our clinic for routine dental examination. He had no history of systemic disease and did not use any medication. Intraoral examination revealed no abnormalities. Physical examination showed no abnormalities on the skin.

Radiology: A panoramic radiograph showed a well-defined, large radiolucent lesion with an unerupted canine tooth in the left mandible and displacement of left lateral and first premolar teeth. Also, resorption of the roots of the lower teeth was observed. In order to have a detailed image, a cone beam computed tomographic image was taken. CBCT showed buccal and lingual cortical bone thinning and expansion of the mandible. On the basis of these clinical and radiographic characteristics, the differential diagnosis included a dentigerous cyst, an odontogenic keratocyst, ameloblastoma, and ameloblastic fibroma.

Pathology: The enucleated soft tissues were sent to pathology. The pathology report revealed features compatible with a dentigerous cyst.

Final diagnosis: Dentigerous cysts are benign odontogenic cysts associated with the crowns of permanent teeth. It may involve impacted, unerupted permanent teeth, supernumerary teeth, odontomas and rarely deciduous teeth. Dentigerous cysts typically have a well-defined cortex with curved or circular outline. The internal structure is completely radiolucent. It may cause displacement of adjacent teeth and resorption of their roots, and also commonly displaces the associated tooth in an apical direction.

Discussion: Odontogenic lesions are common pathologies in the jaw. The dentigerous cyst is the most common type of the non-inflammatory odontogenic cysts. Although the radiologic appearance is significant, it is not specific. Other radiolucent lesions, such as radicular cysts, odontogenic keratocysts and ameloblastomas should be included in the differential diagnoses of dentigerous cysts. The cyst's lining may contain areas of orthokeratinization, ciliated cells, or mucin secreting cells. Because of this inherent ability for metaplastic change, some dentigerous cysts appear to progress to more aggressive lesions such as an odontogenic keratocyst, ameloblastoma, mucoepidermoid carcinoma or squamous cell carcinoma.

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Figure 1: Panoramic view of the patient

Figure 2: Excision of the lesion

Cervical spine body morphology assessed using MSCT and CBCT. A comparative study

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Introduction: The imaging modalities used to evaluate the cervical vertebrae include cervical radiography, helical or multislice CT (MSCT) or, less used, cone beam CT (CBCT).[1] MSCT has been the modality of choice for evaluating bone structures.[1] However, CBCT could be considered a good alternative, with lower radiation dose.[2,3] The objectives of the study were to identify and compare human cervical vertebrae morphology and characteristics using MSCT and CBCT.

Material and methods: Eight cervical vertebrae (4 C1 and 4 C2) from human cadavers were analyzed by CBCT and MSCT. A Promax® 3D (Planmeca) dental CBCT (90 kV, 8 mA, 18 s) and a multislice CT Toshiba Aquilion (120 kV, 250 mA, 9.3s) were used (Fig. 1). Axial and transversal vertebral diameters were measured and morphology and anatomical details were compared using the 2 imaging methods. Three radiologists evaluated the image quality, by determining how proper they could identify the cortical and trabecular bone and their subjective experience of noise level, both on a scale from 1 to 3.

Results: CBCT was better adapted to bone scans, with less noise and higher spatial resolution and sensitivity. CBCT showed higher specificity for identifying cortical thickness, porous structure, cortical and trabecular bone destruction (Fig. 2). Dosimetry of active bone marrow and endosteum was complicated to asses with either imaging techniques due to the complex anatomical structure inside the vertebral spongiosa.

Conclusions: In our study, CBCT proved to be more suited as imaging tool for cervical vertebrae providing images with submillimetre resolution and better at determining the nature and severity of bone destruction than MSCT.

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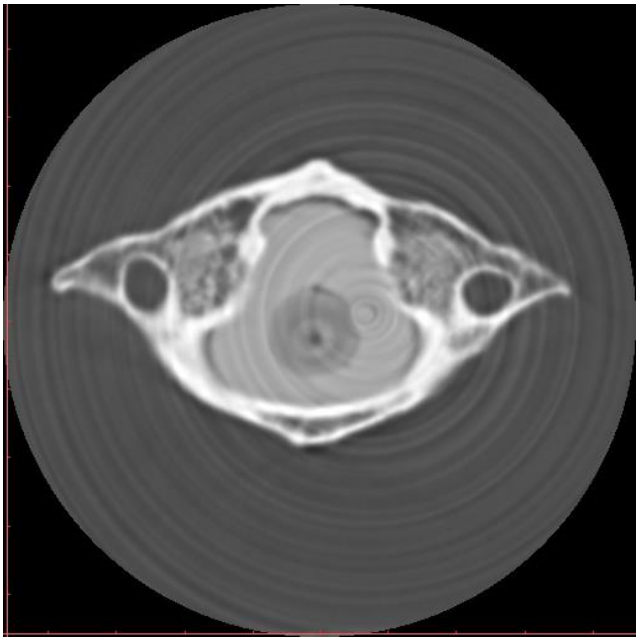

Figure 1: Atlas 2 – axial MSCT: wooden and plasticine support

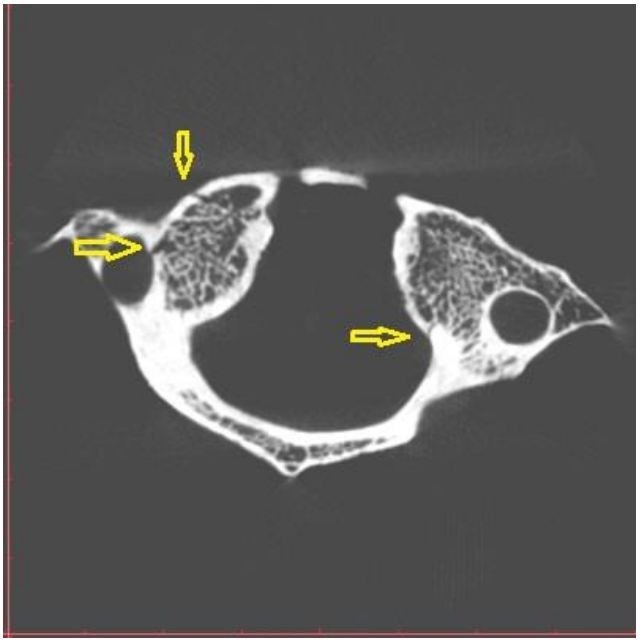

Figure 2: Atlas 2 – axial CBCT - several fracture lines detected on the same vertebra

The importance of CBCT in paranasal sinus lesions

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Introduction: Paranasal sinus imaging was raised to a new level with the introduction after 1999 of CBCT imaging as an alternative to CT imaging in evaluating odontogenic sinusitis[1] or anatomical variations of the paranasal sinus while replacing the insufficient exploration results obtained with panoramic and retro-alveolar examinations supplemented with conventional radiography of the paranasal sinuses. Low cost of equipment, reduction of radiation emissions and isotropic volumetric imaging with large FOV, together with providing high-resolution images,[2] enabled new CBCT devices to provide qualitative examinations of sinuses and dental arches. The aim of this presentation is to provide a revised approach to the importance of CBCT imaging with good resolution in the analysis of different causes of paranasal sinusitis in daily practice.

Materials and methods: CBCT studies of 183 patients with ages between 13–85 years and referred to Medimagis Clinic of Iasi, Romania for acute or chronic sinusitis, implant planning or oral surgery procedure planning (removal of impacted third molars), a suspected tumor or cyst, intra osseous impaction of a foreign body, an oro-antral fistula, orthodontic planning and trauma were retrospectively analyzed and compared to the data reported in the literature.

Results: Among the 183 CBCT examinations, 93 were on females and 90 on male patients. Mucosal thickening (mucositis n = 76), followed by unilateral acute (n = 31) and chronic sinusitis (n = 30) were the most frequently observed, associated with carious teeth, teeth with defective restorations (Fig. 1), or extraction site with or without a radiographically evident periapical lesion. More bilateral odontogenic maxillary sinusitis were found associated with mucous retention cyst, n = 15 and antrochoanal polyp, n = 5, ethmoidal sinusitis, n = 17, frontal sinusitis, n = 10, and sphenoid sinuses, n = 3. It was determined teeth in the maxillary sinuses of 19 patients associated with mucositis, maxillary sinusitis, and dentigerous cysts (n = 7). Thirty one cases with location-premolar or molar teeth with root canal filling radiopaque material fragments displaced into the sinus were associated with chronic sinusitis. Only in two cases, CBCT showed a complete opacification of the left maxillary sinus with thin intralesional calcification, with possible actinomycotic mycetoma, which can better be viewed in magnetic resonance imaging. Twenty one cases of oro-antral fistula were associated with extraction of third or second molar extraction. Hypoplasia of the maxillary sinus was seen in two patients with fibrous dysplasia and 7 patients with bone graft osteointegration. Nine cases presented with mucositis associated with retention cysts, anatomical variation of the last molar (Fig. 2) and also periostitis.[3] Two patients with unilateral

chronic sinusitis presented with intra sinusoidal periapical cysts. Only one patient presented with mucositis around a pedunculated maxillary sinus osteoma.

Conclusions: CBCT imaging provided a fast and accurate diagnosis in cases of sinusitis resistant to treatment when the patient had passed numerous dental and ENT examinations.

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Figure 1: Sagittal CBCT view with 2.7 under the dental bridge, with destruction of the inferior wall of left maxillary sinus and acute sinusitis

Figure 2: Sagittal CBCT view with mucositis, retention cyst and thin elevated layer of new bone adjacent to the 2.7 root apex which presents anatomical variation and periostitis

Characteristic CT and MRI findings of ameloblastoma in elderly patients

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Introduction: Ameloblastoma is a common odontogenic tumor that occurs frequently in a young age group with few reports in elderly patients.[1,2] The purpose of this study was to evaluate CT and MRI findings of ameloblastoma affecting elderly patients.

Material and methods: A total of 6 patients from our hospital older than 65 years and with a confirmed diagnosis of ameloblastoma were included in this study. Each patient underwent CT and MRI examinations that were used to determine 1) lesion site, 2) size, 3) bone expansion, 4) root resorption, 5) impaction of teeth, 6) locularity and 7) MR Signal intensity. Two radiologists independently reviewed the images, and discrepancies were solved by consensus.

Results: 1) Lesion site: maxilla - 17%, mandible - 83%, anterior - 33%, anterior to molar - 33%, molar - 17% and molar to mandibular angle - 17%. 2) Size: average buccolingual diameter - 25.5 mm, average mesiodistal diameter - 18.2 mm and average maximum diameter - 30.7 mm. 3) Bone expansion: yes - 100%, buccal - 50%, lingual - 33% and buccolingual - 17%. 4) Root resorption: yes - 50%, no - 17% and edentulous - 33%. 5) Impaction of teeth: no - 100%. 6) Locularity: unilocular - 50% and multilocular - 50%. 7) MR signal intensity: T1WI was low signal intensity - 40%, low- intermediate signal intensity - 60%, T2WI was non-uniformity low - high signal intensity 80%, high signal intensity 20% (Cystic fluid signal was 40%). STIRI was non-uniformity intermediate- high signal intensity 60%, high signal intensity 40%. DWI was non-uniformity low- high signal intensity 80%, low signal intensity 20%.

Conclusion: In our study, the ameloblastomas affecting elderly patients were distinguished from conventional ameloblastomas by their site of development, size and T2 signal intensity of the cyst fluid.

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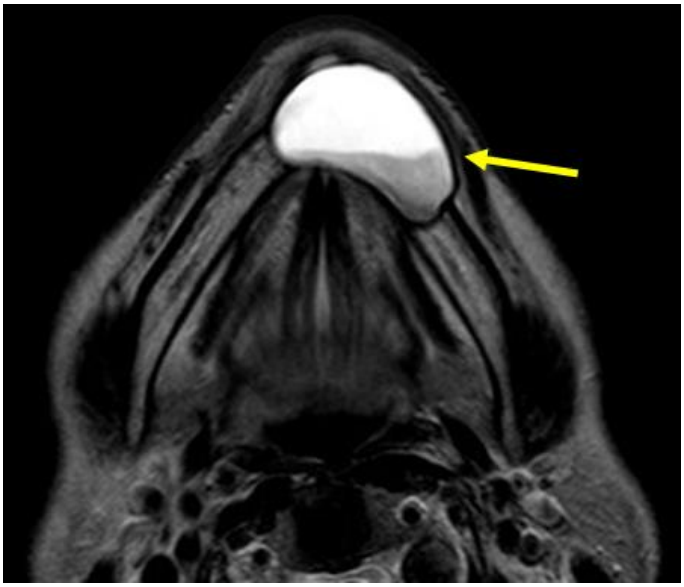

Figure 1: 67 years old male, T2WI. The arrow indicates a decrease of cystic fluid signal with fluid-fluid level

Videofluoroscopic examination of patients with dysphagia

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Introduction: Dysphagia is a highly prevalent condition and a growing concern of the elderly. The causes of dysphagia come from multiple factors, such as strokes, neurodegenerative diseases, dementia, and other age-related entities, etc. It may lead to severe complications such as malnutrition, dehydration, and aspiration pneumonia. Early detection of dysphagia is important due to its high mortality rate. A thorough clinical examination should be done before performing any instrumental examination to evaluate the conditions of patients who may have swallowing problems. Videofluoroscopic swallowing studies (VFSS) have been used as the gold standard of instrumental examination for swallowing disorders evaluation. This technique can be used to assess the swallowing ability with different volumes, textures and viscosities of food, the effectiveness of compensatory maneuvers, and the swallow physiology of patients. And VFSS can detect whether aspiration occurs before, during, or after swallowing.

The purposes of VFSS are:

1. To provide valuable information on anatomy and physiology of structures and muscles used in swallowing.
2. To evaluate a patient's ability to swallow various materials.
3. To study a patient's reaction to secretions.
4. To observe the adequacy of airway protection and the coordination between respiration and swallowing.
5. To help evaluate the impact of compensatory therapy maneuvers on swallowing function and airway protection.

The lateral view is used to:

1. Examine the oral transit time and pharyngeal transit time.
2. Detect movement patterns of bolus and oropharyngeal structures in the oral preparatory, oral, pharyngeal, and esophageal phases.
3. Detect approximate amount and cause of any aspiration that occurs.

The A-P view shows:

1. Asymmetries of bolus flow and pharyngeal residue (vallecula, pyriform sinus)
2. Adduction/abduction of vocal cords

The report of VFFS should include:

1. Diagnostic points: Penetration/Aspiration Scale (PAS), swallow disorders causing the symptoms of aspiration and residue, and reaction to the aspiration/penetration.

2. Therapeutic points: Immediate effect of interventions, therapy recommendations, oral feeding /non-oral feeding recommendations, and timing of follow-up.

The key points of this presentation are:

1. Recognizing dysphagia.
2. The use of VFSS will increase in the near future, so dentists need to be prepared and get ready as soon as possible to meet the demands.
3. Knowing why dentists should be involved in the medical team for the care of dysphagia. A multi-disciplinary collaboration of medical providers is critical to the comprehensive care for patients with dysphagia. Therefore, understanding the purpose and utilizing VFSS to manage dysphagia is imperative for dentists who intend to join the collaboration.
4. Oral hygiene control is effective in the prevention of aspiration pneumonia.
5. Preparatory and oral stages of swallowing are voluntary, so intensive oral function training provided by dental professionals is important.
6. Dental Prosthesis (denture, PAP, etc.) is vital in swallowing and requires the expertise of dentists to support the medical team.

With this presentation, I shall introduce the care delivery model used by dentists in Japan for patients who suffer from dysphagia after being discharged from hospitals, and highlight how crucial a seamless model is to support those patients in their communities. The progress of the treatment of clinical cases will be shown, followed by some modifications done with the valuable information gained from VFSS.

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Effetive Dose (mSv)		Time(min.)
Wright 1998	0.4	4.7
Baba 2015	0.36~2.6	2.5.~ 18
Chau 2009	0.31	4,2
Kanamori 2011	1.05	5
Kim 2013	1.23	4.8
Fujii 2017	1	

Effetive Dose (mSv)	
chest X-ray g	0.01
Trans-Alantic fliht o	0.04
Videoflur oscopi c swallow study	0.04-1.0
CT scan (head)	2
Annual background radiations	3
CT scan(abdominal) c	5

Clinical value of intraoral strain elastography for the assessment of the depth of invasion in early-stage tongue carcinoma

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Introduction: The accurate evaluation of depth of invasion[1] will be mandatory in the primary tumor staging for oral cancer, even in early stage patients. The aim of this study was to propose the use of the intraoral strain elastography[2] for the assessment of the depth of invasion in an early-stage tongue carcinoma.

Materials and methods: A total of 12 patients with histologically verified tongue squamous cell carcinoma were enrolled in this study. Patients with large tumors (maximum diameter: ≥ 30 mm) on clinical inspection and/or tumor thickness of >5 mm on intraoral sonography were excluded from the study. Intraoral strain elastography was performed with a small hockey stick-shaped intraoperative probe and acoustic coupling polymer gel. The depth of invasion was defined as the distance between an imaginary line of deep margin of the adjacent normal mucosal layer and the deepest portion of the tumor invasion. The elasticity of the tumor was classified into four grades, with a score of 1 indicating very soft tissue and 4 indicating very hard tissue.

Results: The average of the depth of invasion was 2.8 mm (range: 0.6–4.9 mm) and the elasticity score was limited to 3 or 4. The histopathological tumor invasion corresponded well with the blue (hard) areas on intraoral strain elastography and therefore, deepest portion of the tumor invasion was easy to define in every case.

Conclusions: The results suggested that intraoral strain elastography could be a promising method for the assessment of the depth of invasion in an early-stage tongue carcinoma.

Acknowledgements: This work was supported by JSPS KAKENHI Grant JP15K15692.

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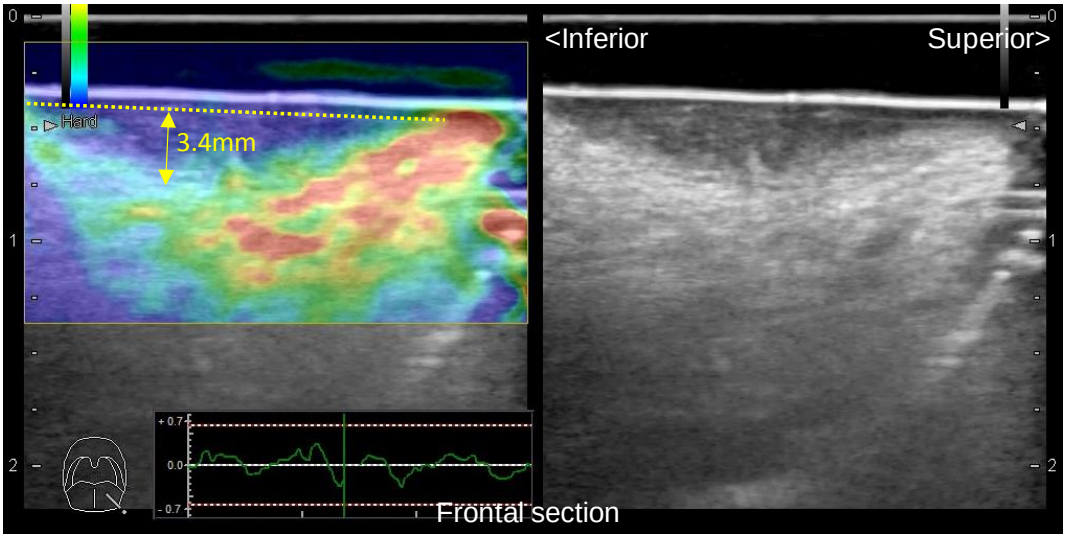

Figure 1: Intraoral ultrasonography images in a frontal section. The carcinoma tissue appears as a focal hypoechoic area continuous with the surrounding normal mucosal layer. DOI was 3.4 mm on the sonography

Eyestrain on the radiographic diagnosis of proximal caries lesions. A pilot study

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Introduction: Eyestrain is a reversible functional modification due to excessive effort of the visual apparatus. Oral maxillofacial radiologists experience visual symptoms depending on the level of their visual defects and the amount of time spent looking at the computer screen.[1,2] The main objective was to evaluate if eyestrain can affect the radiographic diagnosis of proximal caries lesions.

Materials and methods: Sixty human premolar and molar teeth with and without caries were extracted and used in this study. Proximal caries detection was assessed using visual inspection and phosphor plates (PSP). Three experienced maxillofacial radiologists served as observers, all of them had at least four years of experience in the oral diagnostic field. The observers rated caries depth at 120 proximal surfaces using the following rating scale: 0 = no caries lesion; 1 = lesion restricted to the first half of the enamel; 2 = lesion restricted to the full width of the enamel; 3= lesion restricted the first half of the dentine; 4 = lesion restricted to the full width of the dentine. The observers were asked to score twice, once in the morning and the other in the afternoon for assessing eyestrain comparison. Kappa coefficients according to Landis and Koch, 2 × 2 contingency tables and DeLong test were used in this pilot study.

Results: Results showed that eyestrain can affect the radiographic diagnosis of proximal caries lesions. Interobserver agreement was low for R1 and R2 caries diagnosis, for R0 caries diagnosis a moderate agreement was observed. R3 caries diagnosis had a moderate agreement and R4 an almost perfect agreement (Fig. 1).

Conclusion: Eyestrain affected the radiographic diagnosis of caries lesions, as observers reduced their diagnostic capacity during the afternoon evaluation. For R1 and R2 caries interobserver agreement was weak, but for R3 and R4 caries the interobserver agreement was substantial or nearly perfect, both in the morning and in the afternoon.

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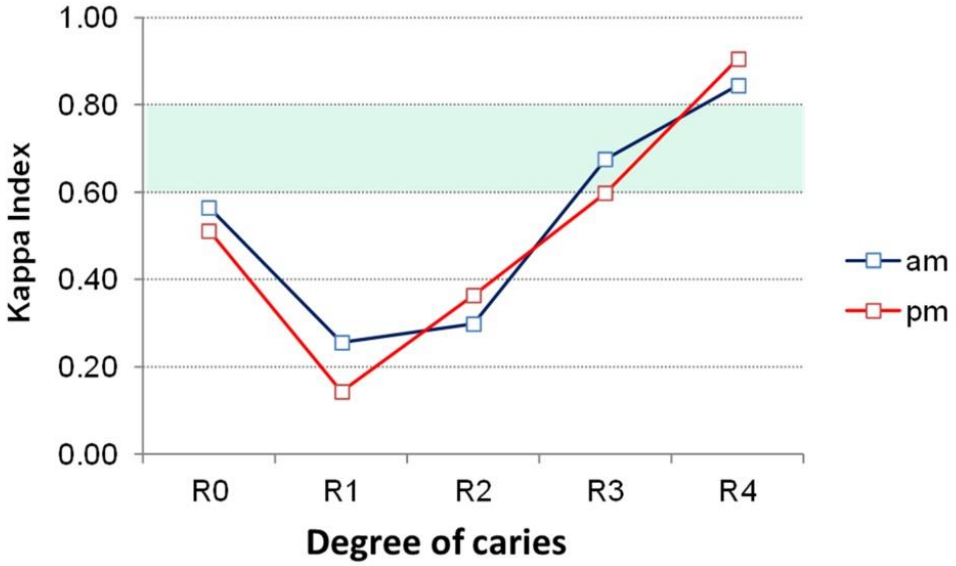

Figure 1: Inter-raters agreement by shift

Temporomandibular joint arthrography: is it necessary for the future?

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Nørgaard a famous radiologist from Denmark successfully performed TMJ arthrography using the periabrosil in 1944. In Japan, Professor Takaku reported the use of TMJ arthrography in 1966 and used an aggressive approach to evaluate its application on the TMJ. In 1970, Ohnishi referred to joint arthrography as the TMJ puncture method and described its application. There are many reports, including those by Farrar in 1971 and Westesson et al. in 1983, which have supported the diagnostic value of this procedure. However, in the 1980s, magnetic resonance imaging (MRI) was developed and widely used. This is a non-invasive technique that can identify the position of the articular disk, survey its morphology, and confirm if fluid exists in the joints; therefore, it has replaced TMJ arthrography for even diagnosing TMJ symptoms. Presently, the MRI is used for clinical diagnoses up to 3 T. However, it cannot still be used to diagnose disk perforation and adhesions (Fig. 1).

Purpose: In recent times, the number of patients suffering from disorders of the temporomandibular joint has been increasing in our hospital, and their symptoms and conditions are also becoming more complex and diverse. We hereby present an overview of an analysis done on examination of patients who visited our department with temporomandibular arthrosis.

Method: The subjects were 208 patients selected from 216 persons aged 8 to 82 years, who were diagnosed as having temporomandibular arthrosis, who visited our department for examination from April 2015 to March 2016. We recorded the age at initial examination, gender, the main complaint, and outlined the treatment plan (daily activity guidance, muscle stretching, splinting, muscle massage, medication, and surgical treatment).

Results: 1. Gender and age distribution: Of the 208 patients, there were 72 male (34.6%) and 136 female (65.3%) patients; thus, the female patients amounted to about two-thirds of the total. The average age was 39.2 years, which was 39.0 years for men and 39.4 years for women. Those in their twenties represented the largest number of patients receiving examination for both males and females. 2. Chief complaints: The TMJ pain is 36, muscle pain is 43, TMJ and muscle pain is 54, noise 38, truisms is 21, discomfort is 8 and in others it is 8. The main complaints were most often pain symptoms (approximately 64%). 3. Treatment plans (multiple choices): We provided daily activity guidance, including the tooth contacting habit (TCH) to control 92.3% of the patients with surgical treatment to alleviate almost

10% of the cases. Pumping manipulation was performed with the purpose of reducing the symptoms of temporomandibular arthrosis for cases which showed no tendency for improvement even after daily activity guidance such as physical therapy, and in cases where surgical treatment (TMJ infusion therapy) was requested.

Discussion: 1. Arthrography of the TMJ was required for a definitive diagnosis of adhesion or perforation of the discs as these conditions could not be diagnosed with MRI. 2. There are patients for whom MRI was contraindicated, such as those who have pacemakers installed. Moreover, unlike CT, this equipment is costly and the running cost for the MRI is very high. 3. The number of cases with surgical treatment has reduced; however, there were some cases that either required pumping treatment, steroid infusion therapy, or arthroscopy.

Conclusion: In conclusion, we believe that temporomandibular joint puncturing treatment will still be necessary in the future except for a limited number of cases.

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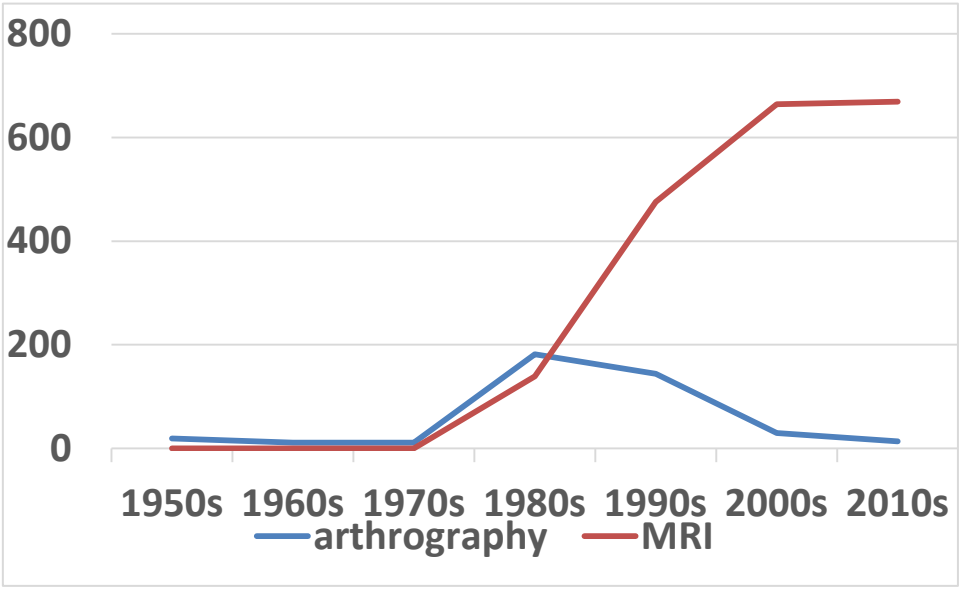

Figure 1: The number of arthrography and MRI articles on the TMJ area (the vertical axis of a graph presents the number of articles; the horizontal axis of the graph presents the decade)

Stress distribution analysis of the temporomandibular joint in condyle asymmetry

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Introduction: The human mandible is connected to the skull by two temporomandibular joints (TMJ). The articulating surfaces of these joints are incongruent, which provides the mandible with a wide range of movability respected to the skull. In between the articulating surfaces, a cartilaginous articular disc is situated, which is assumed to decrease the contact pressure by increasing the contact area between the incongruent joint surfaces. Generally, impaired of the TMJ function maybe due to different etiologies, such as injury to the jaw, muscle hypertonic of the head and neck, grinding or clenching the teeth, displacement of the disc or osteoarthritis as well as condyle asymmetry. Some surveys have reported that 20–25% of the population exhibit one or more symptoms of temporomandibular disorders (TMD). With a large portion of population suffering from TMD, it is a disorder which cannot be overlooked fully. However, the etiology of TMD remains controversial. In order to develop methods to prevent, diagnose, and management of this joint disorders, there is a great demand to be better understanding of the joint. Direct and indirect methods for evaluation of the human masticatory system including the temporomandibular joint have been demonstrated to predict the loads acting on this disc or joint.

Materials and methods: By using cone beam computed tomography (CBCT), image of bilateral temporomandibular joints of a normal subject were taken. Computer aided design (CAD) software was used to build up three dimensional temporomandibular joint model, which includes articular eminence of temporal bone, articular disc, and mandible with teeth. Eventually, we imported these data to finite element analysis (FEA) software to construct three-dimensional FEA models of condyle symmetry (control group) and condyle asymmetry (experimental group) groups which can simulate the situations of the temporomandibular joints after different loading condition. These models were used to investigate the stress distribution in the temporomandibular joint and disc under different loading conditions in control and experimental groups.

Results: More stress concentrated in the lateral pole of the condyle can be noted in the condyle asymmetry group (Fig. 1).

Conclusions: There is more stress concentrated in the lateral pole of the condyles in the condyle asymmetry group than the condyle symmetry group of the temporomandibular joint.

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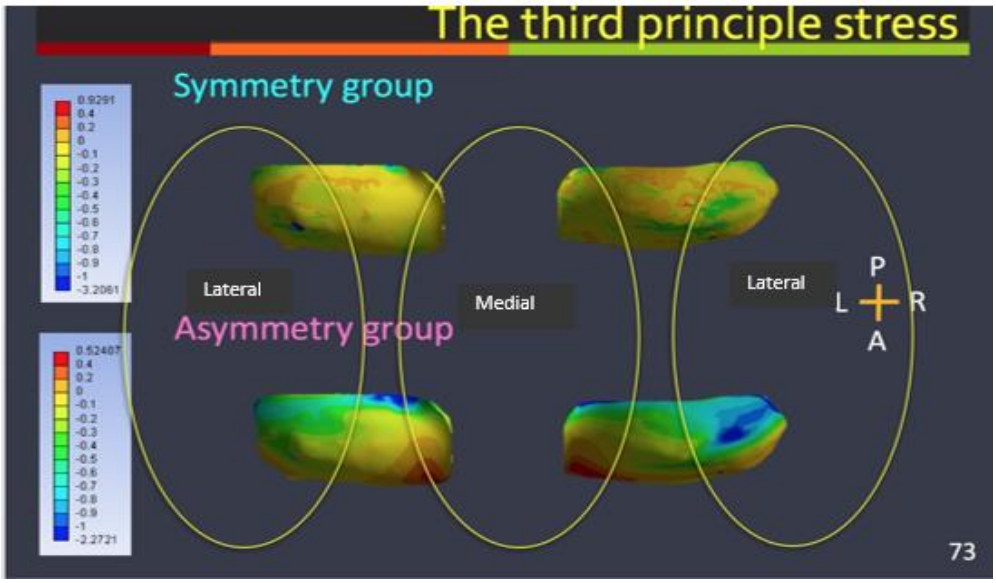

Figure 1: Stress distribution of the condyle in symmetry and asymmetry groups. There is more stress concentrated in the lateral pole of the condyle in the asymmetry group compared to the symmetry group

L-glutamine decreases the severity of oral mucositis in patients with head and neck cancer under radiation therapy

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Introduction: Oral mucositis and skin toxicity are the common side effects for head and neck patients receiving radiation therapy.[1] The evidence of L-glutamine in reducing the oral mucositis and skin toxicity is still inadequate.[2] We aimed to investigate the association between oral supply of L-glutamine and acute toxicity in patients with head and neck cancer under radiotherapy.

Materials and methods: Acute oral mucositis and skin toxicities were documented as primary end points. A total of 58 patients with stage I to IV head and cancer were randomized to receive either oral L-glutamine three times daily (study group) or placebo group.

Results: There were 69% and 70% patients with oral cancer in the placebo group and glutamine group, respectively. A significant reduction in mean maximum grading of oral mucositis was seen in the L-glutamine group compared with placebo (1.6 ± 0.6 vs. 2.1 ± 0.8, $p = 0.009$). No significant difference was found in dermatitis grading scores between the two groups (1.5 ± 0.6 vs.1.7 ± 0.6, $p = 0.221$) (Table 1).

Conclusion: Our study showed the use of L-glutamine resulted in a significant reduction of severity of oral mucositis in the head and neck cancer patients under radiotherapy.

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Table 1: Severity of oral mucositis

	Placebo (n = 29)	Glutamine (n = 30)	P-value
Grade of oral mucositis			0.146
0	0 (0.0%)	1 (3.3%)	
1	6 (20.7%)	12 (40.0%)	
2	17 (58.6%)	16 (53.4%)	
3	4 (13.8%)	1 (3.3%)	
4	2 (6.9%)	0 (0.0%)	

Fracture-like artifacts of gutta-percha cones on CBCT images influenced by the voxel size and FOV

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Introduction and objectives: Root canal filling materials, such as root canal sealers or gutta-percha cones (GPCs), can create distinct 'streak' artifacts on the cone-beam computed tomography (CBCT) images that can mimic root fracture lines, resulting in false-positive findings and misdiagnosis of tooth root fractures. The aim of this study is to determine the optimal scan settings (selecting scan mode and location of the object in the FOV) for reducing the GPC-related artifacts on the CBCT images.

Material and methods: We analyzed the CBCT images of nine extracted human mandibular premolars filled with size 50 GPCs, which were inserted into the tooth sockets of a human skull. Volumetric imaging was performed using two different modes: I-mode (FOV: 102 mm × 102 mm; voxel size: 0.2 mm) and D-mode (FOV: 51 mm × 51 mm; voxel size: 0.1 mm). In I-mode and D-mode, the GPC was positioned at five and three different locations in the FOV, respectively. For quantitative measurement of the change in the artifacts, we evaluated changes in the gray value (GV) of the artifacts. As shown in Figure 1, the line-type ROI was positioned at four points: mesio-buccal portion (MBP) as sound dentin part, mesial portion (MP) or distal portion (DP) as artifact part of the tooth, and the water area on the lingual side of the mandible (WA). To express the strength of an artifact as a relative value to the sound dentin, the rate of decrease in the GV density (RDGV) of the artificial line was calculated using the gray values of the sound dentin and water as reference values (sound dentin: 100%, water: 0%) as follows: RDGV (%) = (GV of MBP − GV of MP or DP) × 100/(GV of MBP − GV of WA).

Results: Both in I-mode and D-mode, an increased distance between the center of the FOV and the GPCs produced stronger artificial lines both of MP and DP. The artificial lines in I-mode were more obvious than those in D-mode when the GPCs were in the same location in the FOV.

Conclusions: The fracture-like artifacts induced by GPCs which can frequently be seen on the CBCT images can be reduced using a scanning mode with a small voxel size and placing the target in the center of the FOV.

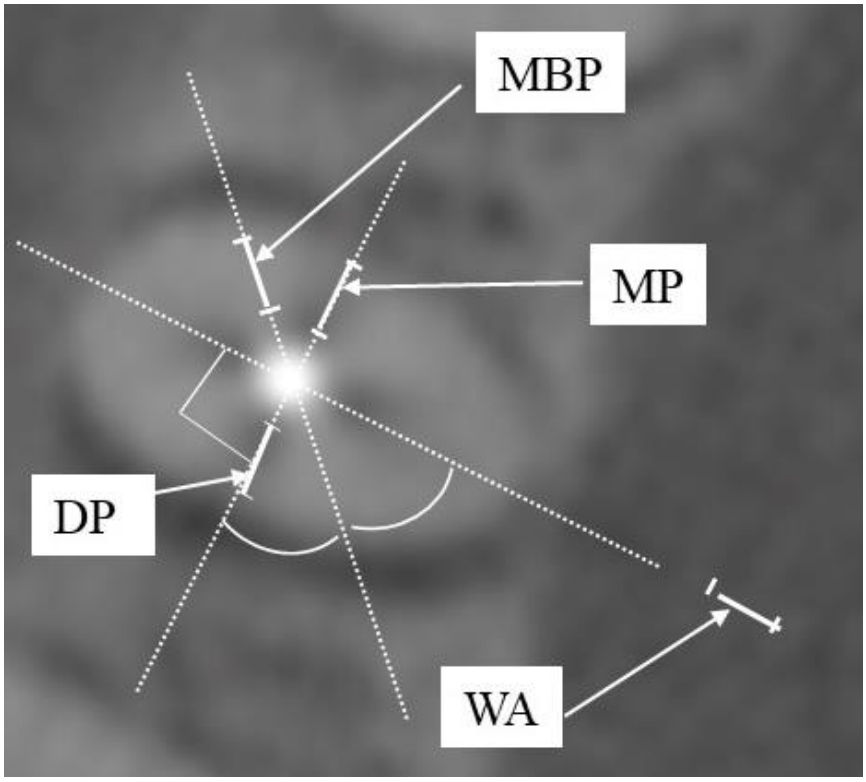

Figure 1: ROI setting of the density value measurement. MBP: mesio-buccal portion, MP: mesial portion, DP: distal portion, WA: water area on the lingual side of the mandible

Computer-aided system for osteoporosis assessment using mandibular cortical width measurement on dental panoramic radiographs

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Introduction: Osteoporosis is a systemic disease characterized by bone loss in various sites of the body including the mandible. Osteoporosis detection using dental panoramic radiographs is generally performed by measuring the width of cortical bone at the mandible.[1] In this research, a computer-aided system to assist osteoporosis assessment has been developed. The system measures the width of mandibular cortical bone on dental panoramic radiographs to detect osteoporosis.

Materials and methods: A dataset of dental panoramic radiographs and BMD assessment from 123 post-menopausal women has been collected. The proposed system consists of four main processes which are region of interest (ROI) selection, cortical bone segmentation, cortical width measurement, and classification. The selected ROIs are located below the left and right mental foramen on dental panoramic radiographs. In the segmentation process, the cortical bone in the ROIs will be separated from its background using statistical region merging.[2] Polynomial fitting is used to measure the width of the mandibular cortical. Finally, classification using Support Vector Machine (SVM) is done to classify the data into two classes, which are normal and osteoporosis.

Results: The experimental results using *k*-fold cross validation show that the proposed system achieves average accuracy of 82.93% for osteoporosis detection on dental panoramic radiographs. The average misclassification error (ME) and relative foreground area error (RAE) of the segmentation results of the system are 5.21% and 12.98%, respectively. From the analysis of cortical width measurement process, patients with osteoporosis have lower average mandibular cortical width than patients without osteoporosis.

Conclusions: This research shows that the proposed computer-aided system that measures the mandibular cortical width on dental panoramic radiographs can be used for osteoporosis assessment.

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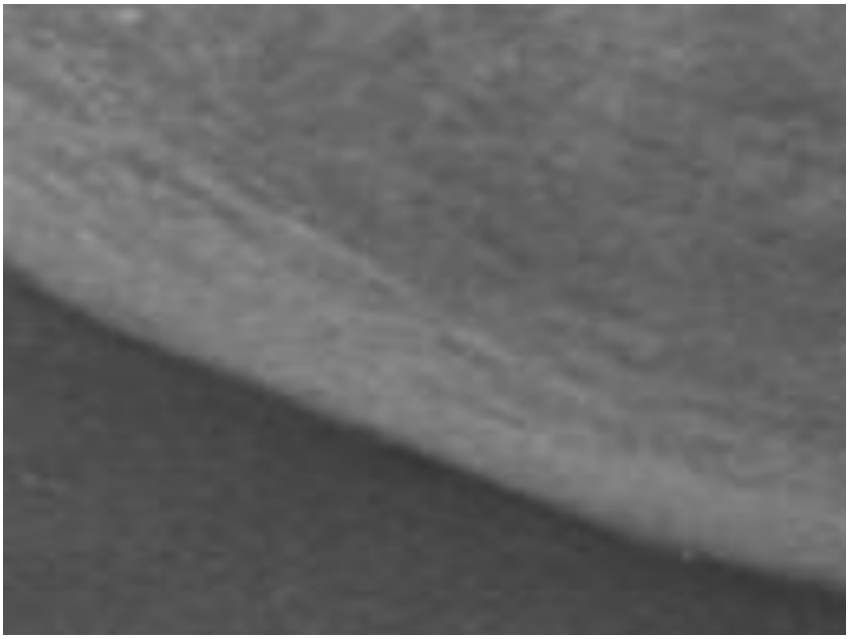

Figure 1: Cortical bone below the right mental foramen as region of interest (ROI)

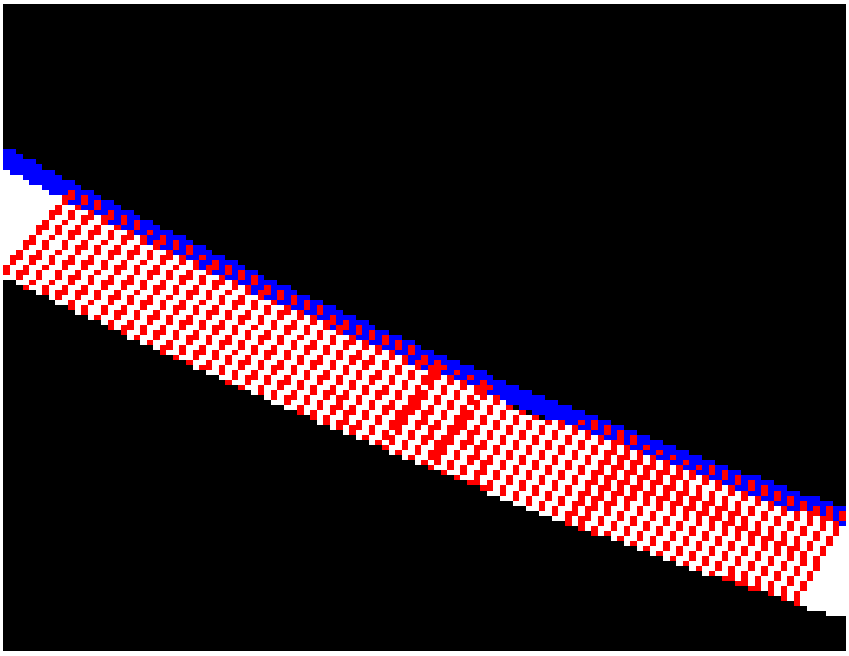

Figure 2: Cortical bone width measurement using polynomial fitting and line tangent

Initial study of personal identification on large scale disaster by practical using CBCT

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Introduction: Many dentists dealt with personal identification on the occasion of the East Japan great earthquake disaster occurrence (March, 11, 2011). There were several reports that dental examinations for postmortem identification inspection were difficult because of postmortal rigidity. So we planed a new method using reconstruction images of cone beam computed tomography (CBCT) for identity of person and started basic examination. The purpose of this study is to evaluate statistical reliability of personal identification with macroscopic by using reconstructed panoramic radiograph from CBCT and panoramic radiograph.

Materials and methods: We selected continuously 100 cases that performed CBCT and had been performed panoramic radiography as inclusion criteria. In addition, excluded 30 cases who has any tumor and/or cyst in maxillofacial region and whom all of teeth were not locate in the field of view as exclusion criteria. After choosing 70 cases, made three groups (20 patients per one group) were made with random allocation design. Reconstructed panoramic radiographs built using ray-summation technique without reference of any panoramic radiograph and personal information. Both of reconstructed panoramic radiograph and panoramic radiograph were output to each film with 300 dpi. Evaluators were four dentists whom each of the diagnostic imaging engaged in history are 35 years, 30 years, 21 years and 2 years. We examined inter-rater reliability with Kappa coefficient between 20 reconstructed panoramic radiographs and 20 panoramic radiographs in each group by macroscopic without any other personal information on the three groups. Personal identification tests of each group were provided with one month interval at least.

Results: All evaluators showed a very high concordance rate (100%) within the three groups. Furthermore, when inter-rater concordance rate for four evaluators who examined the three groups with Kappa coefficient, the value was ‘1’, thus, its reliability was judged as ‘Almost perfect’. In addition, transition of dental condition (each the number of residual tooth, treated tooth and dental implant) didn’t show any effect on the results of all evaluators.

Conclusions: The study showed high reliability and validity about personal identification test with macroscopic using reconstructed panoramic radiograph from CBCT and panoramic radiograph.

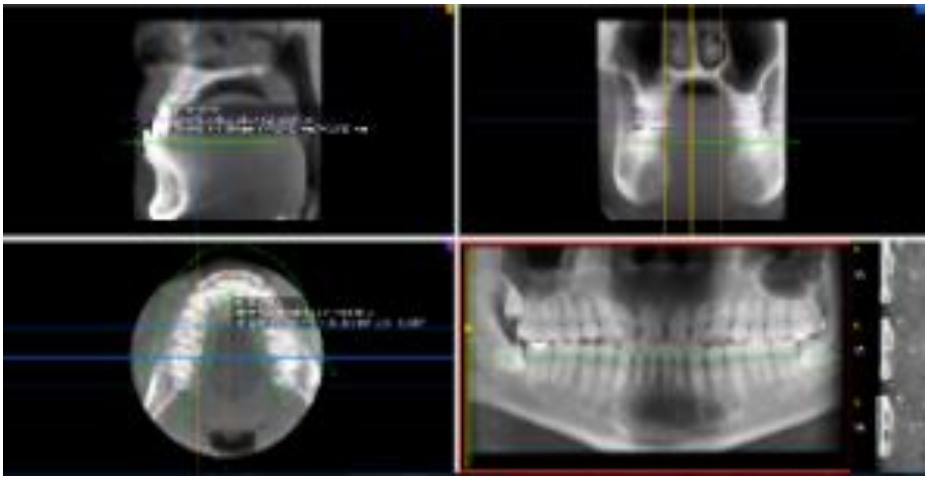

Figure 1: Reconstucted panoramic image were made by OsiriX with Dental3D-plugin, and the Thickness Slab of Ray-Summation was 30mm. The plot point was middle between buccal and lingul of maxilla and mandible

a

Figure 2a: Sample of original panoramic radiograph. It used as antemortem image

b

Figure 2b: Reconstructed panoramic radiograph of same patient with figure 2a. It used as postmortem image to comparing between antemortem and postmortem

Assessment of mandibular invasion in oral cancer

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Oral cancer is a considerable health problem in some countries including Sri Lanka since it accounts for 9.3% deaths of all cancers in both sexes. Majority of oral cancer are squamous cell carcinomas and very often proceeded by a potentially malignant disorder (OPMD). Even though there is a significant improvement in the prevention, detection, and treatment of oral cancer, prognosis of it remains as a significant health issue. Oral cancer is often diagnosed at advanced stages of the disease leading to delayed diagnosis and the possibility of a second primary reduces the success of treatment and favorable outcomes. They can spread to surrounding tissues including bone and to regional lymph nodes in which identification is important for treatment planning and prognosis.

Oral cancers have a tendency to invade surrounding bone (12–88%). It is very important to determine not only the presence of bone involvement but also severity and extent of involvement because it is the key factor in deciding the type of bony resection. Underestimation of bone involvement by oral cancer can lead to incomplete resection of the tumor resulting in local recurrence and potential metastasis. Overestimation will lead to unnecessary bone resection resulting in considerable cosmetic and functional defects thereby reducing the quality of life of the patient.

Clinical examination alone is insufficient to predict and assess bone invasion in oral cancer. Accurate preoperative imaging plays a vital role in identifying bone invasion. Imaging should ideally record the details of bony invasions including presence or absence of cortical and/or cancellous bone involvement, and inferior alveolar canal invasion; depth and length of erosion; height of the intact mandible at the site of invasion. Mandibular invasion can be assessed using multiple types of imagining modalities such as Dental Panoramic Tomography (DPT), bone scintigraphy, conventional CT, multidetector CT (MDCT), Cone-beam CT, single photon emission computed tomography (SPECT), integrated positron emission tomography (PET)/CT, and also with MRI. Sensitivity and specificity of these modalities are different and identification of correct method with high sensitivity without reducing the specificity is important. None of these imaging modalities are adequately reliable when used alone therefore it is recommended to use at least two modalities. Due to low specificity, use of DPT is limited to dental treatment planning prior to definitive cancer treatment. Being an anatomical imaging modality, CT provides accurate morphological information necessary for tumor localization and detection of structural abnormalities but not the functional or metabolic activity of the tumor. CBCT has a high sensitivity and specificity. Even

though radiation dose is low, it has limited scanning volume, contrast, soft-tissue information and tends to underestimate the extent of invasion. MRI is not superior to CT in assessing bone invasion due to high false positives. Functional modalities like bone scintigraphy, PET and SPECT are really useful in the assessment.

In conclusion, even though multiple imaging modalities are available, clinical assessment remains the most sensitive tool for diagnosis of mandibular invasion but only with a low specificity. No single modality with very good sensitivity and specificity therefore a combination of clinical and multiple imaging modalities are needed. More research is needed in this important area.

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Figure 1: Clinical picture of an oral cancer in the anterior mandible

Figure 2: 3D cone beam CT image showing extensive bone destruction in the same patient

Applications of terahertz imaging in dentistry – A new imaging technique in dentistry?

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Introduction: Terahertz (THz) electromagnetic waves occupy the spectrum between microwaves and the infrared optical band, which lies within the frequency range of 0.1–10 THz. They represent a large portion of the electromagnetic spectrum and have wide application potentials. THz radiation can penetrate into thin layers of nonmetallic substances like clothing, plastic, and ceramics up to several millimeters. Terahertz waves are non-ionizing and therefore they do not pose a risk to living organisms. They can be used for security screening, semiconductor inspection, food inspection, pharmaceutical inspection, and 2D and 3D imaging, including medical diagnosis in the areas of tooth structure, skin cancer and tumors. The development of techniques which utilize terahertz waves for applications in medicine is growing rapidly with the development of instrumentation. The aim of this presentation was to document in vivo diagnostic effectiveness of THz systems in light of previous studies conducted by our team.

Materials and methods: With the use of home-built THz-TDS systems, various primary and adult teeth samples were initially analyzed. The refractive index and absortpive properties of the teeth sections were analyzed in the 0.1–1 THz range in the wet-state (right after extraction) and in the dry-state (after drying them for a few days). Afterwards, in order to better understand the interaction of the THz radiation with teeth and implant like materials we constructed both a pulsed and continuous wave reflection mode raster scan THz imaging system that allowed us to investigate various samples in two and three dimensions. In addition, several soft tissue lesions e.g. irritation fibroma were placed between a quartz plate and a gold mirror (quartz was at the top). In this way, shrinkage of the sample and variations in the structure were prevented by pressure using these layers during the measurement.

Results: Certain teeth showed signs of decay, and the refractive index as well as absorptive properties of these samples showed clear differences when compared to healthy ones due to scatttering from the decayed regions. Furthermore the wet samples showed larger refractive index compared to the dry samples suggesting that the liquid content inside the tooth could be quantified using this technique. The refractive index, particularly of dentine in various primary and adult teeth, was measured to be close to 2.5 with slight variation amongs the samples. Although higher median absorption coefficient values were found for primary and carious teeth compared to permanent and healthy teeth the differences were insignificant ($p > 0.05$). Also, no statistical differences were found for refractive index values among different groups ($p > 0.05$). Analyzing the measurements in time, spatial and

frequency domains showed that the THz pulse was sensitive to variations in the structure of the teeth and implant structures. The continuous wave techniques allowed for rapid investigation of various teeth and implants. Figure 1 shows in vivo images of implants taken by THz system. In soft tissue imaging the THz pulse was reflected from the surface of tissue and showed red color. At later times, higher reflections awere observed from the bottom part of the sample. The reflected THz pulse from the middle part of tissue came later and the field amplitude was lower compared to bottom part.

Conclusion: THz imaging has the potential to be used in assessing several structures such as teeth, implants and soft tissues. Future studies will focus on increasing the resolution of the sampled area and imaging human structures upon reflection in 3-D.

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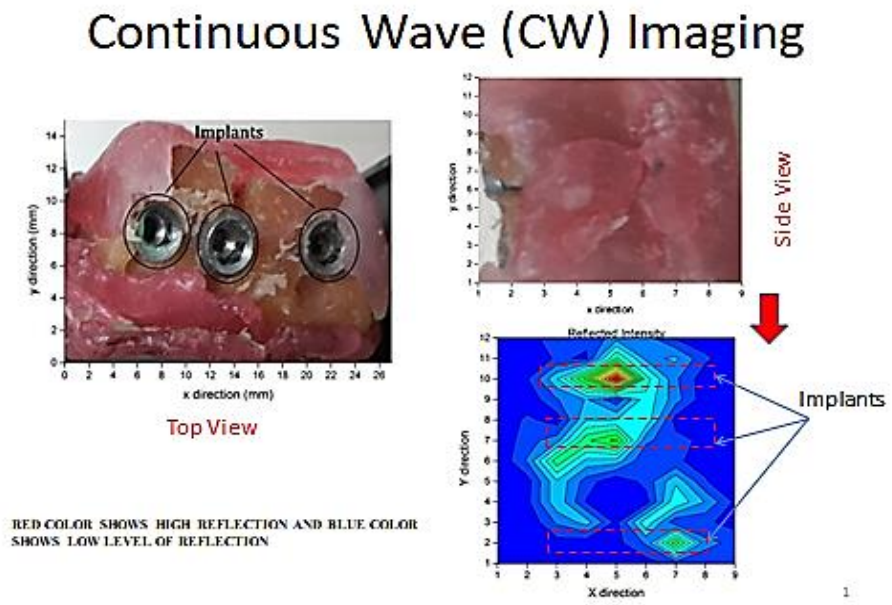

Figure 1: *In vivo* images of implants taken by THz system

MRI and CT of the jawbone lesion: What the oral radiologist needs to know

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Introduction: Diagnostic imaging of the maxilla-mandibular region is an important subsection of the head and neck radiology. Lesions developing within the maxilla-mandibular region can arise from the dental elements, bone, nerves, or blood vessels. In the diagnostic imaging of the maxilla-mandibular region, it has been common clinical practice initially to use plain radiography including an intra- or extraoral technique and panoramic radiography. In recent years, computed tomography (CT) and magnetic resonance imaging (MRI) have been used widely to image these lesions, and they have proved effective for differential diagnosis and determination of the extent of lesions.

Purposes: The presentation is 1) to discuss the use of CT and MR imaging technique of the maxilla and mandible, 2) to demonstrate normal anatomy of the maxilla and mandible, interpretation of images, characteristic findings of CT and MR imaging, 3) to discuss the advanced CT and MRI including multi-detector row CT and diffusion MR imaging for the maxilla and mandible.

Materials and methods: MR and CT were useful to get information about differential diagnosis, and extent of the lesions in the maxilla-mandibular region and soft tissue. CT and MR imaging were also useful in investigating clinically and /or suspected recurrence.

Imaging characteristics of benign odontogenic tumors: Benign odontogenic tumors are characterized by imaging findings of expanding growth and well-defined margins with smooth borders. Thin sclerotic rim is usually identified as the result of interaction between the slow growing tumor and surrounding bone. The lesion may appear as lobulated because of differences in rapidness of the growth at each margin. Trabeculae between locules look like septa by radiography and may suggest multilocular entity falsely. Lesions are circular or semi-circular attaching to the dental crown or apex. Cortical bone swells usually without destruction. Adjacent teeth may show root resorption and dislocation due to chronic compression by the lesion. The mandibular canal may show dislocation as well.

Imaging characteristics of malignant tumors in the mandible and maxilla: A major distinction between malignant and benign lesions is the definition of the margins; in malignancy, the margins are irregular, ill-defined and appear rarely corticated. In addition, radiographic signs of malignancy in the jaw can involve teeth and structures surrounding teeth. A sign of malignancy is the appearance of a tooth totally unsupported by bone, as if it were floating in space. Although the roots are rarely resorbed in malignant neoplasms, some tumors show an irregular

resorption of the root within the suspected area.

Conclusions: CT has many advantage such as excellently the degree of bone resorption, osteosclerosis, cortical bone swelling, destruction, detect of the calcifications. In contrast, MRI is so different imaging modalities comparing with other radiological modalities. It employs non ionizing radiation which is an advantage. MRI depend on the proton density of hydrogen in tissues such as water or lipid contents and effective in differentiation between cysts and tumors, detection of abnormal bone marrow, evaluation of infiltration of malignant tumors.

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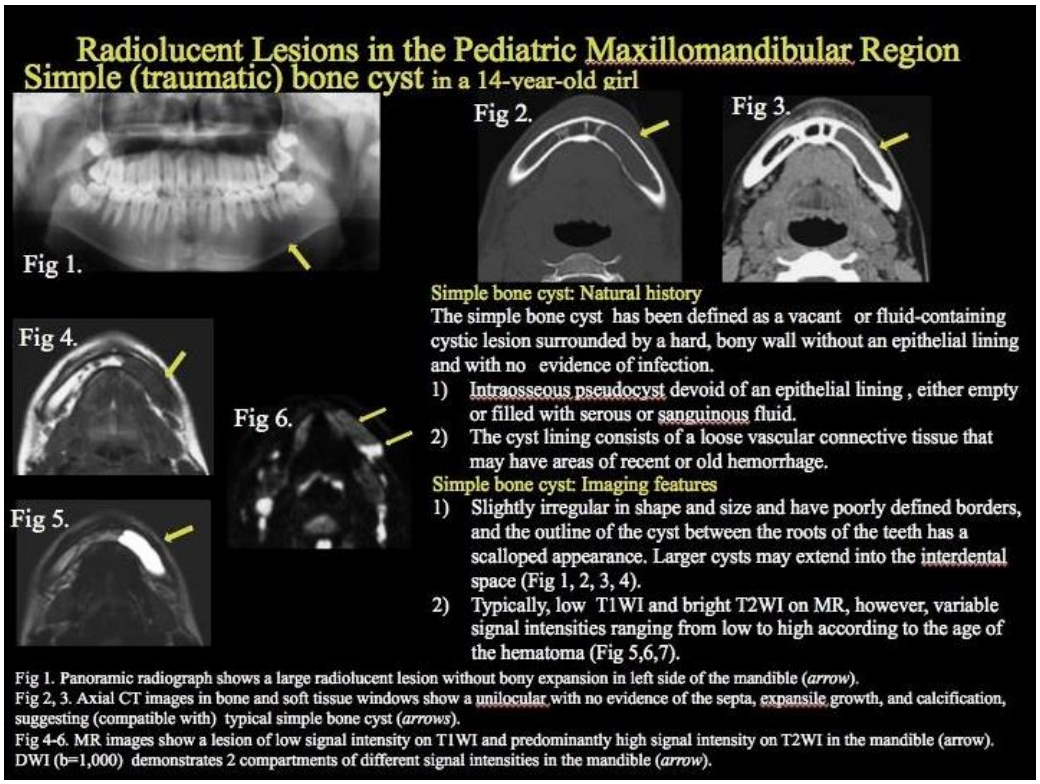

Conventional and CBCT radiographic appearance for calcifying cystic odontogenic tumor: A case report

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Clinical: A 44-year-old Thai female presented with gradual painless swelling at lower anterior region for 1 year. The lesion was fluctuant in consistency with intact mandibular border and normal mucosal coverage.

Radiology: Panoramic and periapical radiographs revealed a unilocular, relative radiolucency with somewhat well-defined corticated border. The lesion extended from tooth 35 to tooth 42 and from the crestal bone to the inferior border of the mandible. Normal trabeculation within the lesion and area of thinning of mandibular cortex were observed. Cross-sectional occlusal view showed severe buccal expansion with intact cortication, periphery scalloped nature and possible faint calcifications. CBCT indicated lesion with asymmetric expansion in buccal aspect of the jaw with minimal mandibular involvement, leaving an impression of mandibular depression with thin buccal cortex. Root resorption of teeth 32–34 was revealed. Radiological differential diagnoses of benign odontogenic cysts or tumors, i.e. ameloblastoma, calcifying odontogenic cyst, were given.

Final diagnosis: The final diagnosis was calcifying cystic odontogenic tumor, characterized by an incisional biopsy result of ameloblastoma-like epithelium with ghost cells.

Discussion: Calcifying cystic odontogenic tumor (CCOT) has been sub-classified into 4 subtypes by international collaborative group in 2008.[1] Several case reports described ameloblastomatous proliferating COC, or Type 3 CCOT, with an intraosseous asymmetric swelling mostly in the mandibular region.[2,3] Although the microscopic result of this present case was simple cystic CCOT or type 1 CCOT, its radiographic features followed similar trend of an asymmetric expansion. Therefore, this finding emphasizes the importance of including CCOT in the differential diagnoses of a well-defined radiolucency with asymmetric jaw expansion.

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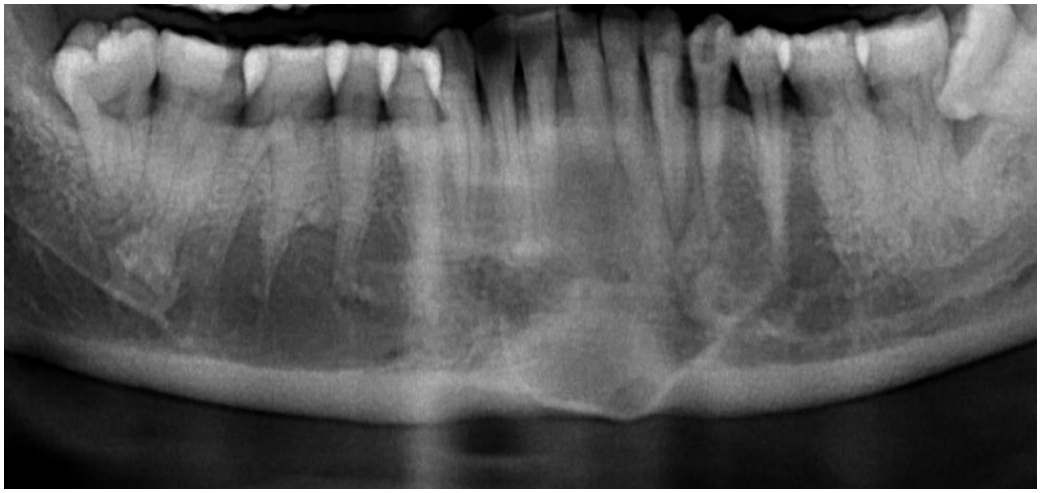

Figure 1: Cropped panoramic radiograph at symphysis region showing minimal radiodensity change

A study on backscatter radiation from dental alloys and a protective device during radiotherapy

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Introduction: Head and neck radiotherapy patients suffer from severe mucositis resulting from mucosal dose enhancement caused by backscatter radiation from dental alloys (DA). The use of a protective device (PD) such as a spacer is recommended to prevent mucosal dose enhancement.[1]The specific details of PD, however, have not yet been clarified. The purpose of this study is to investigate the dose enhancement caused by backscatter radiation from DAs and to discuss the optimal materials and thickness of PD.

Materials and methods: The dose enhancement effect was investigated for the 1 cm^3 DAs (Au, Au-Pd, Ag, and Ti). A Novalis TX linear accelerator was used as the X-ray beam generator. Photon energy, Dose rate, Field size, SAD, and SSD were sat at 6 MV, 100 MU, 10 × 10 cm, 100 cm, and 94 cm, respectively. We measured the depth dose along the central axis using a parallel-plate ionization chamber, and compared the doses among the DAs.

Results: The surface doses of the Au, Au-Pd, Ag, and Ti increased 17.6%, 13.2%, 12.8%, and 5.8% respectively compared with that of the no DA. The relative dose reached almost 100% at more than 6 mm from the DA surface (Fig. 1). The dose enhancement by the backscatter radiation has a positive correlation with both the Z_{eff} (Fig. 2) and the Pd of DA.

Conclusions: The backscatter radiation effects from all DAs disappeared at distances from the DA surface ≥ 6 mm, and the dose enhancement by the backscatter radiation showed a strong positive correlation with both Z_{eff} and Pd. Therefore, it was speculated that the material and thickness of optimal PD should have a lower Z_{eff} and Pd and the thickness of ≥ 6 mm each to prevent mucosal local dose enhancement caused by backscatter radiation from DAs.

Acknowledgement: This work was supported by JSPS KAKENHI, Grant Number JP24592830.

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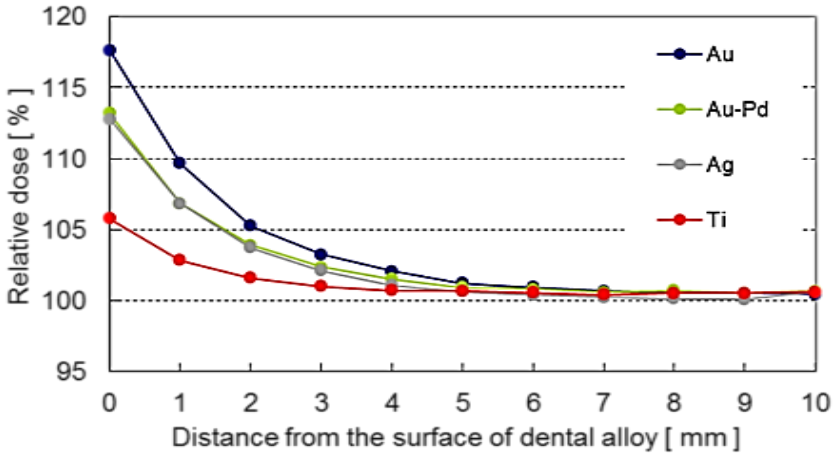

Figure 1: The relative dose curves of the each DA to the no DA. The surface doses of the Au, Au-Pd, Ag, and Ti increase by 117.6%, 113.2%, 112.8%, and 105.8% respectively compared with that for the no DA case. The elative dose decrease with increasing distance from the DAs surface for distances in the 0–5 mm range, with the relative dose reaching 100 ± 1% at distances from the DA surface ≥ 6 mm

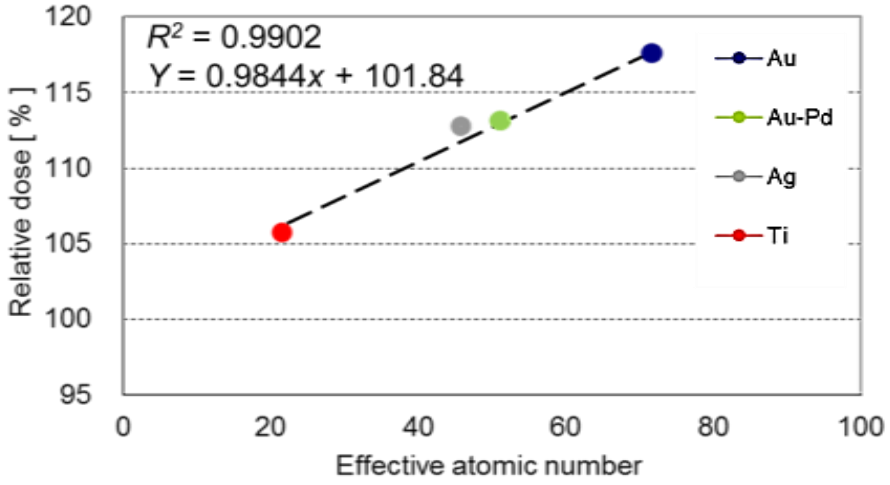

Figure 2: The relationship between the relative dose of the DAs surface and the effective atomic number (Zeff). The relative dose (dose enhancement by the backscatter radiation) shows a strong positive correlation with Zeff

Estimation methods of effective dose in dental radiology

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Introduction: The rapidly increased use of cone beam computed tomography (CBCT) in dental field has led to increased interest in patient dose. Effective dose is a useful metric for comparing alternative imaging modalities in terms of relative risk, despite some limitations. There have been many studies estimating the effective doses in dental radiology (especially, CBCT) using thermoluminescent dosimeters (TLDs) within an anthropomorphic phantom. But this method has several drawbacks. Among them, a major drawback in using TLD technology is the need to replace the TLDs after every exposure, which results in a time-consuming and complicated process. For the assessment of organ and effective dose, the use of Monte Carlo simulation can be an alternative to the above method. The objectives of this lecture were to review estimation methods of effective dose in dental radiology including TLD measurement method and Monte Carlo technique (PCXMC 2.0 and PCXMC20Rotation software), to describe how to use PCXMC software for the calculation of effective dose in CBCT, and to compare the effective doses of CBCT calculated by PCXMC with them measured using TLDs.

Materials and methods: For the estimation methods of effective dose, recent systematic review literatures[1,2] mainly about TLD dosimetry and several research papers[3,4] using PCXMC program were reviewed. PCXMC 2.0 and PCXMC20Rotation software[5] were introduced. And the effective doses in Alphard VEGA CBCT with cephalometric (C), panoramic (P) and implant (I) mode (FOVs with height > 10 cm) were calculated by PCXMC software. These modes of CBCT scanner used one scout image for setting up the patient. For the effective dose of scout image, a kind of true-lateral radiograph, PCXMC program was used. And for main projection, PCXMC20Rotation was used. Dose determining factors in PCXMC20Rotation software were patient age, X-ray voltage, filtration, the number of projection angles and oblique angle of the central ray, focus-to-reference point distance (FRD), X-ray beam width and height at reference point, the reference points on the X-, Y-, and Z-axes, and input dose quantity (DAP). How to determine the value of the X_{ref}, Y_{ref}, and Z_{ref} was described. Effective doses of main and scout projection based on ICRP 103 weighting factors at each mode were calculated and summated. And they were compared with the published data,[6] effective doses obtained using TLD dosimetry for the same CBCT units with the same exposure parameters.

Results and conclusion: Methodologic errors in effective dose estimation using TLD technology could be produced due to different methods of assessing the organ dose and calculating effective dose, difference of phantom positioning, FOV positioning, TLD positioning, different number of dosimeters, and so on. Because of incomplete description of technical parameters of CBCT, it was difficult to assess the cause of the inconsistency. It was proposed that complete information about CBCT units, dosimeters and phantom had to be reported in studies on estimation of effective doses of different CBCT units and scanning protocols.[2] PCXMC software in medical radiology is considered as useful tool for evaluating effective dose. Although PCXMC software might be a promising alternative to TLD technology in estimation of effective dose in dental CBCT, few studies[3,4] on the subject have been published. Effective doses at each mode of calculated by PCXMC and measured using TLDs within an anthropomorphic phantom are shown at Table 1. Effective doses at C, P, and I mode calculated by PCXMC software were 181 μSv, 300 μSv, and 158 μSv, respectively. Effective dose obtained by PCXMC calculation was 16–18% smaller than that by TLD measurement at each mode, revealing comparable to that using TLD dosimetry. For the assessment of effective dose in CBCT with large and medium FOVs, the use of PCXMC software might be an alternative to TLD technology.

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Table 1: Effective doses of CBCT scan calculated by PCXMC software and measured using TLD technology

Protocols of CBCT		C mode	P mode for maxilla	I mode for maxilla
	Scout	7	11	6
E_{PCXMC} (μSv)	Main CBCT	174	289	152
	Total	181	300	158
E_{TLD} (μSv)		216	366	187
Difference		-16%	-18%	-16%

C mode: cephalometric mode, 20.0 × 17.9 cm FOV; P mode: panoramic mode, 15.4 × 15.4 cm FOV; I mode: implant mode, 10.2 ×10.2 cm FOV

E_{PCXMC}: effective dose calculated by PCXMC software

E_{TLD}: effective dose measured using TLD technology

Difference: $(E_{PCXMC} - E_{TLD})/E_{TLD}$

Comparison of the accuracy of intraoral periapical radiography with CBCT taken at 3 different voxel sizes in detecting simulated endodontic complications: An *ex vivo* study

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Introduction: Early determination of endodontic complications is essential in terms of both deciding appropriate treatment procedures and preventing medico-legal actions.[1] Periapical radiography provides valuable information in the mesiodistal dimensions, however; it lacks information in the buccolingual dimensions. Cone beam computed tomography (CBCT) allows the visualization of teeth and related structures in different planes.[2] Our aim was to compare the accuracy of a PSP sensor with CBCT images obtained at 3 different voxel sizes in detecting simulated endodontic complications.

Methods: Following simulated endodontic complications were created in 39 human mandibular molar teeth: Group 1) Instrument seperation (N = 9); Group 2) Strip perforation (N = 10); Group 3) Underfilling of root canals (N = 10); Group 4) Overfilling of root canals (N = 10). PSP and CBCT images (voxel size: 0.075 mm, 0.1 mm and 0.2 mm) were taken. Images were scored by 4 observers for the presence or absence of four simulated endodontic complications according to a 5-point scale. Weighted kappa coefficients were calculated. ROC analysis was performed and chi-square test was used to compare AUC values. Significance level was set at $p < 0.05$.

Results: The intra-observer kappa ranged from 0.446 to 0.835 and inter-observer kappa ranged from 0.230 to 0.543. AUC values ranged between 0.450 and 0.651 for different CBCT images and between 0.348 and 0.611 for PSP. In general, CBCT images taken with different voxel sizes revealed higher AUC values compared to intraoral periapical images without statistical significance ($p > 0.05$). Comparison of AUC values of CBCT images with different voxel sizes and PSP images showed statistically significant difference between image set 1 and 4 ($p = 0.022$), image set 2 and 4 ($p = 0.002$) and image set 3 and 4 ($p = 0.032$) for only 1st reading of observer 2.

Conclusion: CBCT images obtained between 0.1 mm and 0.2 mm voxel sizes would be useful in the detection of endodontic complications as an adjunt to periapical imaging.

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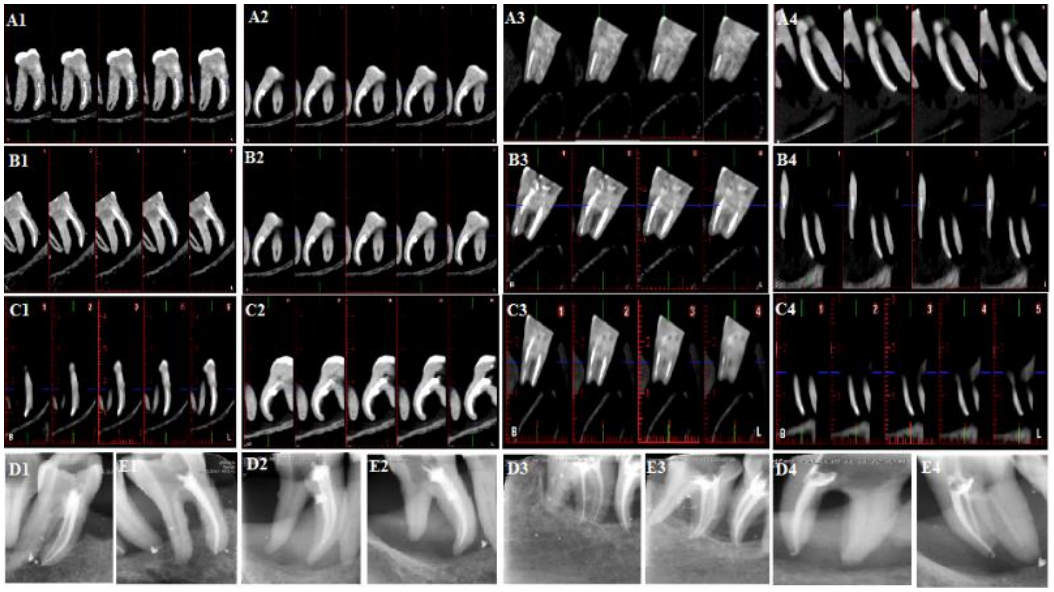

Figure 1: Images taken for the detection of four different endodontic complications as follows: Groups of instrument seperation (1) strip perforation; (2) underfilling; (3) and overfilling (4). (A1, A2, A3, and A4) CBCT images were taken at 0.075 mm voxel size. (B1, B2, B3, and B4) CBCT images were taken at 0.1 mm voxel size. (C1, C2, C3, and C4) CBCT images were taken at 0.2 mm voxel size. (D1, D2, D3, and D4) PSP images were taken from distoradial view. (E1, E2, E3, and E4) PSP images were taken form orthoradial view

CBCT follow up huge perıapıcal pathology along wıth maxıllary sınus mucosal thıckness

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Introduction: Periapical pathologies associated with roots of maxillary posterior teeth may cause mucosal thickening of maxillary sinus due to the anatomic proximity of roots to the maxillary sinuses.[1] For accurate diagnosis and treatment planning considering the limitations of two-dimensional intraoral periapical radiography, CBCT can be used as a imaging modality due to the fact that, it allows three-dimensional assessment of related region. This case report shows healing of periapical pathology and decrease of maxillary sinus mucosal thickening.

Material and methods: A 20-year-old male patient was referred to our clinic with complaint of pain, recurrent swelling on the palatinal mucosa. Intraoral examination revealed palatal swelling. The tooth #26 was slightly sensitive to percussion and there was no respond to heat and electric pulp sensitivity testing. In radiographic examination, it was observed that periapical lesion involving apical region of left maxillary first molar tooth. The patient had a CBCT scan that was taken another hospital previously. In case of evaluation of CBCT scans, besides detection of large periapical pathology and destruction on the palatal bone, maxillary sinus mucosal thickening also noticed. It was observed that the lesion size was actually larger than that determined by periapical radiographs. Two steps routine endodontic treatment performed. 1-year post-treatment CBCT image was taken by using Planmeca ProMax 3D Max with small FOV (Planmeca, Helsinki, Finland). The imaging parameters were set at 0.2 mm voxel and 96 kVp, 5 Ma. At 1 year follow up, CBCT scans showed decrease of periapical lesion size with maxillary mucosal thickness. At the first appointment, we used limited FOV CBCT imaging for evaluation and treatment so that we preferred limited FOV CBCT imaging as an imaging modality of choice for outcome assessment as well.

Conclusion: Limited FOV CBCT imaging was found sufficient for evaluation of changes in periapical lesion and mucosal thickening dimensions.

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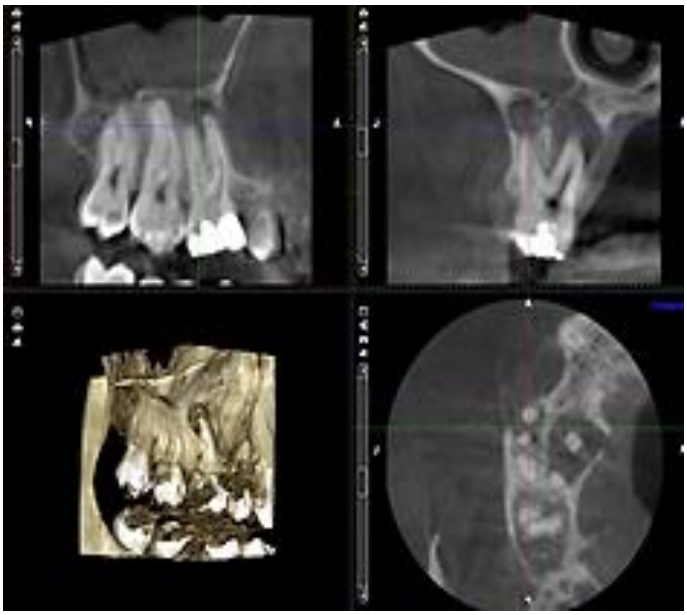

Figure 1: Pre-operative CBCT images

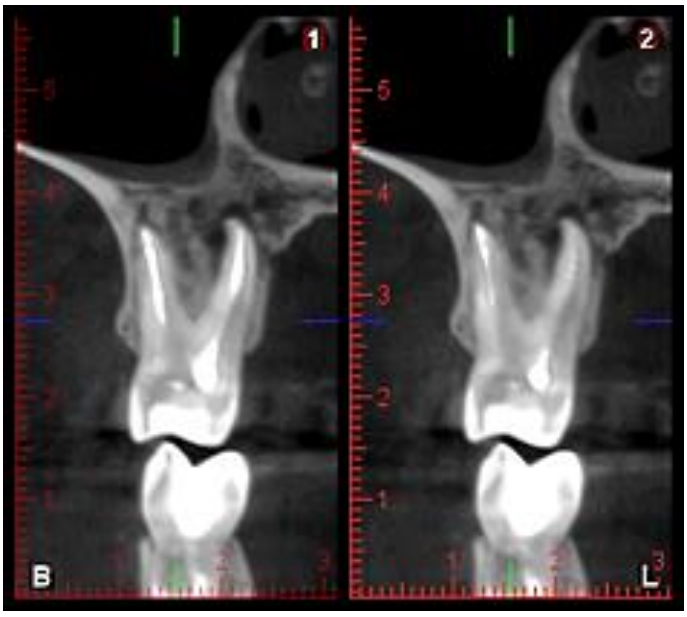

Figure 2: 1 year follow-up CBCT images

Diagnostic performance of MR imaging of three major salivary glands for Sjögren's syndrome

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Introduction: MR imaging, including MR sialography, can bilaterally evaluate all the major salivary glands simultaneously without contrast medium in diagnosing Sjögren's syndrome. However, no reports have focused on the relative diagnostic performance of MR imaging of the parotid, submandibular, and sublingual glands for the disease. We analyzed the diagnostic performance of the MR imaging findings of the parotid, submandibular, and sublingual glands to discriminate between patients with- and without Sjögren's syndrome.

Materials and methods: We retrospectively analyzed the correlation between MR imaging and histopathological findings obtained from 69 patients with clinically suspected Sjögren's syndrome. We evaluated the heterogeneous signal intensity distribution on T1- and T2-weighted images, the multiple high-signal-intensity spots on 3D method MR sialograms, and the volume of the parotid, submandibular, and sublingual salivary glands. We also analyzed the diagnostic ability to detect high signal intensity spots with comparison between 3D and 2D methods MR sialography.

Results: The multiple high-signal-intensity spots in the parotid gland showed the highest sensitivity and diagnostic accuracy (82% and 83%, respectively). In addition, the multiple high-signal-intensity spots and the heterogeneous signal intensity distribution in the submandibular gland showed high specificity (100% and 88% respectively). The volume of the submandibular gland, but not that of the parotid or sublingual gland, was smaller in patients with Sjögren's syndrome. 3D method MR sialography showed higher diagnostic ability to detect the spots than 2D method.

Conclusions: The presence of multiple high-signal-intensity spots on 3D method MR sialogram of the parotid gland should be considered as the best diagnostic indicator for Sjögren's syndrome. The presence of spots, heterogeneity, and the change to smaller volumes in the submandibular gland were also helpful because of their high specificity, particularly in advanced cases.

Table 1: Diagnostic performance of T1-/T2-weighted imaging and MR sialography for the parotid, submandibular, and sublingual glands

		Sensitivity (%) [95% CI]	Specificity (%) [95% CI]	Diagnostic accuracy (%) [95% CI]	Kappa value
Heterogeneous signal intensity distribution on T1-/T2-weighted MR image	Parotid gland	**67** (30/45) [51-80]	**75** (18/24) [53.3-90.2]	**70** (48/69) [57.3-80.1]	0.91
	Submandibular gland	**58** (26/45) [42.2-72.3]	**88** (21/24) [67.6-97.3]	**68** (47/69) [55.8-78.8]	0.94
	Sublingual gland	**33** (15/45) [20-49]	**83** (20/24) [62.6-95.3]	**51** (35/69) [38.4-63]	0.74
Multiple high-signal-intensity spots on MR sialogram	Parotid gland	**82** (37/45) [67.9-92]	**83** (20/24) [62.6-95.3]	**83** (57/69) [71.6-90.7]	0.97
	Submandibular gland	**22** (10/45) [11.2-37.1]	**100** (24/24) [79.6-100]	**49** (34/69) [37-61.6]	0.90
	Sublingual gland	**49** (22/45) [33.7-64.2]	**83** (20/24) [62.6-95.3]	**61** (42/69) [48.4-72.4]	0.87

Fisher's exact test: *P < 0.05, **P < 0.01, ***P < 0.001.

Brachytherapy with ^{198}Au grains for oral cancer: an analysis of treatment results and complications

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Introduction: The aim of the study was to evaluate the clinical outcomes and complications to soft tissue and mandibular bone following brachytherapy with ^{198}Au grains for patients with T1 and T2 oral cancer.

Materials and methods: Between January 2005 and December 2013, 55 patients with T1 and T2 oral cancer were treated with the brachytherapy with ^{198}Au grains. The patients were distributed by their site and tumor size according to the 2009 UICC TNM classification. Classifying all lesions according to each subsite, 35 (T1: n = 18, T2: n = 17) patients had tongue cancer, 10 (T1: n = 3, T2: n = 7) had mouth floor cancer and 10 (T1: n = 3, T2: n = 7) had buccal mucosa cancer. Further, T2 tumors were classified as either early T2 (T2a), a tumor of not more than 3 cm in largest diameter, or late T2 (T2b), a tumor of more than 3 cm in largest diameter. The age range was from 30 to 93 years (average age 64.5 years, median age 65 years). All patients had histopathologically proven squamous cell carcinoma and clinically negative cervical lymph nodes and distant metastases with CT, US, and PET-CT. Macroscopically, 30 tumors were superficial, 8 exophytic and 17 infiltrative. Medical records were reviewed in January 2016. The period ranged from 10 to 123 months (median 58 months). All patients were followed to death or to December 2015.

Results: 55 patients were followed up for the period of more than 2 years or to death. The 2-year local control rate with T1, T2a, and T2b was 91.7%, 100% and 96.2% respectively (Fig. 1). Four out of 55 patients (7.3%) failed to achieve primary lesion control during the follow-up period. Two of tongue (T1 and T2a), one of mouth floor (T2a) and one of buccal mucosa (T1) cancer patients had primary lesion recurrences. All patients had no severe complications of the soft tissue and mandibular bone necessitating surgical intervention.

Conclusions: Our study showed the treatment outcomes of brachytherapy with ^{198}Au grains for T1 and T2 oral cancer. The implantation of ^{198}Au grains for oral cancer did not produce severe adverse effects in the soft tissue and bone of the mandible.

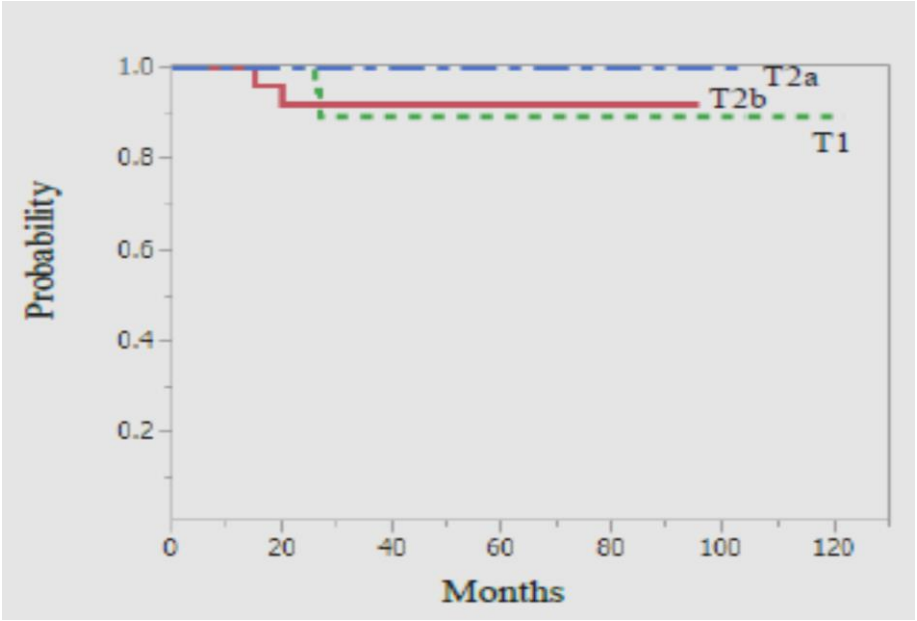

Figure 1: Local control rate for T1, T2a, and T2b. No significant differences among the groups

Effect of three amalgam restorations on the accuracy of caries diagnosis in CBCT – ex vivo study

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Introduction: Diagnosis of proximal caries is generally performed by clinical examination and bitewing radiography. Cone beam computed tomography (CBCT) recently disclosed the accuracy of caries diagnosis comparable to bite wing radiography.[1] One disadvantage of CBCT is the presence of metallic restoration, which causes artifacts and deteriorates images for interpretation.[2]

Objectives: To assess the accuracy of CBCT in caries diagnosis of teeth adjacent to three type of amalgam restorations; occlusal (O), occluso-mesial (OM), and mesio-occluso-distal (MOD) fillings.

Materials and methods: Two hundred and four CBCT images of 68 blocks were evaluated for the presence or absence of dental caries by two observers, using a 5-point scale confidence scale. Each block is composed of three teeth. The middle tooth will be amalgam-filled tooth varying from occlusal, occluso-mesial and mesio-occluso-distal restoration. Both adjacent teeth will be evaluated for either carious or non-carious tissue (Fig. 1). The definitive diagnosis of dental caries was based on histological section. Sensitivities, specificities and accuracy with 90% confidence interval were calculated for different types of amalgam restorations. Kappa values were used to assess the intra- and interobserver reliability.

Results: Sensitivities/specificities of occlusal, occluso-mesial, and mesio-occluso-distal restoration were 0.64/0.98, 0.41/0.94, and 0.50/0.97, respectively. The accuracy of caries diagnosis adjacent to occlusal, occluso-mesial, mesio-occluso-distal amalgam filling ranged from 0.75–0.85, 0.54–0.66, and 0.55–0.57 respectively. Intra- and interobserver reliability varied between 0.86–0.94.

Conclusions: The accuracy of CBCT in caries diagnosis was influenced by adjacent tooth surface, especially in tooth surface with large amalgam filling. CBCT should not be used to evaluate dental caries in tooth surfaces contacting to amalgam fillings.

Acknowledgement: This study was as supported by the Faculty of Dentistry, Khon Kaen University, Thailand.

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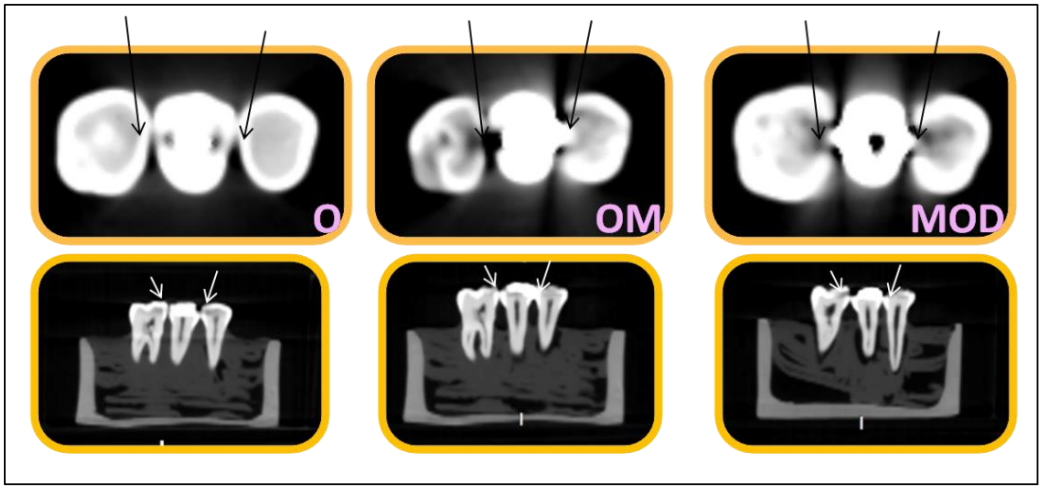

Figure 1: CBCT images of each block containing three teeth. The tooth surfaces (arrow) contacting to O, OM and MOD amalgam filled teeth were evaluated for dental caries

Maxillary sinus mycetoma: Image findings and clinical symptoms

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Introduction: Mycetoma is the most common type in the mycotic sinonasal disease. A mycetoma is a fungal hyphal colonization of a cavity or space.[1] Mycetoma is difficult to distinguish from lethal maxillary sinus carcinoma and acute fulminant fungal sinusitis. However, there are few reports on maxillary sinus mycetoma. The purpose of this study was to investigate image findings and clinical symptoms of maxillary sinus mycetoma.

Materials and methods: MDCT images of 16 mycetoma patients were used to evaluate 1) location and shape of mycetoma, 2) location and shape of calcification, 3) osteolysis, 4) osteosclerosis, 5) bony wall thickening, 6) bone expansion and 7) symptoms.

Results: Evaluation of the different shapes of mucosal thickening of mycetoma resulted in the following findings: 11 patients had conformed to the maxillary sinus shape, 5 patients had a mucosal thickening of the maxillary sinus portion. The infecting organism was mycetoma in the 15 patients who had fungal sinusitis and intrasinus calcification on CT. Location of calcification resulted in the following findings: 13 calcifications were central, 1 calcification was peripheral and 1 calcification was mixed. Evaluation of the different shapes of calcification resulted in the following findings: 9 calcifications had a fine punctate shape, 4 calcifications had a linear shape, 2 calcifications had an eggshell shape and a nodular shape. Preoperative imaging data of patients with mycetoma resulted in the following findings: 3 mycetomas was sinus wall osteolysis, 5 mycetomas were osteosclerosis, 10 mycetomas were bony walls thickened and 4 mycetomas was bone expansion. Invasion range of mycetoma resulted in the following findings: 6 mycetomas invaded the ethmoid sinus and 5 mycetomas invaded the ethmoid sinus and the nasal cavity. Clinical symptoms were observed in all patients.

Conclusions: The findings for maxillary sinus mycetoma on MDCT image findings and clinical symptoms have been elucidated in this study. It has been suggested that these findings of mycetoma are to be useful for distinguishing other sinus diseases and mycetoma.

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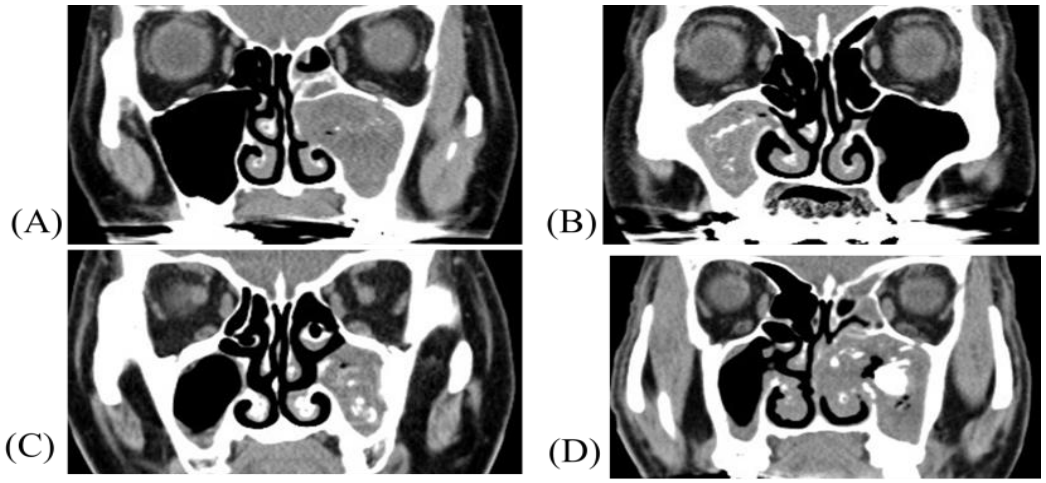

Figure 1: Shape of calcification in mycetoma. Coronal CT images shows: (A) fine punctate, (B) liner, (C) nodular and (D) eggshell

Diagnostic validity of periapical radiography and CBCT for assessing persisting periapical lesions after apicectomy

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Introduction: Traditionally, the healing after surgical endodontic retreatment (SER), i.e. apicectomy with or without a retrograde filling in a root-filled tooth, is assessed in periapical radiographs (PR). During recent years, the use of Cone-Beam CT (CBCT) has increased also within endodontics. Generally, CBCT detects more periapical lesions than PR, but basic research on the true nature of these lesions is missing. The objective was to assess the diagnostic validity of PR and CBCT for determining inflammation in SER cases that were re-operated (SER-R) due to unsuccessful healing (non-healed), using histopathology of the periapical lesion as reference for inflammation.

Materials and methods: Records from 149 patients (165 teeth), receiving SER 2004–2010, were screened. In total 108 patients (119 teeth) were re-invited for clinical follow-up examination, PR and CBCT, of which 74 patients (83 teeth) participated. Three observers assessed the periapical radiographic area as "healed lesion" or "non-healed lesion" using criteria by *Rud*[1] *and Molven*.[2] SER-R was offered to all non-healed teeth which had an expected favorable prognosis for subsequent functional retention; 20 of 23 patients (23 teeth) accepted. During SER-R, biopsy was performed and histopathology verified if inflammation was present (one biopsy was lost).

Results: In total 19 biopsies were examined. Histopathologic diagnosis revealed 42% (teeth = 8) without periapical inflammation and 58% (teeth = 11) with mild to intense inflammation (Table 1). All re-operated cases were assessed non-healed in CBCT while 11 of these were assessed successfully healed in PR. A correct diagnosis was thus obtained in 58% with CBCT (true positives) and 63% with PR (true positives and true negatives).

Conclusions: Of the re-operated teeth, 42% had no periapical inflammatory lesion, and hence no benefit from SER-R. Not all lesions observed in CBCT after initial SER equal periapical inflammatory lesions.

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Table 1: Dichotomized Rud & Molven categories (consensus observer) vs. histopathological diagnosis of SER-R teeth

	Radiographic healing classification		
Histopathologic classification	PR healed/ CBCT non-healed	PR non-healed/ CBCT non-healed	Total
No inflammation	6	2	8
Inflammation	5	6	11
Total	11	8	19

Diagnostic imaging of the TMJ – an update

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Introduction: Patients with facial pain and jaw function problems, collectively named TMD patients, constitute a large and heterogeneous group in our society. Many are referred for radiological examinations of their TMJs. Knowledge about conditions that might occur in these joints is therefore mandatory for maxillofacial radiologists, medical radiologists and others who are interpreting TMJ images. The lecture will focus on the diagnostic assessment of the different TMJ conditions that may be found in TMD patients. To assess TMJ pathology it is however mandatory to know the range of normalcy, i.e. imaging signs observed in healthy individuals. The purpose of this review is to discuss what is unquestionable TMJ pathology in TMD patients (i.e. joint findings either not seen or seen with less severity in asymptomatic volunteers).

Materials and methods: The review is based on available literature with special focus on reports documenting imaging TMJ findings in asymptomatic volunteers, to clear out what might be pathological TMJ conditions in TMD patients.

Results: Disk displacement; anterior disk displacement without reduction is a frequent finding in TMD patients, and this condition seems to occur almost exclusively in patients. Almost in all such joints the disk is completely displaced anteriorly, i.e. in all sections through the joint (Fig. 1). In asymptomatic volunteers the disk displacement is less severe and usually partial, defined as disk displacement only in one portion of the joint. Partial anterior disk displacement will almost always reduce to normal on mouth opening.

Joint effusion, excessive amount of joint fluid may be found in TMD patients (Fig. 2), in particular in joints with disk displacement without reduction. However, joint fluid is frequently found also in asymptomatic volunteers; more than half of the individuals are reported to have fluid. If joint effusion is defined as more fluid than found in any asymptomatic volunteers, only a small proportion of the TMD patients will have TMJ effusion.

Abnormal condyle marrow; abnormalities in the bone marrow is another inflammatory reaction in TMD patients. MR signal alterations are not observed in healthy individuals. Thus, increased signal on T2 combined with reduced signal on T1 or proton-density MR images indicates TMJ pathology; bone marrow edema (Fig. 3). If this is found together with joint effusion, a more pronounced inflammatory reaction is indicated than if joint effusion is found as the only inflammatory sign.

Osteoarthritis; cortical bone abnormalities are frequently found in TMD patients. However, whereas the other imaging signs mentioned can be assessed by means of MRI only, osteoarthritis is more reliably assessed by means of CBCT/CT. Since

cortical bone abnormalities are frequently reported in some series of asymptomatic volunteers, there should be a focus on evident surface changes in TMD patients. It is important to search for bone destruction since bone-erosive osteoarthritis (Fig. 4) seems to be more related to joint pain than bone-productive osteoarthritis.

Conclusions: In the diagnostic assessment of TMJ conditions one should be very careful to classify subtle changes as pathologic. Anterior disk displacement without reduction, more fluid than seen in asymptomatic volunteers, abnormal condyle marrow, and osteoarthritis; evident cortical abnormalities in particular bone destruction, must all be considered TMJ pathologic condition.

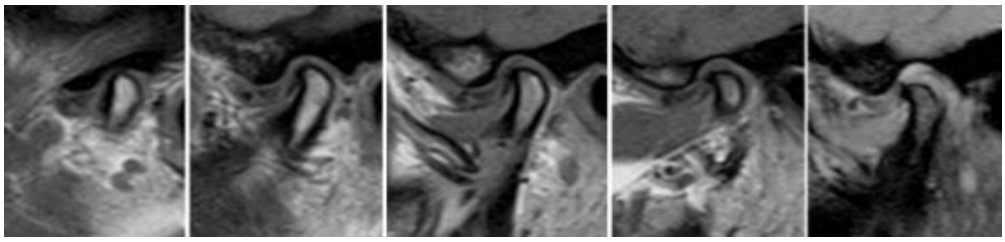

Figure 1: MRI at closed mouth and opened mouth (only image no 5) shows anteriorly displaced disk in all sections; complete disk displacement, without reduction

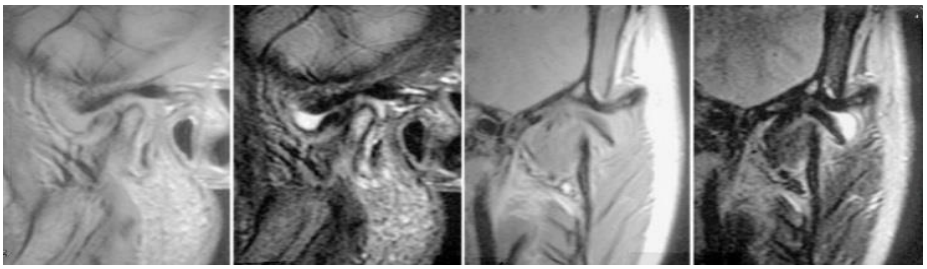

Figure 2: MRI shows joint effusion (high T2 signal) in upper joint compartment of anterolateral recess

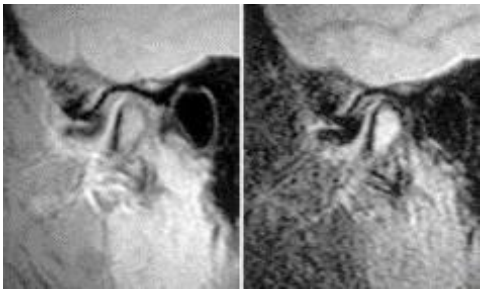

Figure 3: MRI shows edema (high T2 signal) in condyle marrow

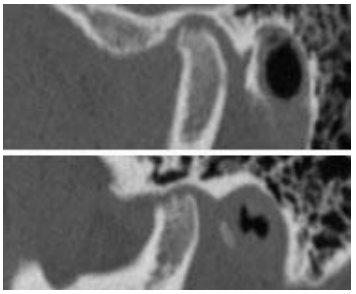

Figure 4: CT shows erosive osteoarthritis in two patients

Awareness and attitudes of dentists regarding radiation safety and protection in Gwangju city

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Introduction: Although the risk of primary cancers from radiation exposure during dental radiography is considered negligible, the risks related to cumulative doses should be assessed. Therefore, special attention should be paid to justification and optimization to minimize any unnecessary radiation exposure in dental practices. We aimed to investigate the radiation safety procedures in the Republic of Korea.

Materials and methods: The study was performed at 54 dental practices including 57 dentists in 2016. We examined the characteristics of the radiography equipment and conducted an anonymous questionnaire survey comprising 11 questions in five categories: i) Radiography equipment, ii) years of practice, iii) knowledge of DRLs, iv) prescription of dental radiography for new patients, v) use of radiation protection procedures, and vi) participation in the radiation safety program. Statistical analyses were performed using SPSS for Windows, Version 12.0 (SPSS Inc., Chicago, IL).

Results: Radiography equipment: Fifty-three (98.1%) of the 54 dental practices were equipped with digital panoramic radiography units, and 22 (40.7%) had cone-beam computed tomography (CBCT) machines. These dental practices used 55 intraoral radiography units and 12 (22.2%) hand-held radiography devices. Years of practice: The responders were classified into six groups according to their years of practice and educational background (Table 1). Knowledge of DRLs: Forty-one dentists (71.9%) reported knowing the definition of DRLs. Prescription of dental radiography for new patients: Thirty-nine dentists (68.4%) preferred to perform periapical radiography for evaluating a new child patient, and 26 (45.6%) usually prescribed periapical radiography for evaluating a new adult patient (Fig 1). Use of radiation protection procedures: Twelve dentists (21.0%) used a rectangular collimator in their practices, and 36 (63.2 %) never used them. Six dentists (10.5%) did not know the definition of a collimator, and three (5.2%) did not answer this question. Forty dentists (70.2%) checked their radiation exposure, and 16 (28.1%) never used a personnel monitoring system. All dental clinics were well equipped with lead aprons and thyroid collars. However, lead aprons and thyroid collar shielding for patients were used only by 27 dentists (47.3%). Radiation safety program: Fifty-three of the 57 dentists (92.9%) had participated in the radiation safety program. Thirty-four dentists (59.6%) were satisfied that the radiation safety program helped them manage the radiography equipment and explain the radiation risk to patients.

Conclusions: Privately practicing dentists may not have enough information on radiation safety training, and without conscious efforts, radiation safety management for patients and employees could be neglected. Therefore, continuous and efficient education on radiation safety and protection for dental workers and patients is required to optimize the use of ionizing radiation in dentistry.

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Table 1: The proportion of responders according to the years of practice and educational background

	1–9 years	10–20 years	21–30 years	Total
General dentists	2 (3.5%)	19 (33.3%)	10 (17.5%)	31
Specialist dentists	3 (5.3%)	13 (22.8%)	10 (17.5%)	26

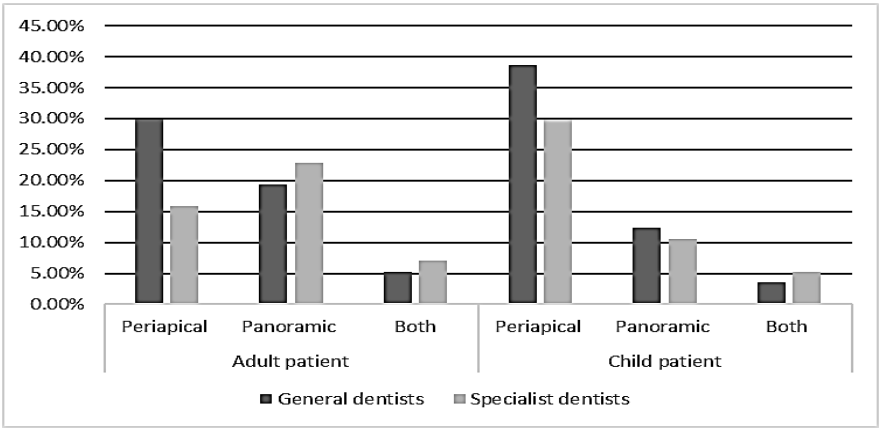

Figure 1: The proportion of dental radiography modalities prescribed for new patients

MRI for dentists: imaging of teeth and nerves, and fMRI visualization of pain response

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Introduction: Use of Magnetic Resonance Imaging (MRI) in dentistry has been generally limited to imaging head and neck pathology or temporomandibular disorder (TMD). 2-D projection radiography, and more recently cone-beam computed tomography, provides most dental imaging needs. However, prevention and evaluation of neurological complications due to third molar extraction, local anesthesia, and implant placement are difficult due to lack of soft tissue information with conventional radiography or CBCT. The capability to directly visualize the lingual and/or inferior alveolar nerves would have significant clinical applications. Another difficult problem in dentistry is the inability to detect cracks in teeth reliably even in 3-D images provided by CBCT due to beam hardening or metal artefacts. MRI does not suffer from the same artefacts, and can provide soft tissue contrast without employing X-ray or other ionizing radiation, but its use has so far been limited by low resolution and the long examination times required. Finally, the use of functional MRI (fMRI) allows visualization of brain activity, which provides new avenues for physiological pain assessment. This talk will begin with a brief introduction to MRI and fMRI physics and applications, discuss challenges and progress in MRI imaging of nerves and teeth, and application of fMRI imaging to pain patients.

Conclusions: New advancements in the field of high resolution MRI make direct visualization of inferior alveolar nerve a possibility and have shown promise in proof of concept research in direct imaging of cracked teeth. fMRI has the potential to assist in diagnosis and treatment of patients with chronic head and neck pain, including neuropathic pain.

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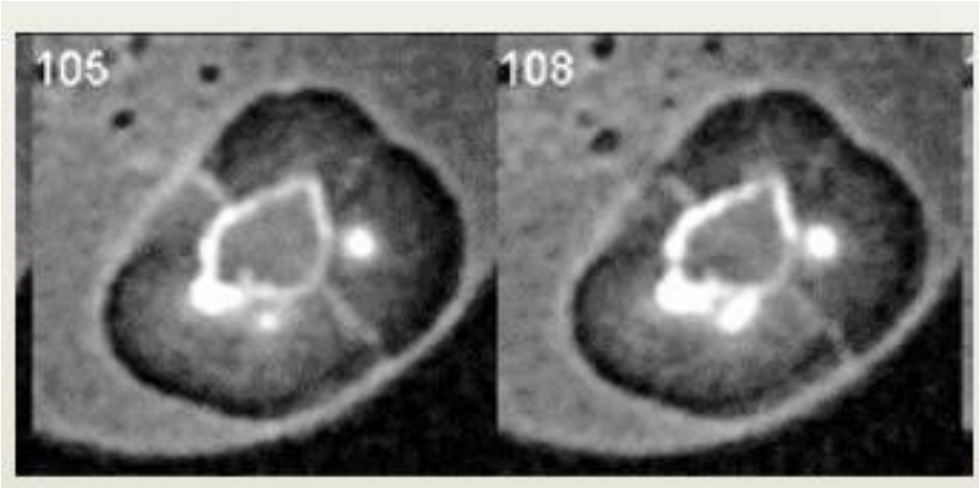

Figure 1: Crack lines visualized using 4T MRI with SWIFT pulse sequence by Idlyatullin D (2016)

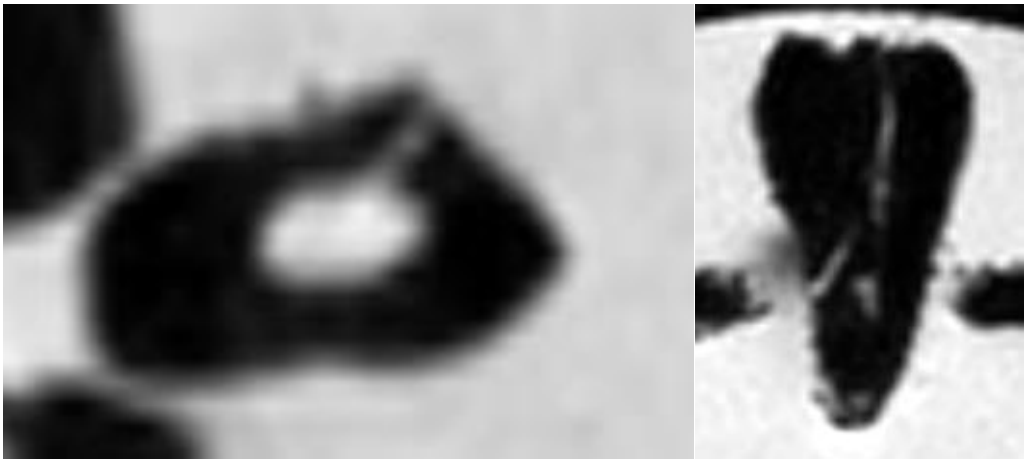

Figure 2: Crack lines visualized using 3T MRI with BFFE pulse sequence by Lee P and Hoff MN

CBCT as a diagnostic aid for difficult edodontic therapy: a case report

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Clinical: A 55-year-old female with toothache after endodontic treatment. An upper left second premolar (#13) with biting pain after endodontic therapy half a year later. The patient's medical history was non-contributory. Intraoral examination showed a buccal pus discharge.

Radiology: The periapical radiographic examination (Fig. 1) revealed the root canal with intact filling but radiolucency was around root apex. CBCT radiography (Fig. 2) shows a missed palatal canal (red arrows) and the fenestration of buccal alveolar bone (black arrows). After proper endodontic therapy, the symptom subsided and buccal pus discharge disappeared.

Final diagnosis: a missed palatal canal of left upper second premolar.

Discussion: A challenge in the endodontic therapy is complex teeth anatomy and architectures. Traditional radiography, such as periapical radiography, is essential in regular diagnosis, treatment planning and post-treatment evaluation. Nevertheless, some factors including superimposition and geographic distortion will affect the interpretation of the image. Cone beam computed tomography (CBCT) aids in exploring the details of endodontic architectures can overcome most problems and results in proper treatment plan, following better prognosis.[1,2] CBCT is a non-invasive, patient-friendly, three dimensional imaging system, with reduced radiation dose, to easily view images in three orthogonal planes namely axial, sagittal and coronal simultaneously allowing selected reconstruction of slices in all three planes, thus, allowing the area of interest to be dynamically traversed in 'real time' rather than being restricted to the limited two dimensional mesio-distal (proximal) plane of conventional radiography.[3] In our cases, periapical radiographs cannot interpret the clinic manifestations, but after the use of CBCT, the final diagnosis was confirmed. In order to avoid overdose of radiation exposure, ALARA (As Low As Reasonably Achievable) is emphasized. Clinicians should use CBCT only when the need for imaging cannot be answered adequately by lower dose conventional dental radiography or alternate imaging modalities. On the other hand, CBCT nowadays are preparing multi-function for reducing the exposure dose compared to traditional CT. In these cases, CBCT helped in showing the aberrant root canal system, which was not visible with traditional radiography, and aided in an appropriate root canal therapy without any endodontic mishaps. CBCT in endodontic treatment of teeth with aberrant and complex architectures is an

excellent diagnostic tool, meanwhile is a valuable task-specific imaging modality establishing a confirmatory diagnosis and providing enough information to the dentist.

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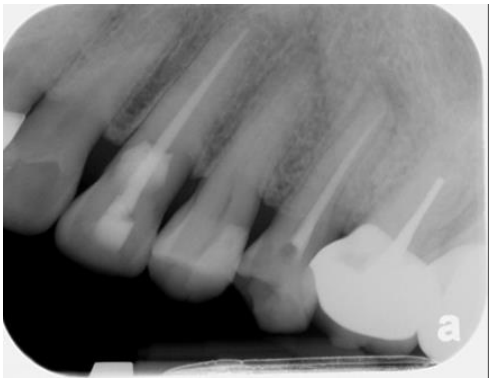

Figure 1: The periapical radiographic examination revealed the root canal with intact filling, but a radiolucency was around root apex

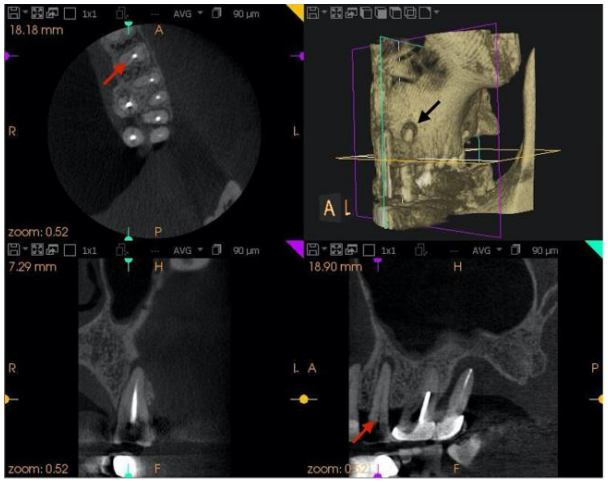

Figure 2: CBCT image shows a missed palatal canal (red arrows) and the fenestration of buccal alveolar bone (the black arrows)

Assessment of an algorithm for noise reduction in MSCT

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Introduction and objectives: Traditional MSCT protocols for dental evaluation employ high mAs, which leads to higher radiation dose. Recently, some authors proposed the use of low-dose MSCT in Dentistry, by decreasing the mAs.[1,2] However, decreasing the mAs increases noise in the image. In this study, we assessed an algorithm for noise reduction in MSCT images.

Material and methods: DICOM datasets of 30 patients, acquired in a MSCT unit (Toshiba Aquilion; 120 kV, 5 mAs, pitch 0.6), were randomly selected from a hospital database. Each DICOM was evaluated twice, using OsiriX software, with and without the algorithm for noise reduction. An axial slice situated at the middle of the apical third of superior anterior teeth was selected and a region of interest (ROI) with 10 cm of diameter was delimited in the anterior region, including dentin, bone tissue, soft tissues, and air. The greyscale tool was used for the assessment of maximum, minimum, mean, and standard deviation of grey values inside each ROI.

Results and discussion: DICOM images treated with the algorithm showed a smoothed appearance compared to the raw images (Fig. 1). The range of maximum and minimum grey values was wider for raw images (-1022.10 to 2869.03) compared to those with the algorithm (-998.87 to 2218.84). Moreover, the mean (Me) and standard deviation (SDev) of grey values were higher for raw images (Me: 851.9; SDev: 49.09) compared to those with the algorithm (Me: 587.2; SDev: 15.25). The lowest variation of grey values, represented by the smallest standard deviation found in the images with the algorithm, is consistent with the uniform image appearance, improving image quality. Further studies should evaluate the impact of this algorithm on clinical diagnosis.

Conclusions: The assessed algorithm for noise reduction reduced grey values variation, and seems adequate for MSCT images correction acquired with low mAs protocols.

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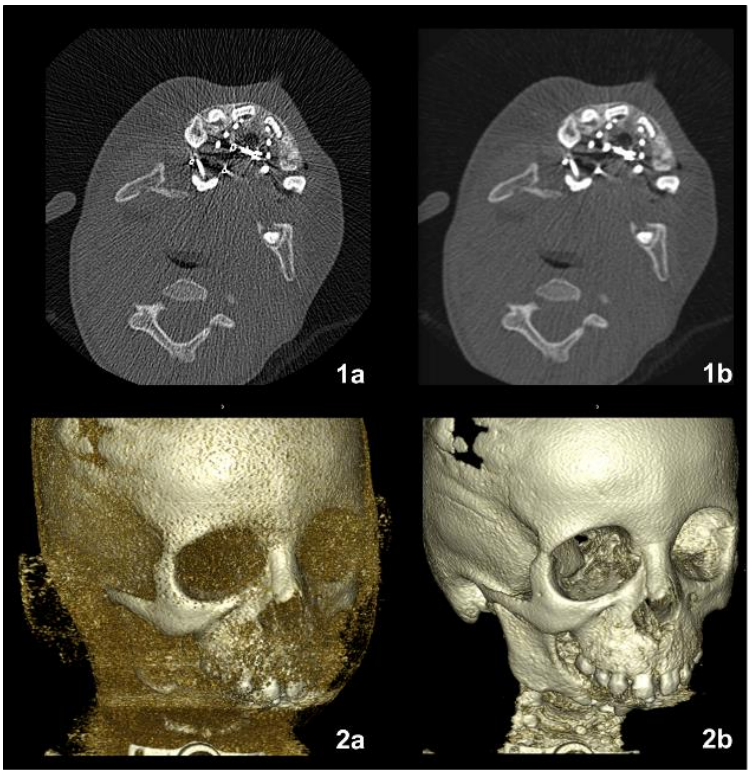

Figure 1: Axial (1a and 1b) and 3D reconstructions (2a and 2b) of a low dose MSCT raw image (1a and 2a), and the same low dose MSCT after the use of the algorithm for noise reduction (1b and 2b)

Factors affecting the buccal bone thickness accuracy measured adjacent to titanium implants in CBCT images

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Introduction and objectives: The accuracy of assessing buccal bone thickness adjacent to implants is questionable.[1] In this study, we assessed the reliability of buccal bone thickness (BBT) measurements adjacent to titanium implants in CBCT sagittal images, and the impact of a number of implants, voxel resolution, and reconstruction thickness on these measurements.

Material and methods: One, two, or three titanium implants, abutments, and metal-ceramic crowns were inserted into 40 bone blocks, with varying distances to the buccal cortical bone. CBCT were performed in two voxel sizes: 0.20 mm, and 0.13 mm. Sagittal images of the middle implant were reconstructed with 2.0 mm and 5.0 mm thickness. Three examiners assessed the images to identify the crestal and/or the buccal bone to measure the BBT. The gold standard was the BBT from digital photographs of the bone blocks. The diagnostic accuracy of BBT measurements was defined by DiAcc-BBT, which describes the gold standard measurement on digital photographs minus the measurement made in the CBCT sagittal images. One-way ANOVA with Tukey post-hoc tests were performed for each of the assessed variable: voxel size, number of implants and reconstruction thickness.

Results and discussion: Overall, most of the measurements had a DiAcc-BBT up to 0.5 mm error, corresponding to the accepted spatial resolution of CBCT images.[2] ANOVA showed significant differences between the true buccal bone thickness and the CBCT measurements in each of the three groups of variables assessed ($P < 0.05$).

Conclusions: Buccal bone adjacent to titanium implants is measured to be thicker than the true bone thickness, normally within 0.5 mm accuracy. Number of implants, voxel resolution, and reconstruction thickness affected the measurements, leading to errors of up to 1.5 mm.

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Table 1: Mode of examiners' detection of buccal bone, and distribution of Di-BBT regarding each variable

Implant number	**1**				**2**				**3**			
Voxel size	**0.13**		**0.20**		**0.13**		**0.20**		**0.13**		**0.20**	
Rec thickness	**2**	**5**	**2**	**5**	**2**	**5**	**2**	**5**	**2**	**5**	**2**	**5**
TP												
Di-BBT ≤ 0.5 mm	29	27	27	26	26	25	24	17	25	22	24	21
Di-BBT > 0.5 mm	1	2	1	3	1	4	1	13	1	7	3	9
TN	7	5	8	4	7	4	6	2	3	3	3	1
FN	2	2	3	2	3	2	4	1	4	2	3	0
FP	1	3	0	4	1	4	2	5	5	4	3	6
Not evaluated	0	1	1	1	2	1	3	2	2	2	4	3

TP = true positives, or true buccal bone; TN = true negatives, or true dehiscence; FP = false positives, or false buccal bone; FN = false negatives, or false dehiscence.

Radiographic assessment of bone quality and quantity prior to dental implant surgery applied with CBCT

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Introduction: Studies have demonstrated that optimization of exposure parameters according to the diagnostic task is of importance.[1] Consequently, CBCT low dose protocols have been developed, to reduce the patient radiation dose and maintain sufficient image quality. In this in-vitro study, the visibility of anatomical landmarks and the assessment of bone quantity and quality using newly developed ultra-low dose protocols for the ProMax3D CBCT (Planmeca Oy, Helsinki, Finland) were evaluated.

Material and methods: Eight human dry skulls with simulated soft tissue, consisting water and acrylic, were exposed using one standard and 3 ultra-low dose protocols: high, mid and low definition. A total number of 32 CBCT scans with an 8×8 cm field of view were obtained. The overall image quality and the precision of anatomical landmarks were assessed on a 4-rank ordinal scale by seven observers. Logistic regression analysis was applied to analyse differences in image quality and recognition of the anatomical structures for the mentioned protocols. Additionally, bone quality assessment and bone quantity measurement were performed at 96 predefined 2D cross sectional images. Intraclass correlation coefficient and paired t-test was applied to analyse the agreement and the differences in linear measurements between the protocols. Pearson Chi-square test between protocols was used to analyse bone quality assessment differences.

Results: The results showed that the ultra-low dose high and mid were diagnostically acceptable regarding overall image quality ($p = 0.068$). No statistically significant differences were found for the visibility of most anatomical structures for ultra-low dose high and mid as compared with standard protocol. However, to recognize the border of the mandibular canal and the border of the maxillary sinus, standard protocol may be indicated for some patients. Good correlation (0.902 or better) and no statistical differences were found in bone height measurements between any of the protocols.

Conclusion: Ultra-low dose high and mid may be recommended for clinical use prior to implant treatment.

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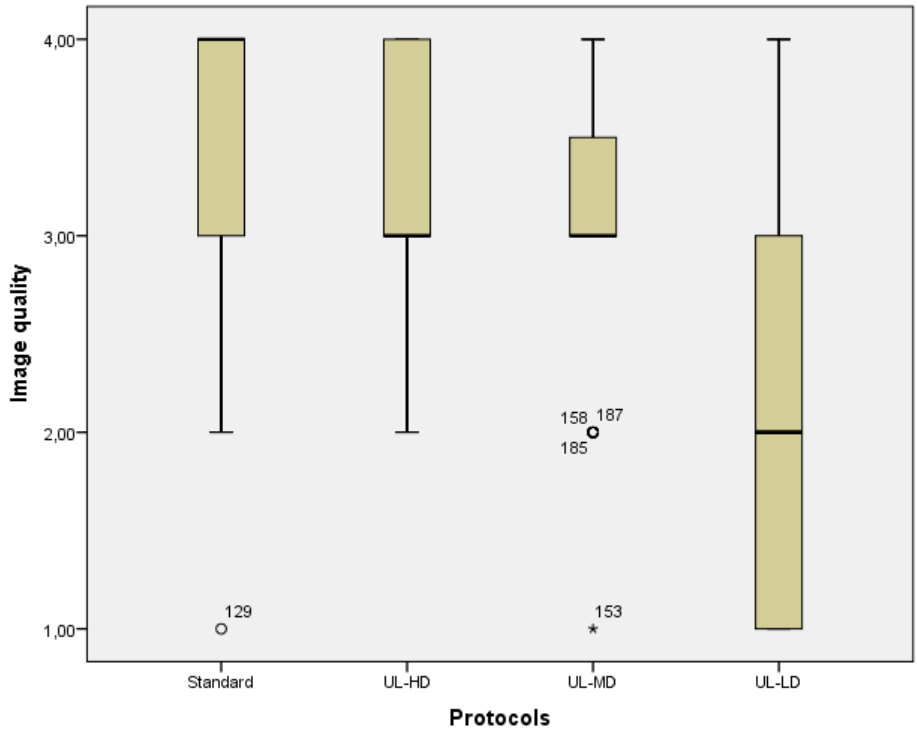

Figure 1: The overall image quality of the standard protocol and the three ultra-low dose protocols based on the observer's assessment indicating that the image quality of ultra-low dose high and mid may be similar to the standard protocol

Validity and reliability of radiographic imaging in interpreting the symptoms and signs of temporomandibular disorders

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Introduction: TMD (temporomandibular disorders) is the 2nd most common disorders in orofacial region.[1] Its aetiology of TMD can be multifactorial; symptoms and signs among individual patients often vary. Clinicians rely on clinical features as well as morphological abnormalities of imaging to set up diagnosis and management of TMD. The accuracy and consistency of imaging to interpret TMJ morphological pathosis have been discussed. Furthermore, relevance of images to the patient's symptomatology is also the clinicians' concern.[2]

A TMD patient without image significance: A female patient (26 years old) presented long-term jaw aching and painful joint noise. Her range of motion (ROM) was 50/52/53 mm with double-deviated opening pathway which was associated with bilateral late clicks (at 40 mm jaw opening). Pain intensity (VAS: Visual Analogue Scale) was 7–8/10. Her TMJ image (transpharyngeal view; Fig. 1) revealed intact TM joints condyles; only not-noticeable eroded-and-repaired cortical outlines over the anterior border and medial poles were found. The clinical assessment did show that the worst pains were found in masseter muscles, temporal tendon (intensity: 2*) and trapezius muscle (intensity: 3*, with trigger point and distant pain referral). However the pain over TM joint only presented "tender" (intensity: 1*).

[*Note: TMD pain severity during clinical assessment is categorized as (1) tender, (2) pain, and (3) pain with withdrawal behavior]]

A TMD patient with image significance: A female patient (55 years old) had suffered from jaw-joint aching (VAS = 4–6/10) and noise since five years ago. Her range of motion was 38/40/42 mm with a straight opening pathway. She had painless soft clicks (crepitus-like noise) over her bilateral TM joints. Clinical assessment revealed the significant pain over her masseter muscle (intensity: 2) and trapezius muscle (intensity: 2 with latent triggers). The pain of her TM joint was only mild (intensity: 1) even though her TM joints images showed osteoarthritic changes (Fig. 2A). Her one-year post-treatment assessment demonstrated great improvement although her TM joints images still presented further arthritic change (Fig. 2B). No pain was either reported or detected. She could open her jaw to 40/41/42 mm without any disturbance or deviation.

Conclusion: Pain is the most common desire for TMD patients to seek treatment. The traditional TM joint X-ray (transpharyngeal, transcranial, antero-posterior projections and panoramic X-ray) utilized for screening TMJ pathosis possesses a limited capacity to identify pain issue in the masticatory system. Patients more often report the worst pain over masticatory muscles. Identification and management of pain should be applied in treating TMD patients.

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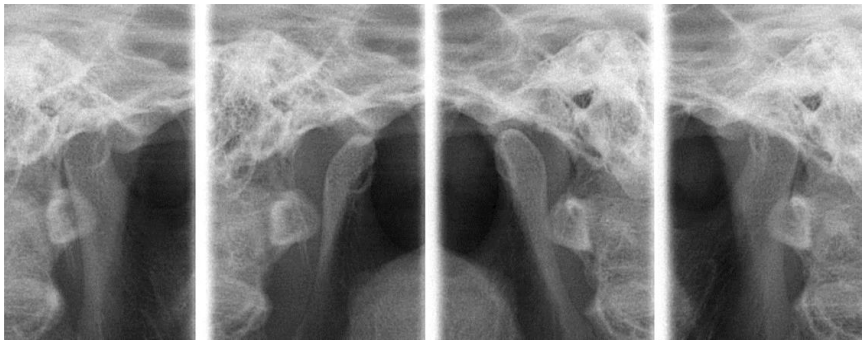
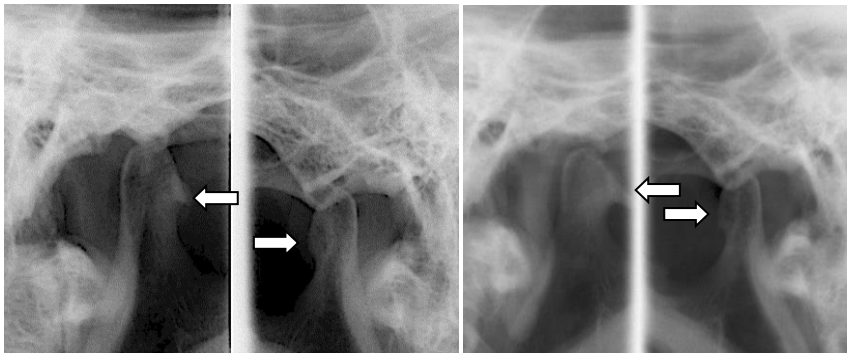


Figure 1: Transpharyngeal projection of TMJ image of a 26-year-old female patient who suffered from long-term jaw aching and painful joint noise. The arrows indicate the adapted cortical outline of the anterior border and medial poles despite its intact condyles



A: pre-treatment **B: post-treatment**

Figure 2: A: pre-treatment; B: post-treatment. Transpharyngeal projection of TMJ image of a 55-year-old female patient suffering from the arthritic TMJs, masticatory myalgia, and cervical myofascial pain. Even her review X-ray indicated the worse change in the TMJ's, little pain was detected

Calcifying odontogenic cysts – a case report

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Clinical: A 15-year-old male patient visited the department of oral and maxillofacial surgery of MacKay Memorial Hospital, Taipei, Taiwan, with the chief complaint of a tumour on the left maxilla that was accidentally noted on the panoramic radiograph. Neither facial asymmetry nor intraoral swelling was discernible during clinical examination.

Radiology: The panoramic radiograph (Fig. 1A) showed a mixed radiolucent/radiopaque lesion with well-circumscribed borders in the right upper anterior region. In addition to the illustration of the impacted left maxillary canine, the images of cone-beam computed tomography (CBCT) revealed a well-circumscribed unilocular radiolucent lesion with thin cortical margins. Multiple irregular or tooth-like structures were is discernible within the lesion (Fig. 1B-C).

Pathology: Microscopically, it showed a cystic lesion lined by odontogenic epithelium (Fig. 2A) with juxtaepithelial dentin substance in focal areas (Fig. 2B). Evidence of ghost cells (Fig. 2C) in the epithelial component with areas of calcification (Fig. 2C) was also noted. The irregular radiopaque structures revealed compound odontomas (Fig. 2D).

Final diagnosis: A diagnosis of a calcyfing odontogenic cyst (COC) with odontoma was made.

Discussion: COCs are characterized by various clinical and histopathological manifestations.[1] Radiographically, COCs usually represents as well-defined radiolucent lesions, in which one third to one half of the cases consist of radiopaque structures.[1,2] About one-third of the cases are associated with an unerupted canine.[1,2] COCs may be associated with odontomas, with a mean patient age of 17 years.[1,2] The above features were demonstrated by our case. CBCT images have the advantages of providing important information via the separation of overlapped images, illustrating the possible nature of the calcified substance, the relationship to the adjacent anatomical structures and the extent of the lesion.[3] Combined with all the clinical information and the result of image study, the accuracy of the tentative diagnosis will be raised, leading to a predictable prognosis for the intervention and treatment.

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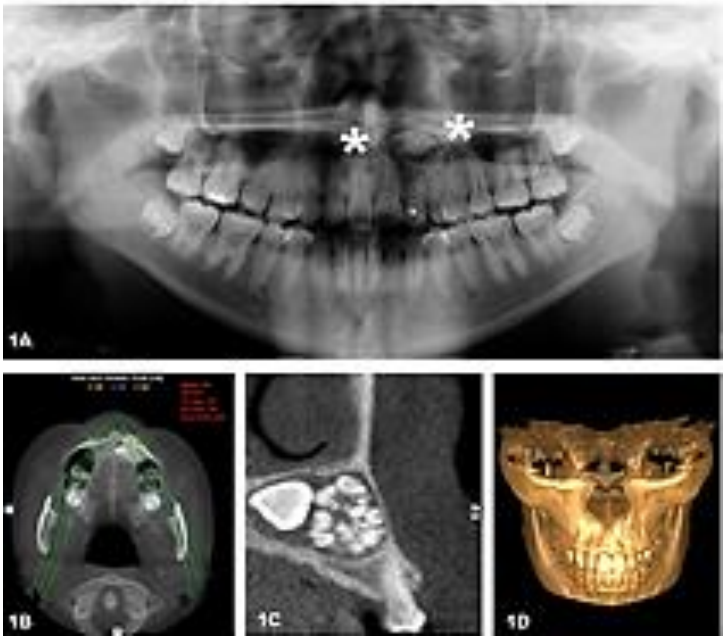

Figure 1: Radiographic appearance

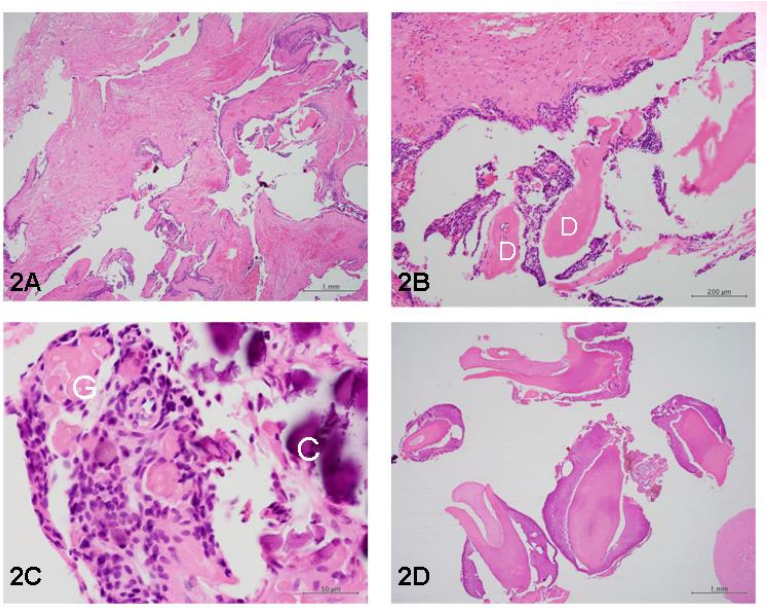

Figure 2: Microscopic appearance

Images and histopathology findings in Vx2 induced rabbit squamous cell carcinoma

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Introduction: The purpose of this study was to use Vx2 induced rabbit hind limb and oral squamous cell carcinoma (SCC) to observe the stages of tumor development with the aid of FDG-PET-CT and ultrasound (US) and 3D-CTA, and to compare and analyze the images and histopathology findings during development of the tumors.

Materials and methods: A total of 35 New Zealand white male rabbits with implanted Vx2 SCC in the hind limb and oral maxillofacial regions were used in the study. The size and shape of the tumor were measured grossly and FDG-PET, US and 3D-CTA imaging were recorded with pathological (including autopsy) findings.

Results and discussion: 1. Compared with FDG-PET imaging (Fig. 1), the US examination was easier to detect tumor size, shape, content, and depth in all tumors. 2. Multiple cervical lymph nodes, tooth and alveolar bone invasion (Figs. 3,4) and pulmonary metastasis (Figs. 2,3) were found in the different tumor implant approaches. The primary SCC's and their metastasis were microscopically moderated to poorly differentiation. 3. Some Vx2 induced rabbit SCC showed spontaneous regression (SR). This was possible due to transiently immunologic stimulus and *en-bloc* tumor necrosis or degradation.

Conclusion: 1. 3D-CTA examination was found to be the most appropriate for the morphologic study tumor angiogenesis including the distributed pattern and diameter of new blood vessels. The PET CT could detect the function of the tumor and US was a non-invasion and inexpensive tool for the detection of tumor deposits. 2. Local invasion and distant metastasis showed different pathways of spread which may be through collateral circulation or Batson plexus.

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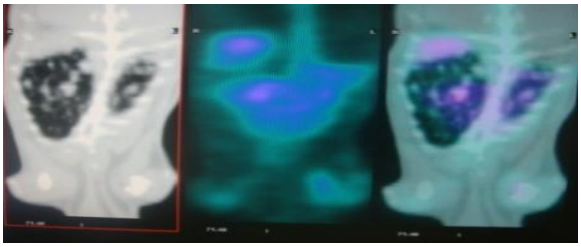

Figure 1: FDG-PET CT showing metastasis in the lungs

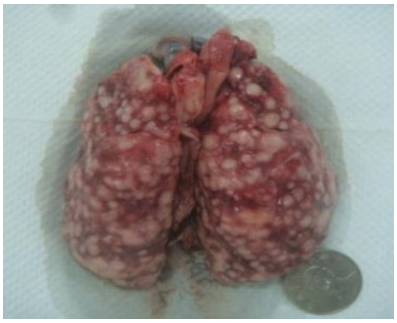

Figure 2: Gross specimen showing metastatic deposits in the lungs

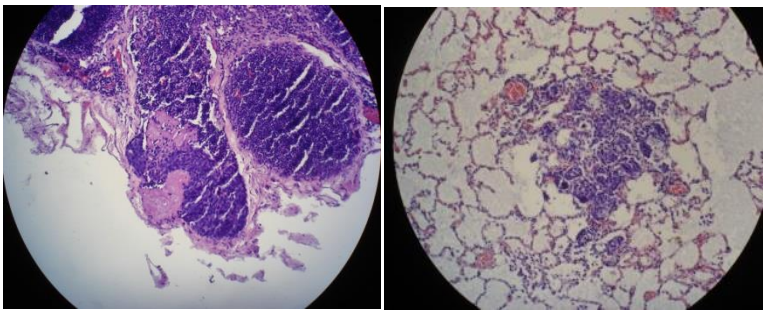

Figure 3: Cervical and lung metastasis (H&E stain)

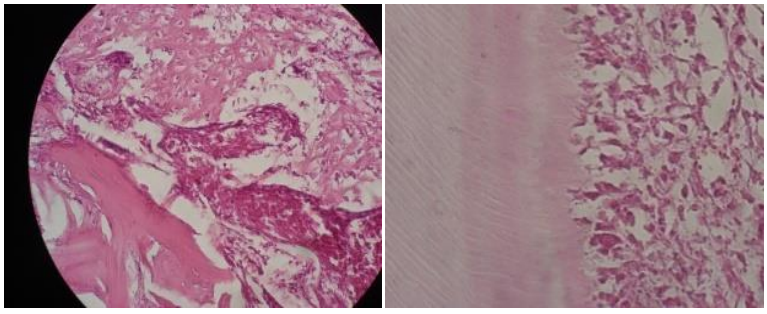

Figure 4: Tumors invading bone and teeth (H&E stain)

Synoptic summary of the radiographic, clinical & laboratory characteristics, with review of the literature, of the recurrent diffusive sclerosing osteomyelitis (DSO)

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Abstract: The diffusive sclerosing osteomyelitis (DSO) represents a clinical dilemma and challenge, where to establishing its diagnosis and effective managements requires extensive collaborative teamwork (i.e. X-rays, CT/CBCT or MRI imaging, blood tests & cultures, bone biopsy or/and ultrasound or Tc99m scans, etc.). DSO is featured by the radiographic changes of extensive sclerosis with periosteal reaction (proliferative periostitis) and variable osteolysis on diagnostic imaging readings. Typically, a mixed varieties of microbes associated with periodontal or/and mucosal infections, i.e., periodontitis, peri-implantitis/mucositis or/and odontogenic etiologies may be identified as potential coupling or complicating factors, which manifest during the progression of disease; yet, remission from such progression is often un-warranted, rendering the clinical management a major threat to both doctors and patients. Herein, we summarized the records of treating a 60-year-old subject, who presented an expansile mass with pain and a mucosal fistula with bony-fragments over left mandible body in a course of 5 years, after being diagnosed recurrent "DSO" through biopsy with histopathology report. Medically, there was no detectable clinical paresthesia, nor contributable local/systemic disorders in the past, except multiple-implants placed for dental reasons. The radiographic features of this relatively homogenous radiopaque lesion spanning over the left edentulous mandibular body to ramus (5 × 3 × 4 cm) were characterized by an expansion of cortex, an expansile distal border with radiolucency, bony sequestra detected above the sockets, a characteristic bone-to-bone radiographic pattern, and increased radioactivity detected in left mandible from bone-scan (Fig. 1: clinical and radiographic images). Clinically, this lesion manifested intermittent remissions with closure of the fistula post-antibiotics prescriptions, based on the microbial culture analyses. By Immunohistochemistry, there were detectable specific vimentin (+) cells in mesenchyme of the lesion (i.e. pre-fibroblastic vs. osteoblastic lineage), accompanied by other bio-markers being totally negative (i.e. granulocyte- monocytes/macrophages & natural killer (NK), p53, E-cadherin; Fig. 1), suggesting the non-neoplastic inflammatory fibrous-and-hyperplastic nature.

Summary: The present analysis has featured the clinical, radiographic, histopathological characteristics, with literature reviews, highlighting the inflammatory fibrous hyperplasia, bone sequestra, bone-to-bone X-ray pattern, IHC-staining on vimentin (+) mesenchyme and its clinically rationales; thereby, supported the DSO diagnosis, including radiographic vs. clinical implications on its differential diagnoses, which may be distinguished from the other types of osteomyelitis, the fibrous-osseous lesions of benign or malignant properties, as briefly summarized in Table 1. Future analyses on the molecular biomarkers and imaging are required to delineate the diagnostic dilemma of DSO and other significant fibro-osseous lesions/dysplasia for the purposes of achieving more efficacious clinical treatments.

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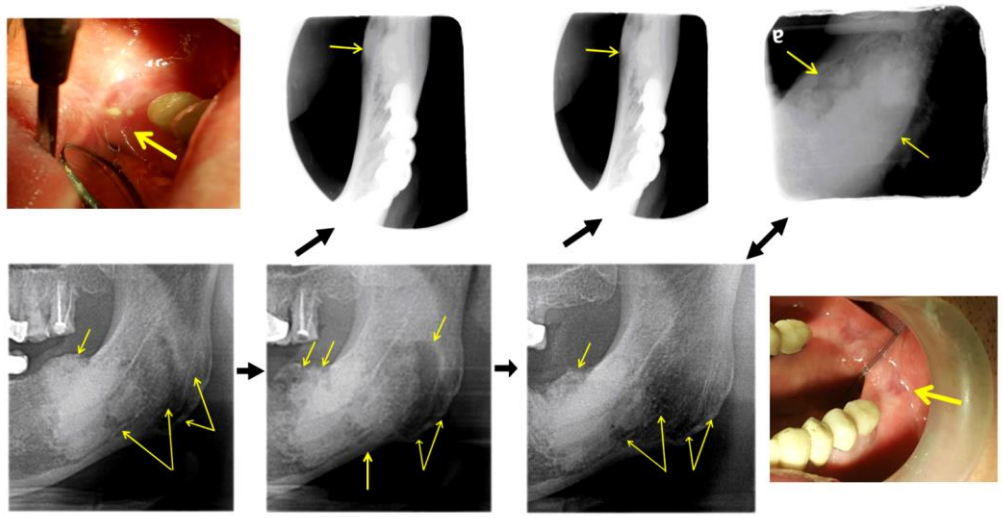

Figure 1 (Clinical and radiographic images): A 60-yrs old subject presented an expansile mass (of mixed radiopacity & radioleucency) in the left mandibular body with pain and a clinically observable mucosal fistula (see the yellow-arrow in upper left picture) was diagnosed DSO, whose manifestations reoccurred along with clinical symptoms in the same area over a course of five years. Please be noted: the immuno-histochemical analyses often yielded strongly Vimentin(+)-stromal cells of the mesenchymal origin (i.e., prefibroblastic/ osteoblastic leneages), with other bio-markers being negative on granulocyte-monocytes/macrophages, myeloid, NK, p53, E-cadherin lineages; yet, alkaline phosphatase activity may be variably expressed, representing reactivity for active bone turnover within or around the osteolytic areas of the lesion.

Items\diseases	**Table-1: Differential diagnosis of diffuse scleorsing osteomyelitis (DSO: chronic or recurrent)**
Benign lesion	- focal condensing osteitis - synovitis, acne, pustulosis, hyperostosis and osteitis (SAPHO) syndrome - proliferative periostitis - Garrè's sclerosing osteomyelitis - primary, secondary or persisting chronic osteomyelitis - florid cemento-osseous dysplasia (FCOD), fibrous dysplasia & cemento-ossifying fibroma - osteochemonecrosis of Jaws (ONJ) or/and MRONJ (medications-related ONJ) [Note: must first be distinguished from radiation & cancer-metastasis associated ONJ]
Malignancy (Exclusion of malignant tumors is essential.)	- osteosarcoma (including: low-grade osteosarcoma associated with the fibro-osseous lesions or dysplasia) - chondrosarcoma - Ewing sarcoma - carcinomatous metastases from other organs - non-Hodgkin-lymphoma

Numb chin with mandibular pain or masticatory weakness as indicator for systemic malignancy – A case series study

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Background and purpose: Numb chin syndrome (NCS) is a critical sign of systemic malignancy; however it remains largely unknown by clinicians and dentists. The aim of this study was to investigate NCS that is more often associated with metastatic cancers than with benign diseases.

Methods: Sixteen patients with NCS were diagnosed and treated. The oral and radiographic manifestations were assessed.

Results: Four (25%) of 16 patients with NCS were affected by nonmalignant diseases (19% by medication-related osteonecrosis of the jaw and 6% by osteopetrosis); yet 12 (75%) patient conditions were caused by malignant metastasis, either in the mandible (62%) or intracranial invasion (13%). NCS was unilateral in 13 cases and bilateral in three cases. Mandibular pain and masticatory weakness often dominate the clinical features in NCS associated with cancer metastasis. In two patients, NCS preceded the discovery of unknown malignancy (breast cancer and leukemia). In nine others, NCS heralded malignancy relapse and progression. Metastatic breast cancer in four (36%) cases accounted for the most common malignancy. Other metastatic diseases included two multiple myelomas, and one each of leukemia, prostate cancer, colon cancer, lung cancer, maxillary sinus adenoid cystic carcinoma and adrenal gland neuroblastoma. Radiographic examinations showed obvious mandibular metastasis with compression of the inferior alveolar nerve or mental nerve in nine patients, and leptomeningeal seeding or intracranial metastasis to the trigeminal nerve root at the skull base in two patients.

Conclusion: NCS without obvious odontogenic causes or trauma often signals systemic malignancy. It may be the first clue of occult malignancy.

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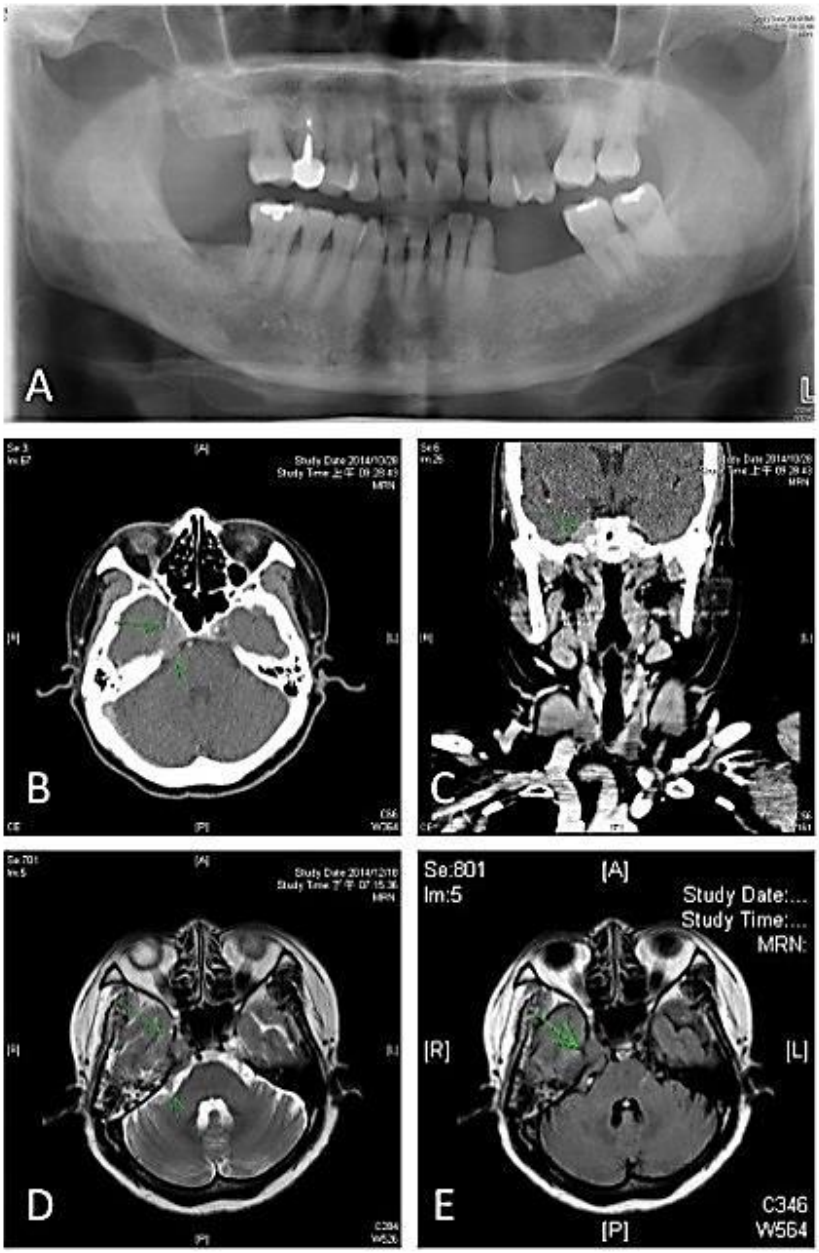

Figure 1: An example (Case 4) demonstrated numb chin with masticatory weakness as the initial manifestation of intracranial metastasis from breast cancer. (A) No gross pathology of the mandible in panoramic radiograph. Brain CT scan (B and C) and MRI (D and E) showed tumor metastasis to the right cerebellopontine angle, meninges and para-cavernous sinus in the area of the root of right trigeminal nerve

Vertical height and horizontal width assessment of mental foramen for sex determination from panoramic radiograph

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Introduction and objectives: In dentistry, a panoramic radiograph is not only used as an additional diagnostic tool, but also for sex determination by using the vertical and horizontal dimension of the mental foramen as an indicator. The purpose of this study was to determine the differences in the vertical height of the mental foramen to the inferior border of the mandible between men and women, and the differences in horizontal width between the mental foramen in both men and women.

Material and methods: The material for this research was 80 panoramic radiographs (40 males and 40 females) from Dento- and Maxillofacial Radiology Installation, Faculty of Dentistry, Trisakti University. The method used in this study was comparative analysis.

Results and discussion: The results showed that the mean of the vertical height of the mental foramen to the inferior border of the mandible in men (14.9333 mm) is significantly greater than in women (13.3185 mm). However, the mean of horizontal width between the mental foramen in men (57.7395 mm) and women (56.7775 mm) are shown to be similar.

Conclusions: As a conclusion, vertical height of the mental foramen to the inferior border of the mandible evaluated from panoramic radiograph is can be used as an indicator for sex determination.

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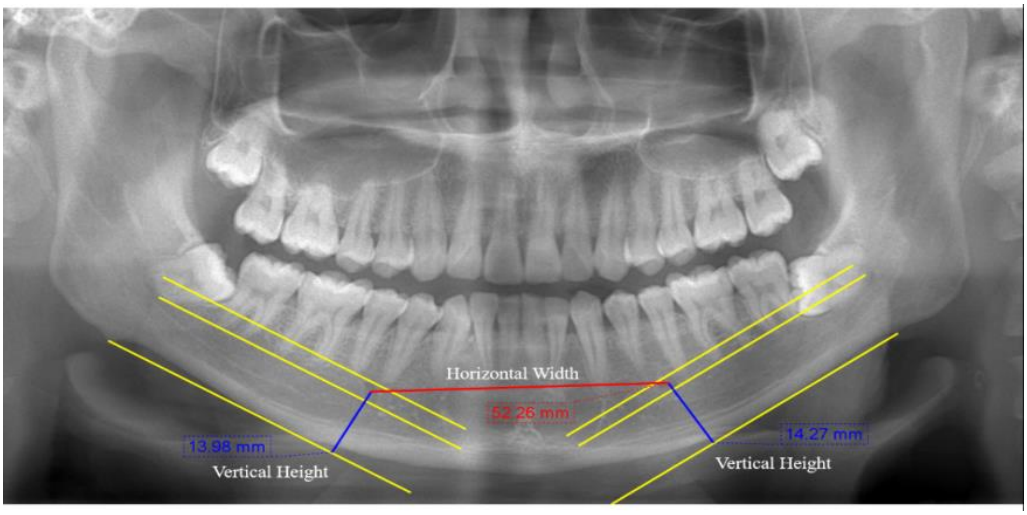

Figure 1: Vertical height and horizontal width measurement of the mental foramen using a panoramic radiograph

Vertical Height

	Males	Females
Number of radiograph	**40**	**40**
Vertical height means	**14,9333**	**13,3185**
Normality test value	**0.084**	**0.723**
Means ± SD	**1.6146 ± 0.3980**	
t-value	**4.056**	
P-value	**0.001**	

Horizontal Width

	Males	Females
Number of radiograph	**40**	**40**
Horizontal width means	**57.739**	**56.777**
Normality test value	**0.624**	**0.473**
Means ± SD	**0.9620 ± 0.9855**	
t-value	**0.976**	
P-value	**0.332**	

Dental radiographs – are they justified?

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Introduction: Clinical audit is a quality improvement process that aims to improve patient care through a systematic review of care against explicit criteria.[1] Use of ionizing radiation requires the adoption of measures that limits the exposure to as less as possible to both the patient and clinician. All exposures done should be clinically justified.[2] It is important that any dose of radiation exposure given to the patients must benefit the patient and aid in diagnosis or treatment.[3] The aims and objectives of the research were to assess if radiographic prescription was required in accordance to patient's chief complaint and to enumerate the commonly diagnosed pathologies in the panoramic radiographs recorded.

Materials and methods: Digital panoramic images and the associated dental records of patients at Ajman University Dental Clinics, UAE between January 2015 and December 2015 were analyzed for information on demographics, chief complaint, provisional diagnosis, radiographic findings and treatment completed.

Results: Radiographic findings showed radiolucency (31.9%), radiopacity (3.4%), bone resorption (17.8%), impaction (4%), retained roots (25.1%) and edentulous ridges (23.4%). Treatments completed based on the findings of the panoramic radiographs were third molar extraction (16%), multiple extractions of teeth (38.4%), partial dentures and bridges (3.6%), and complete denture (0.4%).

C**onclusion:** Panoramic digital radiography is justified in diagnosis and treatment planning of dental treatment. All X-ray examinations must be justified on an individual patient's basis by demonstrating that the benefits of the patient outweigh the potential detriment. The anticipated benefits are that the X-ray examination is likely to add new information to aid the patient's management. Routine radiography is an unacceptable practice, and when referring a patient for a radiographic examination, the dentist should supply a sufficient clinical information (based upon history and clinical examination) to allow the practitioner taking clinical responsibility for the X-ray exposure to perform the justification process.

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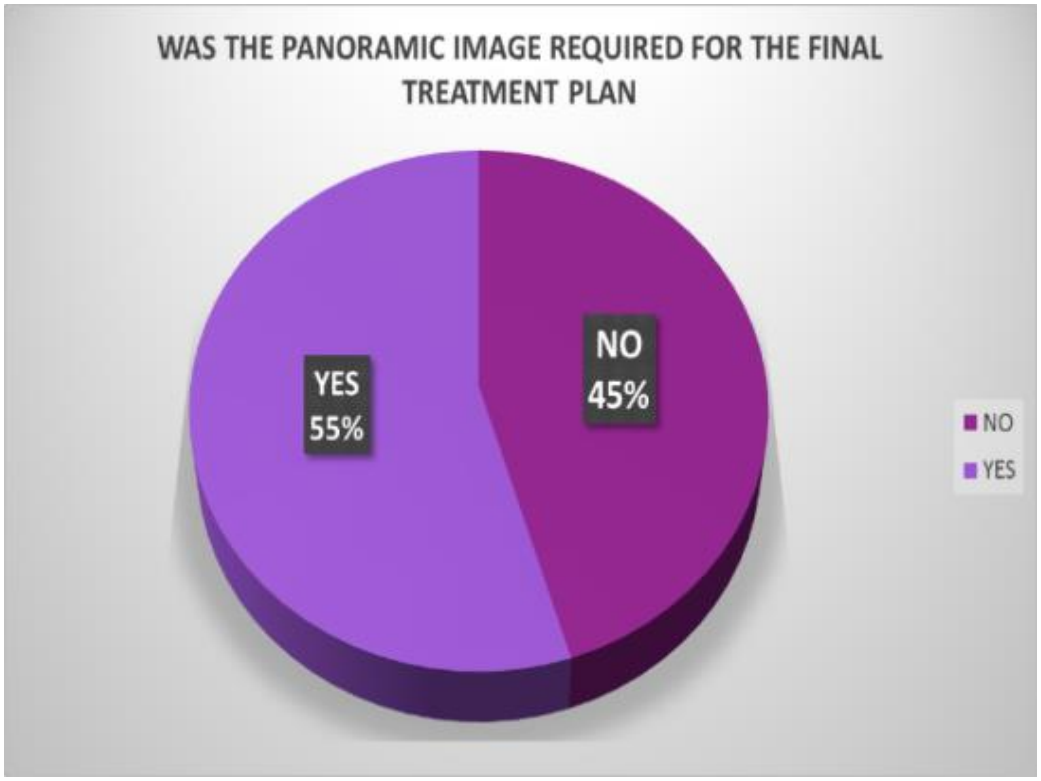
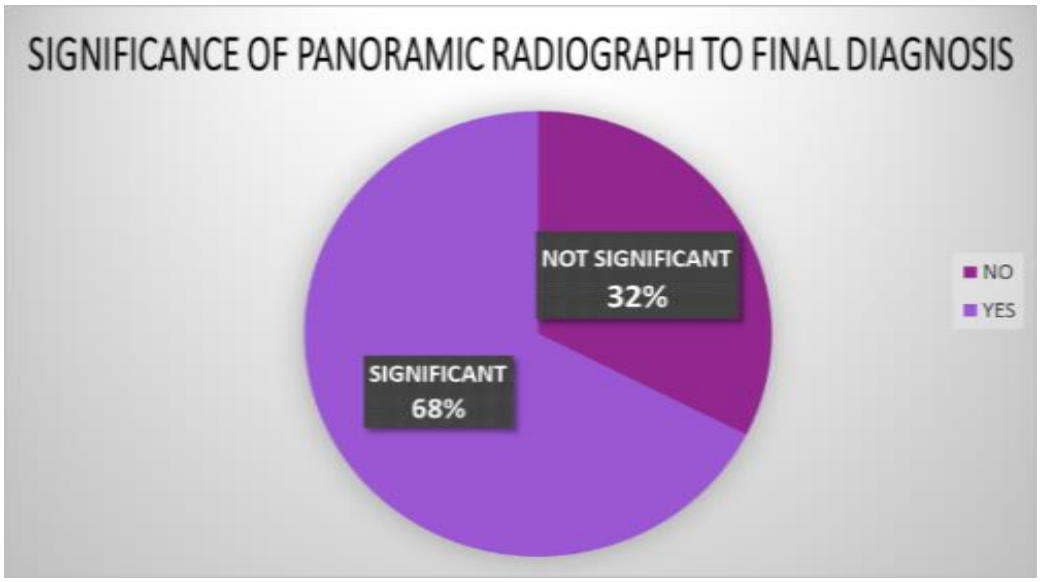

WAS THE PANORAMIC IMAGE REQUIRED FOR THE FINAL TREATMENT PLAN
NO 45%
YES 55%
NO
YES


SIGNIFICANCE OF PANORAMIC RADIOGRAPH TO FINAL DIAGNOSIS
NOT SIGNIFICANT 32%
SIGNIFICANT 68%
NO
YES

Quantitative analysis of trabecular bone density changes in dental digital radiograph: Preliminary study

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Introduction and objectives: The aim of this study was to evaluate the possibility to quantitatively detect the trabecular bone density changes in dental digital radiograph using a computer assisted method utilizing Matlab® software.[1, 2]

Material and methods: A total of 54 dental digital radiographs were obtained as secondary data from four macaca nemestrina, where the periodontal defect was created in the mesial and distal aspect of maxillary and mandibular lateral tooth. Dental digital radiographs of the defect were taken as a baseline. Regenerative material was placed into the defect, subsequently the laboratory experimental study was done and other radiographs were taken as follow-up images. The images were analyzed using Matlab® software. The techniques were image registration, point adjustment and image subtraction.

Results: The increasing of trabecular bone density among treatment groups of regenerative material was detected, as the increasing of grey levels utilizing Matlab® software. The results revealed a concordance as showed that the highest increase of trabecular bone density was found in the treatment group of the regenerative material treatment which has highest potential of healing process and bone regeneration.

Conclusions: This study showed that the software used in this study could be used as a future tool for quantitative analysis of digital radiographic images in the evaluation and detection of hard tissue changes. For the future study, diagnostic test has to be performed to evaluate the diagnostic value of the method, which using histological findings as the gold standard with higher number of subject for bigger sample size to obtain more reliable result.

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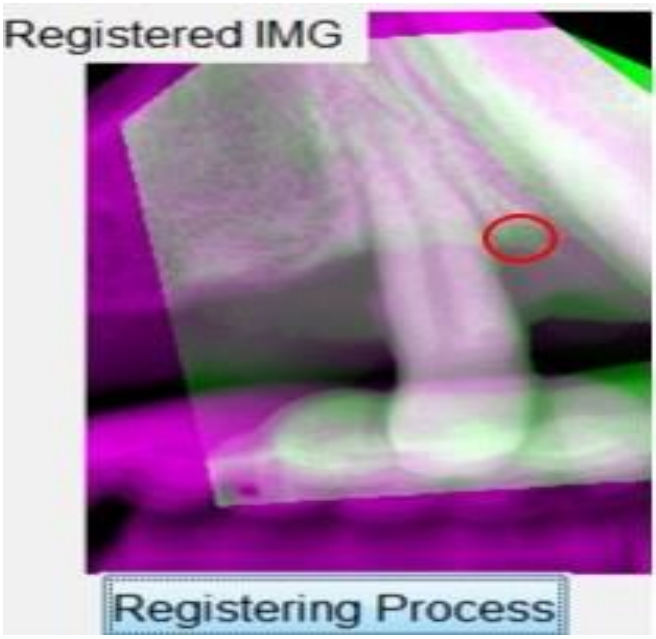

Figure 1: Image registration configuration using multimodal optimizer and metric

Figure 2: The result of subtracted image

CBTC: prevalence of morphological and bone degenerative changes of TMJ

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Introduction and objective: Imaging exam is complementary information provided in the clinical examination, assisting in the diagnosis and treatment of temporomandibular dysfunction, as this is the main orofacial pain from a non dental origin. The objective of this research is to address the incidence of degeneration process and morphological alterations related to the jaw head and the relevance of the cone beam computed tomography (CBCT), over the identification of these alterations and guides the diagnosis of DTMs.

Research method: This study is based on a random sampling of 65 patients from the Clinic of Dental Radiology College São Leopoldo Mandic, Brazil, containing images from temporomandibular joints (TMJs) and clinical diagnosis of TMD. This is an observational, quantitative, and cross-sectional analytical study, using tomographic analysis from patients aged between 20 and 75 years old, comparing both genders, partially or completely toothless. The author of this research assessed the presence of bone changes in jaw head, such as: osteophytes, planing, erosions, subchondral cysts and bony sclerosis, initially at the axial cut and from this in the coronal and sagittal reconstructions. The statistical analysis applied the qui square test, correlating age, gender, and affected side.

Results and discussion: The results obtained showed that 72.3% of the evaluated patients presented radiographic changes. Regarding gender, females presented 48 (73.8%) of cases, demonstrating higher incidence. Regarding the affected side, it is possible to observe that 10 cases (22.2%) presented bilateral changes, in reconstruction sagittal, and 10 cases (20.4%) while coronal reconstruction. The most frequent alterations were bulging with 511% (sagittal cut) and 67.3% (coronal cut), smaller osteophyte (coronal cut 2%) and cyst (sagittal cut 4.4%). In relation to age, it was found that female patients were between 20 and 75 years of age, with a mean of 53.26 years, with a standard deviation of 12.26%, while males between 20 and 68 years, mean of 52.95 years, and standard deviation of 9.61%. The age group most affected was between 50 to 59 years of age. As for the affected side, sagittal reconstruction in 23 cases observed of planing (51.1%), 10 cases (22.2%) were bilaterally; 6 cases (13.3%) on the left side and 7 cases (15,6%) occurred on the right side; while coronal reconstruction, in 33 cases (67,3%) observed of planing, 18 (36.7%); 10 bilaterally (20.4%) occurred on the left side and only 5 (10.2%), on the right side, showing a prevalence of occurrence the bilateral on the left side.

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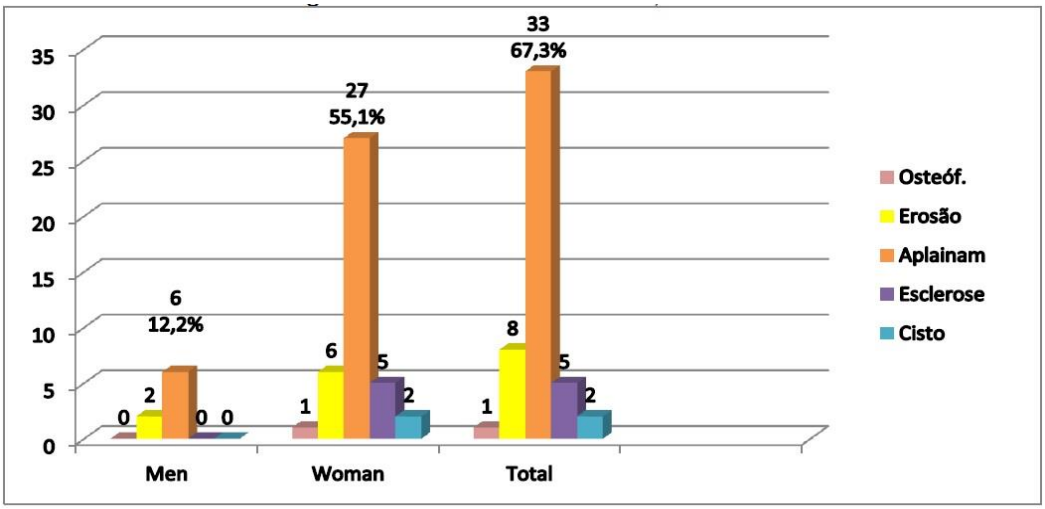
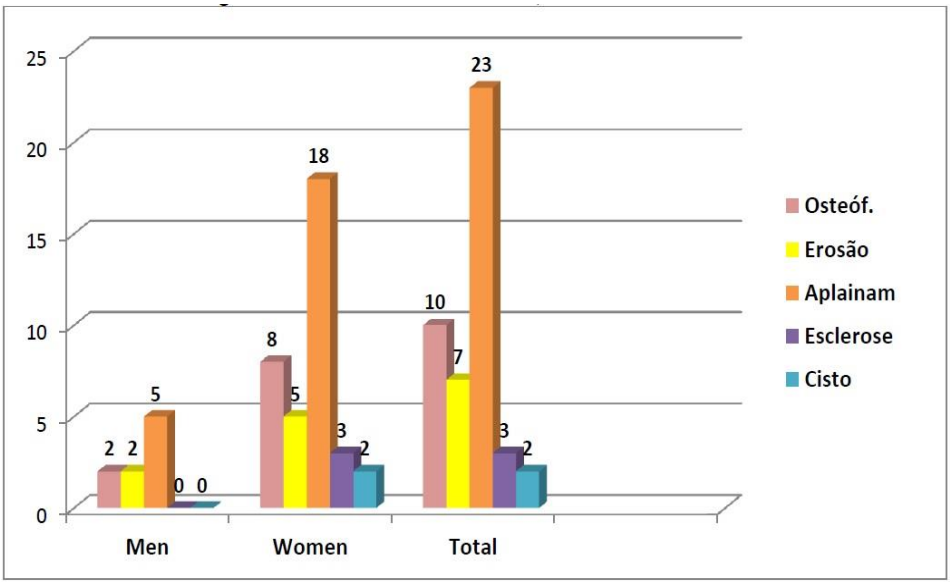


Coronal reconstruction: Absolute distribution (n) and relative (%) of cases found in the various changes observed in ATM in men, women, and the total



Sagittal reconstruction: Absolute distribution (n) of the cases found in the various changes observed in ATM in men, women, and the total

Imaging used before failed dental implant treatment in compensated malpractice claims

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Introduction: Diagnostic imaging is an essential part in patient selection and treatment planning for dental implant treatments. Information is required on bone volume, structure and density, topography, relationship to important anatomical structures: nerves, vessels, roots, nasal floor, sinus cavities, and clinically relevant pathology.

Objectives: The aim of the study was to assess the types of preoperative radiological imaging method used in failed implant treatments.

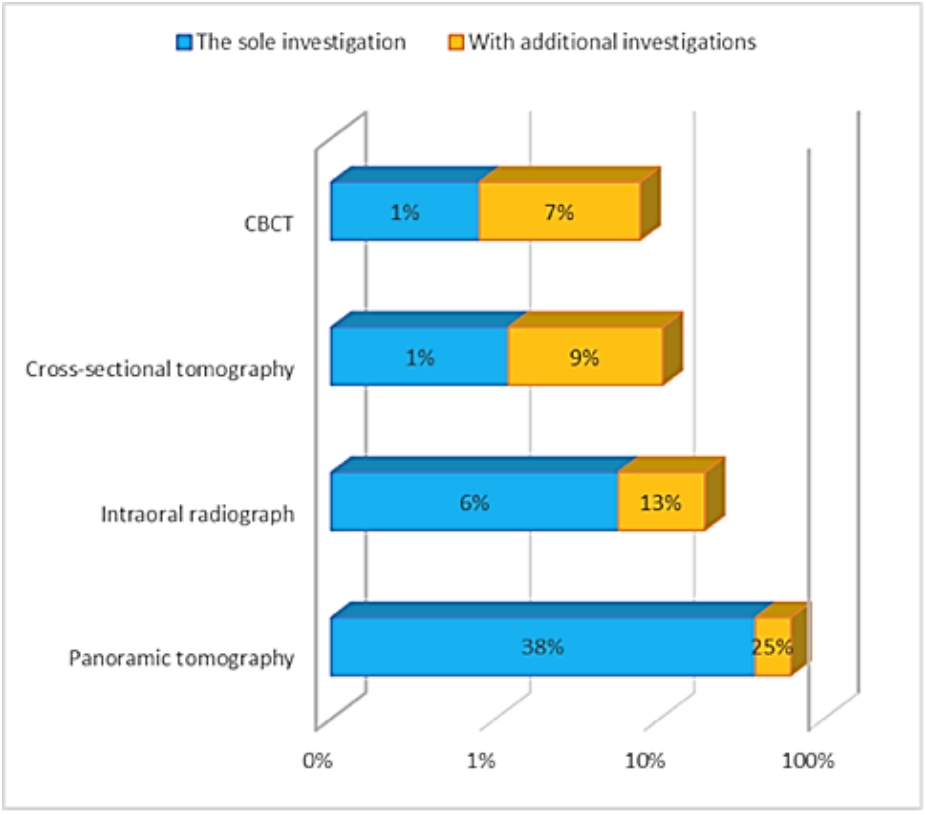
Methods: There were 330 malpractice claims filed for implant treatment to the Finnish Patient Insurance Centre during the years 1997–2011. Financial compensation was granted in 200 cases. We analyzed the types of preoperative radiological examinations as well as the gender and mean age for these 200 subjects.

Results: Most of the subjects (70%) were women; mean age of the subjects was 52 years (SD, ±14; range, 15–85 years). Reasons for filed complaints included permanent IAN injuries, improper implant position, insufficient amount of bone, loss of implant, infection, lack of osteointegration, pain, overloading, and miscellaneous reasons. The patient may have reported more than one complaint. In 21 cases (11%) there was no preoperative radiological investigation performed. A total of 249 radiographic investigations were made. Panoramic tomography (PTG) was the most common method (63%; Fig. 1). PTG was the sole imaging method in 38% of the investigations. Prevalence of intraoral radiographs was 19%, and it was sole method in 6%. Cross-sectional tomography was used in 10% of the investigations, being the sole method in 1%. Prevalence of CBCT examination was 8%. CBCT has been available in Finland since 2002.

Conclusions: Panoramic tomography was the most commonly used imaging method, often combined with other imaging methods. We found a relatively small number of cases where CBCT was taken preoperatively, which may be interpreted that the treatment failed seldom when CBCT was available. The proportion of subjects with no radiological investigations was high. There may be many variables explaining the failure. However, all complications cannot be avoided. More

research is needed to show the possible benefits of using different imaging methods and selection criteria for the use of each method.

Acknowledgement: Supported by the Finnish Dental Society Apollonia (travel grant).



Assessment of magnetic resonance imaging findings and clinical symptoms in patients with temporomandibular joint disorders

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Introduction: This study was performed to investigate the relationship between TMJ disk, mandibular condyle and articular fossa. In addition, we also correlated MR imaging findings with clinical symptoms.

Materials and methods: 431 patients with temporomandibular disorders who underwent MR imaging were selected for this study. Protocol included sagittal oblique proton density and T2-weighted imaging with the jaw in closed and opened position. MR imaging included transformation patterns of TMJ disk, disk displacement, degenerative condylar morphology, classification of condylar bone marrow, and joint effusion. Clinical subjective symptoms included TMJ pain, noise and limitation. For statistical analyses, Spearman's rank correlation coefficient and logistic regression analysis were applied.

Results: The subjects consisted of 98 males and 333 females with a mean age of 47.29 years. Disk displacement without reduction (DDWOR) had significant moderate correlation with folded form of TMJ disk, condylar osteophyte, and the degree of joint effusion. Disk displacement with reduction (DDWR) had significant moderate correlation with flatten form of TMJ disk. Condylar bone marrow edema showed significant weak correlation with DDWOR and degenerative condylar morphology, specifically with osteophyte. Significant increases in risk of TMJ pain occurred with DDWOR, specifically without the posterior disk attachment (PA) between condyle and fossa in the opened position, bone marrow edema and sclerosis, and grade 2 and 3 of joint effusion in logistic regression analysis. TMJ noise showed the same determination. Mouth opening limitation was significantly related to DDWR and DDWOR.

Conclusions: The results suggest the correlation between the transformation

pattern of TMJ disk and the disk displacement, and the correlation between bone marrow edema with osteophyte. The data also confirm that the clinical symptoms are related to MR imaging finds of the high degree of joint effusion, and TMJ disk and condylar abnormality.

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Table 1: Odds ratios for MRI findings with TMJ functional pain (n = 862)

MR findings	OR	95% CI
Bone marrow sclerosis	4.93	1.34-18.16
Bone marrow erosion	3.01	1.65-5.77
DDWOR	2.78	1.76-4.39
Joint effusion, grade 3	2.48	1.34-4.60
Bone marrow edema with sclerosis	2.02	1.01-4.03
Joint effusion, grade 2	1.85	1.16-2.94
Osteophytes	0.54	0.31-0.93

Table 2: Odds ratios for MRI findings with TMJ noise (n = 862)

MR findings	OR	95%CI
Condylar flattening	5.45	1.51-19.63
Joint effusion, grade 3	3.84	2.07-7.15
Joint effusion, grade 2	2.63	1.67-4.15
DDWOR	1.83	1.17-2.86

Standardized method to quantitatively assess image quality in CBCT images of dental materials

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Introduction: Quantitative image quality assessment provides information on CBCT units' operation consistency.[1] This study suggests a standardized method to quantitatively assess image quality parameters (mean density values/MDV, noise/N, signal-to-noise ratio/SNR, and contrast-to-noise ratio/CNR) in CBCT images of a personalized phantom containing commonly used dental materials.

Materials and methods: Phantom images were acquired by two CBCT units (Cranex 3Dx/CRAN; Scanora 3D/SCAN) at high and standard resolution at two sessions, using the smallest available field-of-view. The phantom consisted of four plastic bricks (15 × 15 × 15 mm), each with an empty interior cylinder (5mm diameter). One of the bricks was left empty (control in air) while the other cylinders were filled with one of 11 dental materials (for tooth restoration, impression, core-building, prosthetic-building, molding, and cementing). Each session consisted of four exposures with 30 minutes time-between-exposures followed by three exposures with 15 minutes between exposures. MDV, N, SNR, and CNR for each tested material were assessed using open-source software. Descriptive statistics was used to describe the variation (%) of the assessed parameters within a session, for each tested material.

Results and discussion: Time-between-exposures had no major effect on image quality. Some tested materials (e.g. amalgam) reached the highest possible MDV in all exposures. Both units and sessions differed considerably. CRAN showed smaller variation for all quality parameters when using high resolution. No visible trend was observed for SCAN. Considering control in air, MDV variation ranged between 0.05–32%, N between 12–47%, SNR between 14–153%, and CNR between 10–280%. For the tested materials, ranges were 0.2–787%, 11–73%, 4–695%, and 10–130%, respectively.

Conclusions: Large variation in image quality parameters was seen within an evaluation session for both tested units. Dental materials were associated with larger variation in image quality parameter than was air. This variation goes far beyond the acceptable limits defined by the SEDENTEXCT guidelines.

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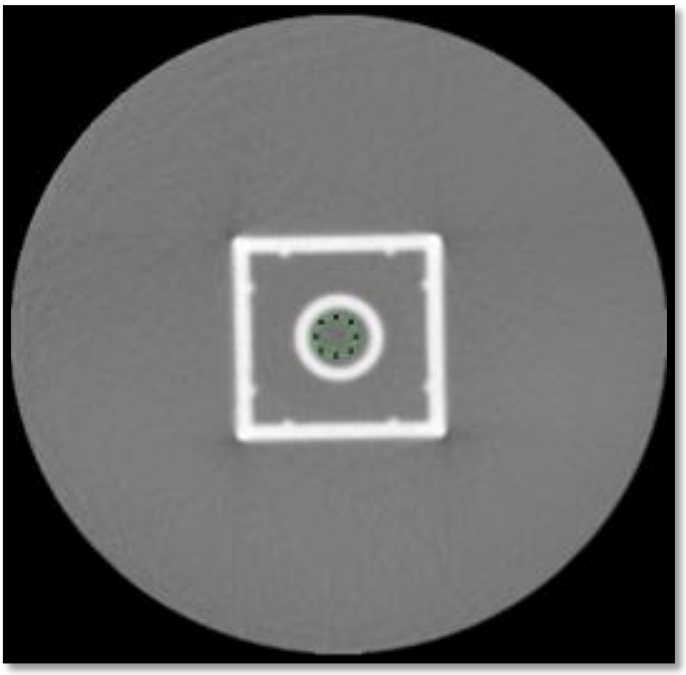

Figure 1: Representative image of the phantom interior, showing an axial section of an empty cylinder, in which the image quality parameters were assessed

An analysis of CDCA radiographic screenings at a US dental school

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Introduction: Dental students in the US challenge licensing board examinations. Students are required to bring their own patients for demonstration of clinical competency. Competencies included diagnosis and management of dental caries, periodontal disease, pulpal disease and partial edentulism. Radiographic and clinical examination is required for proof of existence and extent of carious lesions. Radiographs must be current and diagnostic. Interproximal caries must be demonstrated as penetrating the dentinoenamel junction (DEJ). The Commission on Dental Competency Assessments (CDCA) guidelines stated that radiographs must not be retaken to produce a perfect image. Despite instructions, candidates took excessive radiographs. This study was initiated to evaluate radiographic acquisitions for CDCA examination.

Material and methods: After obtaining IRB approval, records of 100 patients, including their radiographic examinations completed before the 2015 CDCA examination, were selected. Patients who received a Full Mouth Series (FMS) using the school's facilities were included. Calibrated viewers analyzed data by number of images and types of radiographs (bitewings versus periapical radiographs), as well as adherence to the radiographic prescriptions and image acceptability.

Results: Of the 100 patients screened, 72 patients received an FMS (more than 10 radiographs). On average each patient had 17 images taken. Of the 72 series, 62 patients required retakes (86%). Posterior periapicals constituted 38% of retakes. The rest were bitewings (69%) and anterior periapicals (72%). When considering the total number of retakes in comparison to the number of images in the series, on average, patients had 21% more images taken than diagnostically necessary. (Standard Deviation, σ = 14.33) Of the 72 patients who received more than 10 radiographs, the prescriptions were assessed to determine how many additional images were taken in comparison to what the prescription indicated. On average, 31% more images were taken than were prescribed. (Standard deviation, σ = 32.68).

Conclusions: Overall, students did not apply radiographic selection criteria appropriately and used excessive radiation without any patient benefit. Judgment was likely altered by the significance of the examination to their careers. Retakes were probably acquired for perceived improved acceptability. This is ethically and clinically unacceptable. Examining bodies must take measures to safeguard patients

where potentially harmful conflicts exist.

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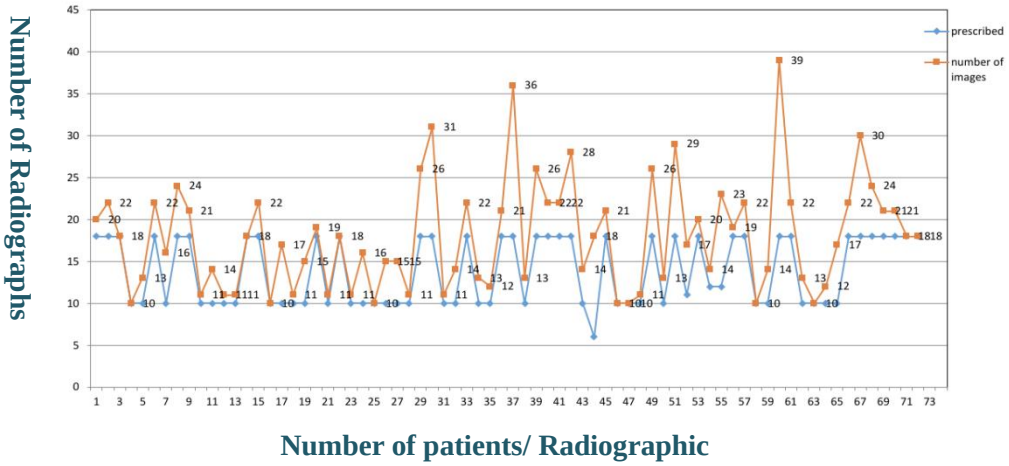

An evaluation of relationship of impacted mandibular third molars and mandibular canal using panoramic radiography and CBCT

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Introduction: Surgical removal of an impacted mandibular third molar is a commonly performed surgical procedure, and may result in injury to the Inferior Alveolar Nerve (IAN), leading to neurologic complications.[1]To optimize surgical planning and avoid complications, such as paresthesia, precise identification of the mandibular canal is important. The aim of this study was to determine the type of relationship between impacted mandibular third molar and mandibular canal using panoramic radiograph; and to determine the true relationship between the two using CBCT and to correlate which radiographic signs on panoramic radiograph indicate true relationship on CBCT.

Materials and methods: A total of 40 samples with signs or symptoms of impacted mandibular third molar and panoramic radiograph showing signs of a close relationship with the mandibular canal as described by Félez-Gutiérrez et al, modified by Gomes et al[2] were included in the study. These cases were then subjected to CBCT, and the images were evaluated by using Planmeca Romexis Software.

Results: Out of 40 samples from 24 patients, darkening of the apex was found to be the most frequent type of radiographic sign of a close relationship on panoramic radiograph (21 samples, 52.5%) (Fig. 1). In 23 samples (57.5%), there was confirmation of a true relationship on CBCT (Fig. 2). Of the 21 cases of the darkening of the apex, 13 samples (56.5%) showed a true relationship on CBCT, followed by narrowing of the canal (4 samples, 17.4%).

Conclusions: This study showed that the presence of a close sign on a panoramic radiograph is associated with a true relationship to the canal. Hence all patients with a close relationship on panoramic radiographs should be referred for CBCT. In CBCT, coronal and axial sections are better predictors of true relationship. Thus 3D imaging is justified to improve risk assessment and surgical decision making.

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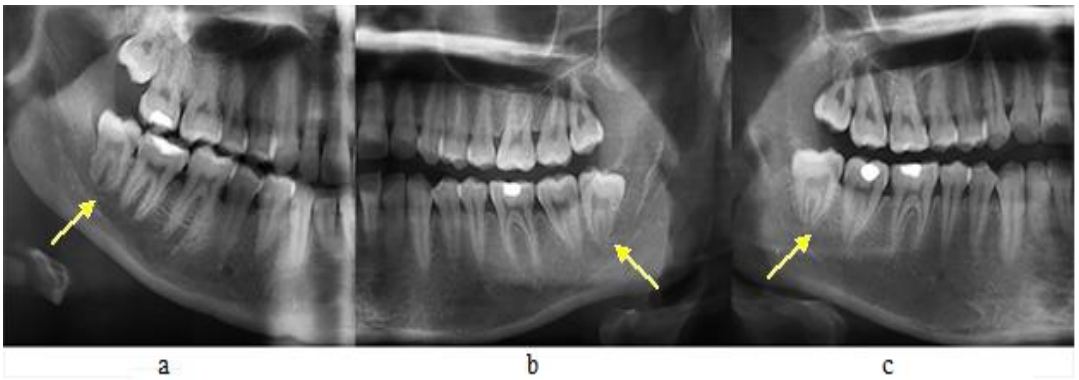

Figure 1: Cropped panoramic image showing a) darkening of the apex, b) deflection of the root apex, c) narrowing of the apex

Figure 2: CBCT cross-sectional images showing (a) coronal section: buccal position, canal cortex intact, (b) coronal section: buccal position, canal cortex not intact, (c) axial section: canal cortex intact, (d) axial section: canal cortex not intact

Diagnostic ultrasound in the management of facial swellings including salivary glands

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Introduction: Diagnostic ultrasound, being non-ionising, is the safest of all the imaging modalities. It is an excellent first line investigation for salivary gland disease and facial swellings. By localising the abnormal structure, it allows the first step in the "surgical sieve" differential diagnosis. The next step is to observe the size, shape, echogenicity, echotexture, outline of the abnormality and then the effect on adjacent structures. These features, together with the clinical history, all contribute to the final imaging diagnosis.

Methods: Swellings of the face have many possible causes, including salivary gland lesions, spreading infection of dental origin, skin lesions, haemangioma and lymphadenopathy. Extraoral and intraoral ultrasound imaging can be performed depending on the site of lesion, size of ultrasound transducer and ease of access. Diagnostic ultrasound uses high frequency (2 to 15 MHz) sound waves. Depth penetration is about 3 cm at 10 MHz. A coupling agent is necessary as ultrasound cannot travel through air; thus gel is used during extraoral scanning, and water for intraoral scanning. Echoes are reflected by interfaces between tissues which have different acoustic impedances and stronger echoes are given by interfaces that are perpendicular to the beam. The time taken for echoes to return to the transducer is calculated as distance below skin. Doppler ultrasound aids detection of blood flow in or around a lesion.

Cysts (Fig. 1) can be differentiated from solid lesions by being more echolucent, having no internal vascularity and often accompanied by posterior acoustic enhancement. Suspicious mass lesions tend to have an unusual vascularity pattern, or irregular infiltrative margins.[1] Metastatic lymph nodes may show loss of hilum, cystic necrosis, extracapsular spread or clustering. Acute infection will cause effacement of fascial planes, tissue "stranding" and, when severe, fluid (pus) collections. Chronic infection may appear as echolucent lines emanating from the source and tracking to skin where clinically it may manifest as a discharging sinus. Sometimes a periosteal reaction can be seen as a hypoechoic dome rising from the bone surface. The first report of sunray appearance, due to osteosarcoma, diagnosed by ultrasound was originally published by this author.[2]

Ultrasound imaging, being dynamic, is invaluable for providing real-time guidance when undertaking procedures such as needle biopsy, retrieval of sialoliths,[3] drainage of cysts, removal of foreign bodies, injection of botox (to treat excess saliva) and during sclerotherapy. Real-time guidance helps to ensure accurately taking biopsy samples from the correct areas; to avoid injury to adjacent

structures (e.g. carotid artery); to ensure a sialolith has been captured inside a retrieval basket; to know when to stop (e.g. if aiming to completely drain a cyst) and to ensure correct location of needle tip prior to injecting medicaments such as botox. Guided fine needle aspiration biopsy is useful for mass lesions in salivary glands, cysts and suspect metastasis to lymph nodes (e.g. from oral squamous cell carcinoma). Guided core biopsy is useful for lymph node disease particularly lymphoma.

Conclusion: Diagnostic ultrasound imaging is safe and effective in the management of facials swellings including diseases of salivary glands.

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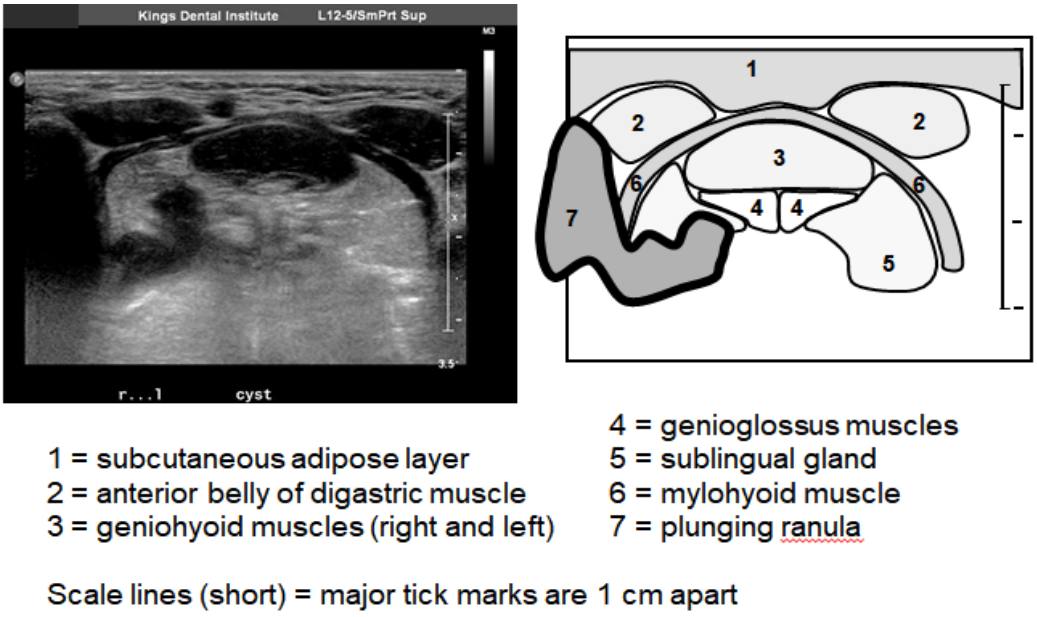

Figure 1: Plunging ranula imaged by ultrasound from under the chin

Osseous dysplasia – a radiological-pathological correlation

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Introduction: The nomenclature applied to the osseous dysplasia group of jaw bone lesions is inconsistent and lacks a biological basis. The prefixes "cementum", "familial" and "gigantiform" are ambiguous remnants of previous classifications[1] and the perplexities were not addressed in the recent WHO manual.[2] The purpose of this presentation is to provide a revised approach to the terminology applied to the osseous dysplasias.

Materials and methods: The radiographs and microscopic slides of cases diagnosed in the group of osseous dysplasias in an African population sample over a 4 years period were reviewed and compared to the data reported in the literature.

Results: Radiographs of 577 cases were included in the study. Twenty seven cases presented with gross expansion, the remainder fulfilled the criteria for florid (n = 401), periapical (n = 99) and focal (n = 0, Fig.1) subtypes. The epicentre of all lesions was periapical, none of the lesions were attached to the roots of teeth and all lesions showed radiological and microscopic evidence of maturation (Fig.1 and 2) of the mineralized component. The expansive lesions affected younger females, most were non-familial and evolved from osseous dysplasias which showed a large radiolucent component compared to those with limited growth potential. Simple bone cysts were common in the expansive- and florid subtypes.

Conclusions: In order to standardize terminology applied to osseous dysplasias this study supports the following: The universal characteristic of the osseous dysplasias is maturation of the mineralized component. Use of the term "cementum" should be discouraged as the lesions are not attached to the root surfaces. Expansive growth can be predicted in young females with a large radiolucent component, most expansive lesions are non-familial in our sample and the term periapical osseous dysplasia should be discouraged as the epicentre of all subtypes was found to be in the periapical region. The following classification of the osseous dysplasias is therefore recommended:

Non-expansive osseous dysplasia: Subtypes- florid, focal and anterior Mandibular.

Expansive osseous dysplasia: Subtypes- familial and non-familial

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Figure 1: Cropped panoramic radiograph of a focal non-expansive type osseous dysplasia in the body of the mandible. Note the bone deposits which enlarge and will ultimately displace the radiolucent component of the lesion

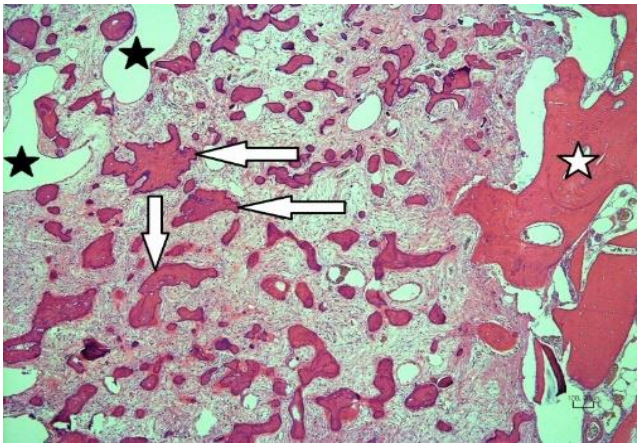

Figure 2: Microscopic appearance of an osseous dysplasia (white stars – foci of early simple bone cyst formation, white arrows – bone deposits in fibrous stroma which enlarge and mature, black stars – premorbid bone of the mandible) (H&E stain, ×100)

Evolution of diagnostic reference levels in Spanish intraoral radiology: 14 years on (2002–2015)

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Introduction: he annual inspection of dental installations, including the use of quality control procedures, is thought to be an effective means of reducing possible overexposures in dental radiology.[1,2] The objectives of this study were to determine the current progress of DRLs and mean doses administered to intraoral radiology patients monitored over a period of fourteen years (2002–2015) in Spain.

Materials and methods: A total of 25,853 official reports from 2002 to 2015 on radiological standards were examined. The variables analyzed are the mean radiation dose according to the imaging system used for a periapical radiograph of the second upper molar, second lower molar, upper incisor and lower incisor in each dental surgery or centre. The actual mean radiation dose (10 exposures, expressed in mGy, in accordance with Spanish legislation) was determined using an UNFORS XI or PMX III detector. The degree of dependence and correlation between variables was assessed via analysis of variance, complemented with a comparison of means using the minimum significant difference method ($p < 0.05$).

Results: A DRL of 2.7mGy was set in 2015, which represents a 43.7% decrease compared with the dose set in 2002 (4.8 mGy). Over this same period, the mean dose fell by 54.5%. The DRL recommended by the European Union in 2004 for intraoral radiology was 4 mGy, and our study shows that 99.3% of installations used a dose below this. Furthermore, a mean dose of 1.3 mGy was set in 2015, which represents a decrease of 55.2% compared with the dose set in 2002 (2.9 mGy), although over the last four years it has remained at 1.3 mGy. Over this four year period, the mean dose has undergone no reduction whatsoever and DRLs have only decreased by 6.3% (Fig. 1).

Conclusions: The progress in DRLs over recent years show a gradual reduction, which may be interpreted as an increase in the optimization of intraoral radiology techniques in Spain, yet fundamentally is due to the substitution of conventional imaging systems for modern digitals ones.

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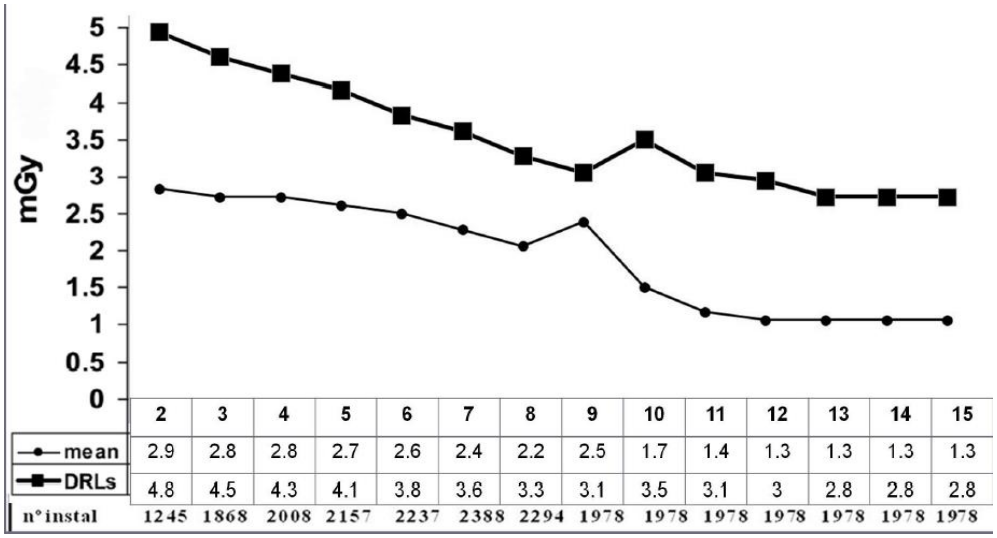

	2	3	4	5	6	7	8	9	10	11	12	13	14	15
mean	2.9	2.8	2.8	2.7	2.6	2.4	2.2	2.5	1.7	1.4	1.3	1.3	1.3	1.3
DRLs	4.8	4.5	4.3	4.1	3.8	3.6	3.3	3.1	3.5	3.1	3	2.8	2.8	2.8
n°instal	1245	1868	2008	2157	2237	2388	2294	1978	1978	1978	1978	1978	1978	1978

Figure 1: Evolution and progression of DRLs and mean doses (2002–2015) (n° of installations, number of dental installations; DRLs, diagnostic reference levels; Dmean, mean dose)

New undergraduate radiological protection course: E-learning for health sciences

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Introduction: The European Higher Education Area (EHEA) requires university teaching models is adapted to suite modern needs.[1] Subsequent to the approval of a project (Spanish Official Bulletin (BOE) dated October 23rd 1997), material was prepared for on-line courses (e-learning) to be offered[2]. The aim was to provide students with up-to-date knowledge on radiological protection via a user-friendly and stimulating platform using interactive didactic methods. The study here presented describes the process of incorporating and developing e-learning courses based on the 12 annual editions held to date.

Materials and methods: A webpage with HTML formatting, developed for use via the internet, hosted by University of Murcia servers. Currently the course and relevant material are available on the University of Murcia website http://webs.um.es/mab/miwiki/doku.php?id=docencia and includes original material (Fig. 1). Access is free of charge and open to all. The course encompasses 115 study hours and provides students with 6 ECTS credits. On finalizing the course, a survey is carried out among students and professors. The first course held was developed thanks to a specific R&D grant (I+D+I 2001) offered by the Spanish Nuclear Safety Commission.

Results: To date, 3,225 students have completed this course, in its various editions. Seven partial assessments and one final exam were undertaken related to the course content based on recommendations stipulated by the European Guidelines on Education and Training in Radiation Protection. The content of the course was considered as good (4/5) or excellent (5/5) by 85% of the student body, on a scale of 1 to 5. Furthermore, 90% of students described the experience as useful, innovative and necessary.

Conclusions: E-learning is a teaching method which allows access to educational opportunities from any location and in an attainable and appropriate manner, including the analysis of diagnostic images, in an affordable format.

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Figure 1: Information of the course. Guideline for the students

Postgraduate course on cbct in odontology – Characteristics, uses & applications (CBCT training)

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Introduction: Over recent years, significant advances have been made in cone beam computerized tomography (CBCT) in the field of Odontology; however in Spain, specialization in the field of maxillofacial radiology does not exist, nor does any regulated training for professionals and operators of such equipment. As such, our proposal is to offer a specific postgraduate course at a university department of Radiology, within the field of Odontology, as a solution to this situation.

Materials and methods: This course encompasses four different stages: 1) the drafting of scientifically up-to-date teaching material on CBCT, adapted to local characteristics according to SEDENTEXCT guidelines;[1] 2) the drafting of a syllabus for students and teachers; 3) the presentation of said material for approval as a recognized university activity by the relevant bodies of the University proper; 4) the implementation and assessment of the course. The course has been organized into two stages, with lectures and training clinics (Fig. 1) providing a total of 5 ECTS credits, with a total duration of 140 hours divided into a compulsory attendance component and another, online or e-learning component involving the Universitys own I.T. network (the ATICA and SUMA programs of the University of Murcia).

Results: Currently, this course has been presented to and approved by the University of Murcia and inscriptions are currently being taken. The first course will take place in June 2017. The plan is to offer 2 courses per year.

Conclusions: Students will be capable of properly operating CBCT equipment, making correct imaging diagnoses and harnessing the full potential of this technique.

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Figure 1: CBCT machine used for the course. ProMax 3D, Planmeca, HELSINKI, FINLAND

Substitution of radiographic films by digital systems in Spanish intraoral radiology

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Introduction: The incorporation of digital systems is gradually replacing manual processing systems in the last years [1]. The aim of this study was to assess the rate of substituting the use of film with digital imaging systems in Spanish dental radiology practice over an 18-year period (1997–2015).

Materials and methods: A total of 34,143 official reports from 1997 to 2015 on radiological standards in private dental surgeries (98%) and university and hospital dentistry units (2%) were examined. The installations covered in the reports encompass 16 Spanish autonomous regions. The degree of dependence and correlation between variables was assessed via Analysis of Variance complemented with a comparison of means using the minimum significant difference method ($p < 0.05$). Quantitative means were compared via regression and linear correlation analysis.

Results: The substitution of radiographic films by digital systems in Spanish intraoral radiology is significant. In the year 1997, virtually all installations (95.6%) utilized conventional film as opposed to a minority (4.4%) which used some form of digital imaging system. However, in the year 2015, 43% of installations continued to make use of conventional film, albeit 57% utilized a digital imaging system. Since 1997, radiographic films have been replaced by digital systems in Spain at an annual rate of 3.1%. In 2007, we determined that 50% of dental services utilized digital imaging systems while the other 50% used radiographic film. However, in recent years (2007–2010) the speed at which digital equipment has been incorporated at dental installations diminished significantly, reaching 52.2% of all installations in the year 2010 and 57% in the year 2015, which implies a growth rate for digital systems of only 1.2% over these years (Fig. 1).

Conclusions: The tendency in intraoral radiology towards substituting radiographic film with digital imaging systems has diminished over the last six years, implying a resistance to renouncing conventional radiographic film by Spanish dental radiology installations.

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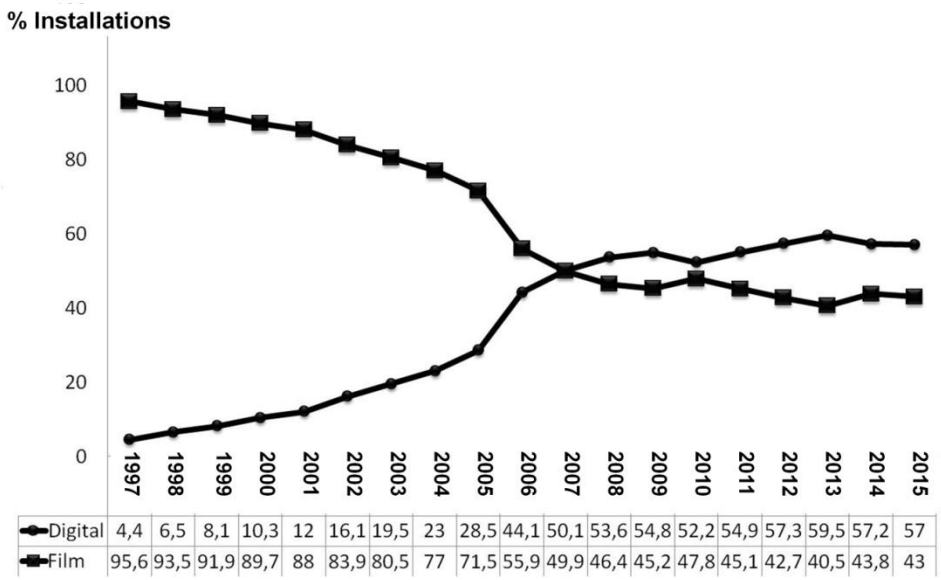

Figure 1: Progress in the use of film and digital imaging systems over an 18 year period (1997–2015) [number (%) of dental installations using digital systems; film, number (%) of dental installations using radiographic films]

Evaluation of pleomorphic adenoma by multislice computed tomography and ultrasonography images: a case report

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Introduction: Pleomorphic adenoma (PA) is the most frequent benign neoplasm of salivary gland origin. It accounts for 60% to 70% of all benign tumours of the parotid gland[1], and it is more frequent from the 4th to the 6th decade[2] of life with a slight predominance in females. The diagnosis of parotid neoplasm begins with clinical history and physical examination. Ultrasonography (USG) and computed tomography (CT) scans contribute to the treatment plan.[3]

Case report: A 58-year-old leukoderma man was reported with a complaint of "a swelling below the ear". Clinical examination revealed an abnormal increased volume near the right parotid gland, painless, with a history of approximately two years. Cervical USG with colour Doppler of the parotid gland and multislice CT scans were performed. This showed a solid nodular image with homogeneous enhancement after the intravenous infusion of the medium iodinated contrast, located in the posterior and superior aspect of the parotid gland, measuring 1.7 × 1.5 cm. Another rounded hypodense image was visualized on the posterior and inferior aspect of gland, with annular enhancement after iodinated contrast, measuring 2.5 × 1.8 cm, with a liquefied center. The two nodular lesions were diagnosed as AP and the diagnosis was confirmed with histopathological examination.

Conclusions: The early diagnosis of AP promotes a more conservative treatment and better prognosis for the patient. The USG and CT contributed to the diagnosis and surgical planning of the case.

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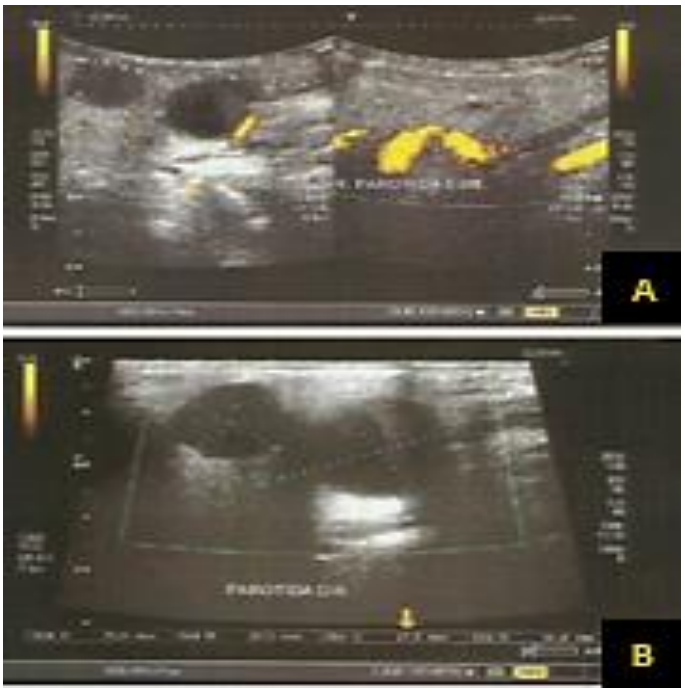

Figure 1: A. Cervical ultrasonography images with color Doppler of both parotid glands; B. Two hypoechogenic images, with regular contours, with homogeneous content, with peripheral circulation

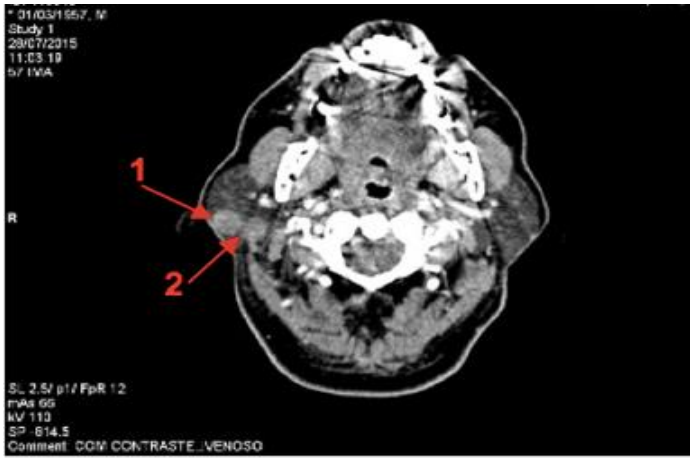

Figure 2: Axial view of the hyperdense nodule with regular contours, in the superficial portion, homogenous post-contrast iodized intravenous enhancement (arrow 1) and nodule with central cystic area, irregular contours, located in its deep portion, peripheral enhancement (arrow 2)

Occurrence and regression of simple bone cyst in a mandibular condyle: A case report

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Introduction: Simple bone cyst is an uncommon non-epithelial lined cavity of the jaws. It occurs on the mandibular symphysis and body rather than on the mandibular condyle. It is asymptomatic and often discovered incidentally on routine radiographic examination. We report a simple bone cyst which occurred in a mandibular condyle during orthodontic treatment and then decreased.

Case report: A 13-year-old female patient, undergoing orthodontic treatment, did not have any unusual findings on her pre-treatment radiography including cone beam CT (CBCT). But 1 year & 2 months later, we accidentally found an osteolytic and asymptomatic lesion in her right mandibular condyle. CBCT revealed a well-defined ovoid radiolucent lesion on the superior portion of the right mandibular condyle. One year and 5 months later after the first visit, the lesion decreased and CBCT showed a clearer cortical outline of the right mandibular condyle. She did not have any clinical symptoms. One year and 8 months later after the first visit, the CBCT finding was relatively normal. We diagnosed a simple bone cyst based on these radiological examinations without any clinical symptoms and decided to follow up.

Discussion: This report represents a rare case of simple bone cyst which occurred in a mandibular condyle during orthodontic treatment and then decreased rapidly. A simple bone cyst is asymptomatic and often discovered incidentally on routine radiographic examination. Radiological evaluation was useful for the diagnosis and follow-up of a simple bone cyst.

References

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Figure 1: First visit: non-specific CBCT finding on right TMJ

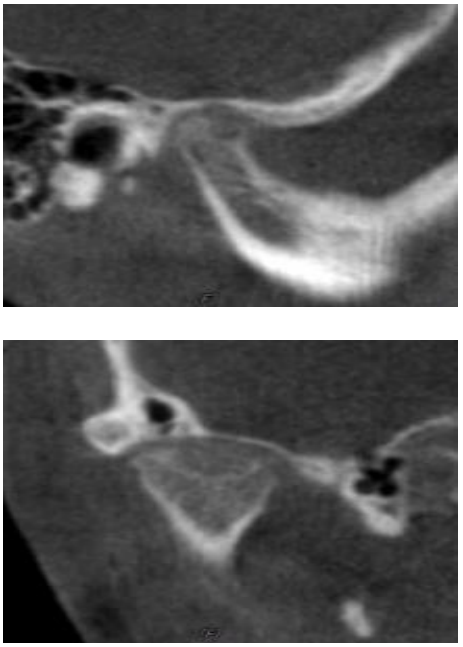

Figure 2: 1 year and 2 months later, an osteolytic and asymptomatic lesion in the right mandibular condyle

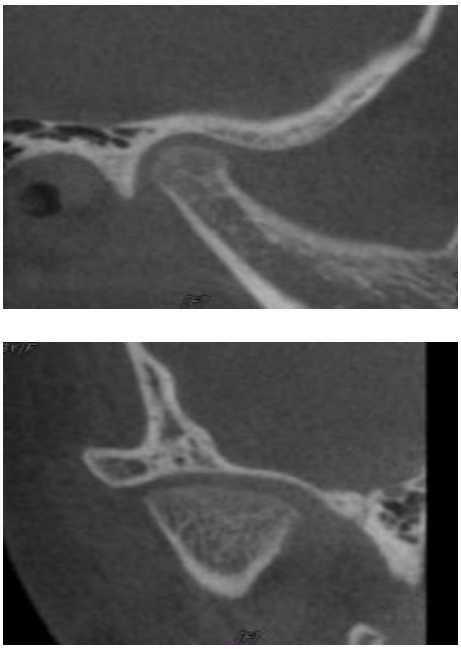

Figure 3: 1 year and 5 months later after first visit, the lesion decreased

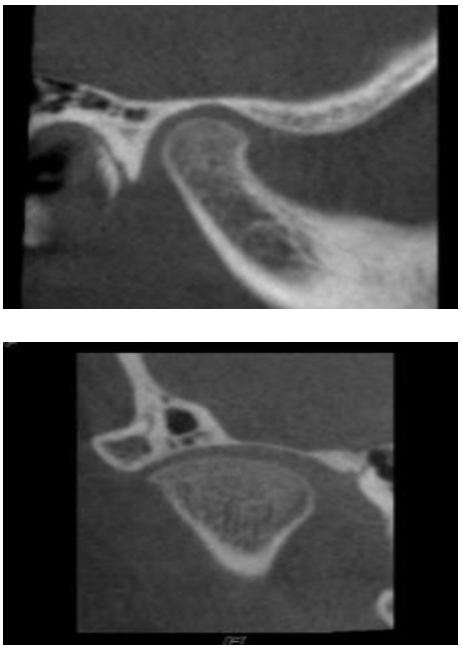

Figure 4: 1 year and 8 months after first visit, relatively normal finding

Radiation measurement on parotid gland in periapical radiographic techniques when using circular and rectangular collimation

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Introduction: The most common periapical technique in Chile is the bisecting angle technique used with circular collimation, while the American Dental Association (ADA),[1] the National Council for Radiation Protection & Measurements (NCRP),[2] the International Commission on Radiological Protection (ICRP)[3] and the European Commission[3] recommend the paralleling technique with rectangular collimation. The purpose of this study is to quantify which combination of rectangular-circular collimation/paralleling-bisecting technique obtains the smaller amount of radiation above the parotid gland, one of the major glands at risk of being damaged by radiation from intraoral radiology, when taking a full-mouth series of periapical radiographies.

Materials and methods: The amount of ionizing radiation above the parotid gland was quantified through collective dose measured in nanocoulomb (nC), using TLD-100 dosimeters during a full-mouth series of paralleling and bisecting angle technique with rectangular and circular collimation (figure 1). Fourty patients with previous indication of a full mouth series of periapical radiographs participated in this study, having previously provided their informed consent at the Department of Maxillofacial Radiology, Universidad Mayor.

Results: The highest amount of radiation is received by the parotid gland when using paralleling technique with circular collimation: PC ($\bar{X}$: 4.02 nC) followed by bisecting angle technique with circular collimation: BC ($\bar{X}$: 2.95 nC), bisecting angle technique with rectangular collimation: BR ($\bar{X}$: 2.45 nC), and the less amount of radiation is received when using paralleling technique with rectangular collimation: PR ($\bar{X}$: 2.06 nC) (graph 1).

Conclusions and discussion: The results demonstrate significant difference ($p < 0.05$) between the different technique combinations, with a 30.16% difference between the radiation obtained above the parotid gland taken with the method recommended in Europe and the U.S.A (paralleling technique using rectangular collimation), and Chile's most used technique (bisecting angle technique using circular collimation), which makes us question the methods used to take intra oral radiographs that are currently being applied in Chile.

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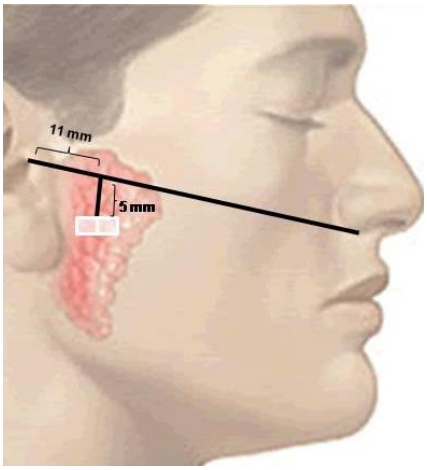
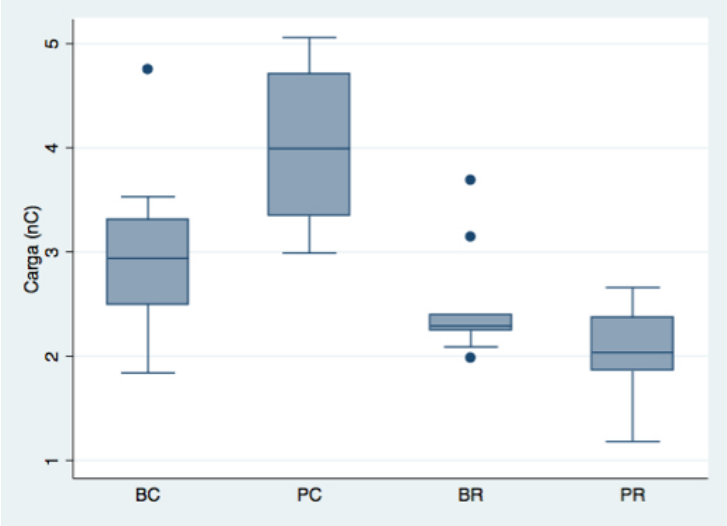


Figure 1: Dosimeter location, 5 mm under point located 11 mm ahead of tragus on a plane established by the superior border of tragus to the inferior border of the ala of the nose (Camper's plane)



Graph 1: Boxplot shows collective dose distribution between the four groups

Utilities of CBCT in dental urgent care

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Introduction: Common dental diseases are often associated with acute pain that bring the patients to a dental clinic for urgent care. Conventional radiographs are routinely taken to assist the diagnosis with important information on dental disease status. Though a combination of history, clinical exam and conventional intra-oral and extra-oral radiographs may be adequate in a majority of dental patients for routine dental care, dentists face challenges daily to determine the sources of dental pain and reach a definitive diagnosis in many patients for urgent dental care. Routine dental radiographs represent 2-D images of 3-D subjects and may have significant image magnification and structural overlaps that hinder correct diagnostic interpretations, especially for patients in an urgent care setting where historical information is not readily available. Cone beam computed tomography (CBCT) allows 3-D visualization of dentoalveolar and orofacial structures and may provide valuable information for differential diagnoses in patients with acute dental and orofacial pain.

Materials and methods: Approximately 8,000 unique patients visited our dental urgent care center in the past year for acute dental and orofacial pain. A limited oral examination focusing on the tooth of chief complaint is routinely performed in conjunction with a 2-D radiograph of choice. Based on patient history, clinical exam and the dental radiograph, a definitive diagnosis could be reached in most patients. We could not arrive at a clear diagnosis for a small fraction of the patients and CBCT was needed to aid in the diagnosis and to facilitate treatments. We analyzed the patients who received CBCT exams and reviewed relevant literature.

Results: About 2% of the patients in the urgent care clinic needed CBCT exams in addition to the routine 2-D radiographs. Conditions examined with CBCT could be largely classified as follows: Dentoalveolar infections of endodontic origin, root fracture, root resorption, third molar surgeries for identification of inferior alveolar nerve, maxillary molar surgeries for identification of dentoantral relationship, differential diagnosis between odontogenic sinusitis and dental pain secondary to sinusitis, acute pain associated with a sialolith, and orofacial pain associated with pathologies such as neoplasms and temporomandibular joint diseases. Our findings support that a routine CBCT is seldom indicated for any condition associated with acute dental and orofacial pain, but is useful when 2-D images could not provide adequate information for definitive diagnosis and safe treatment (Figs. 1,2).

Conclusions: CBCT exams are useful in facilitating diagnosis and treatment in a dental urgent care clinic for a selective group of patients with acute pain.

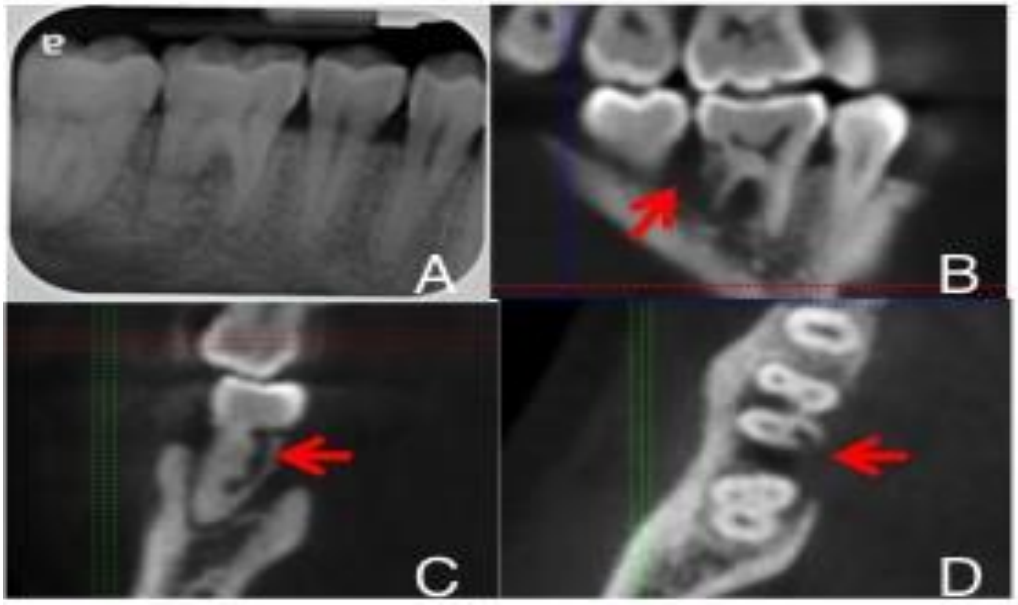

Figure 1: Patient with acute pain from lower left 1st molar. Clinical exam and 2-D image (A) failed to provide a definitive diagnosis. CBCT images support acute infection associated with internal root resorption (B-D)

Figure 2: Patient with swelling, numbness and pain from lower quadrant. Periapical image (A) shows apical abscess at lower left 2nd premolar. CBCT images indicate infection spread through inferior alveolar canal and mental foramen (B-D)

Association between histopathologic and cone beam CT features of oral squamous cell carcinoma (OSCC) involving mandible

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Introduction and objectives: Impact of status of surgical resection margins of OSCC, on recurrence and survival is well proven to be significant.[1–3] One of the most challenging surgical dilemmas is determining the resection margin when tumour invades the mandibular bone. Radiologic extent of tumour involvement may not mimic the actual histopathologic involvement.[1]

Objective: to determine the relationship between depth invaded by OSCC in the mandible measured by CBCT and degree of differentiation, pattern of invasion, host response, nodal metastasis.

Material and methods: Retrospective analysis was carried out in 28 OSCC patients presented to University Dental Hospital Peradeniya. Demographic data and histopathologic features of epithelia-mesenchymal components of OSCC were extracted from records. All CBCT mandibular scans were evaluated for the presence of alveolar bone and mandibular canal involvement and depth of involvement at the deepest point of OSCC involvement.

Relationship between the selected variables was calculated using the non-parametric tests.

Results and discussion: The study sample included 28 (25% females, 75% males) with age range of 38 to 74 years. Among them, 24 cases had radiological evidence of mandibular involvement. The bone invasion measured was ranged between 2.8 mm to 32.1 mm (median: 9.95 mm). The distribution of bone invasion among the categories of degree of differentiation ($P = 0.341$), pattern of invasion ($P = 0.983$), host response ($P = 0.526$) and nodal metastasis ($P = 0.679$) were insignificant ($P = 0.05$).The results could be an actual fact or could have been attributed to inadequate sample size and confounding factors.

Conclusion: There was no relationship between the selected histopathological parameters and the depth of bone invasion in the mandible of OSCC assessed by CBCT.

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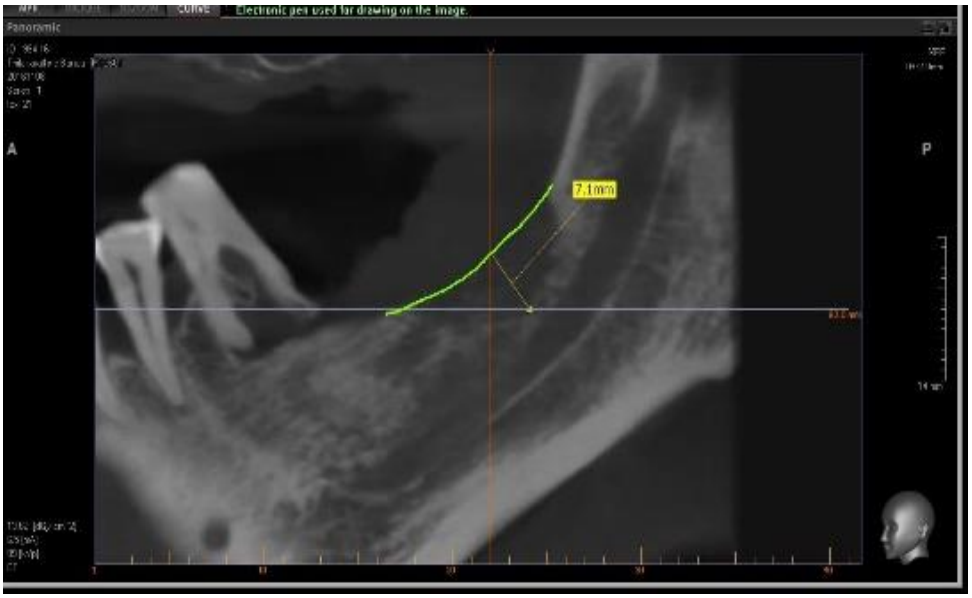

Figure 1: Measurement of depth of invasion when superior mandibular cortical plate was absent

Tonsilloliths prevalence in dental panoramic radiographs in the Polish population

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Introduction: Tonsilloliths are calcified deposits located in the crypts of palatal tonsils. They are incidental findings on dental panoramic radiographs (DPTs), but can be confused with salivary stones which lead to overdiagnosis of sialolithiasis and prescribing unnecessary imaging diagnostic examinations such as ultrasound. The objective of the study was to examine the prevalence of tonsillar calcifications visible in DPTs in a sample of Polish population.

Material and methods: The material consisted of 1000 consecutive digital DPTs taken by means of a Planmeca Prostyle X-ray machine in 577 females and 423 males aged from 5 to 88 years. In the radiographs there was noted presence of tonsilloliths, their characteristics (single or multiple) as well as localization according to 6 regions (1–3 shadows cast on the mandibular ramus above, at and below the level of soft palate, 4 – below mandible, 5 – below and posterior to mandibular angle, 6 – posterior to mandibular ramus).

Results: Tonsillar calcifications were found in over 24% of the examined panoramics with comparable prevalence in females and males. In total the tonsilloliths were detected in 511 regions in 242 patients and in 116 cases they were single. The findings were more frequent in the age groups 30–39 and 50–59 years (37.5%) as well as 40–49 years (35%), and their occurrence was much lower in patients below 30 years of age. Almost two-thirds of the calcifications were found on the region 2 and the next one-fourth in the region 3.

Conclusion: Shadows of tonsilloliths are a frequent incidental finding on dental panoramic tomographs and dentists should be aware of their radiological appearances.

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Table 1: Prevalence of tonsillar calcifications in age groups

age	tonsilloliths found	total numer of patients in age group	%
< 9	2	61	3.27
10-19	20	173	11.56
20-29	49	287	17.07
30-39	49	131	37.04
40-49	42	116	36.2
50-59	39	104	37.5
60-69	26	77	33.77
70-79	8	29	27.59
80-89	7	21	33.33
Total	242	1000	100

Cone-beam computed tomography in orthodontics – not only impacted canines!

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Introduction: Since the advent of cone-beam computed tomography (CBCT) this imaging technique has been widely used in orthodontics. One of the most common applications of CBCT in orthodontics is diagnosis of retained and impacted teeth, mainly canines. The aim of the paper is to present other applications of CBCT than impacted teeth.

Material and methods: The material consisted of literature review and own observations based on CBCT volumes acquired by means of the Galileos (Sirona, Germany), CS 9000 3D (Carestream Health, USA) and CS 9300 (Carestream Health, USA) CBCT machines.

Results: The first applications included diagnostics of impacted and retained teeth including ankylosis and resorption, supernumerary teeth as well as craniofacial anomalies such as cleft palate or cleidocranial dysplasia. Increasing use of CBCT led to elaboration of guidelines based at first on case reports and clinical observations, since evidence-based papers were lacking. Nowadays imaging diagnostics by means of CBCT becomes more sophisticated and covers a variety of new applications including not only simple diagnostics but also treatment planning. Virtual planning in three or even four dimensions is available. Some CBCT machines combine simultaneous acquisition of radiographic volume, laser scanning of facial geometry and digital capture of face texture. Other earlier underestimated applications of CBCT include measurements of thickness of alveolar bone covering anterior teeth before orthodontic teeth movement in order to avoid bone fenestrations and dehiscences leading to gingival recessions as well as TMJ evaluation to avoid pain dysfunction syndrome after poorly planned orthodontic treatment. Follow-up includes e.g. morphology of midpalatal suture after rapid maxillary expansion and pharyngeal airway volume following orthognathic surgeries.

Conclusions: CBCT may soon become a golden standard in dental clinical practice, therefore it is indispensable to commonly apply the rules of justified referral and profound reporting. However in many countries volumes are only viewed by practitioners and not reported, which leads to under-diagnosis of many incidental findings.

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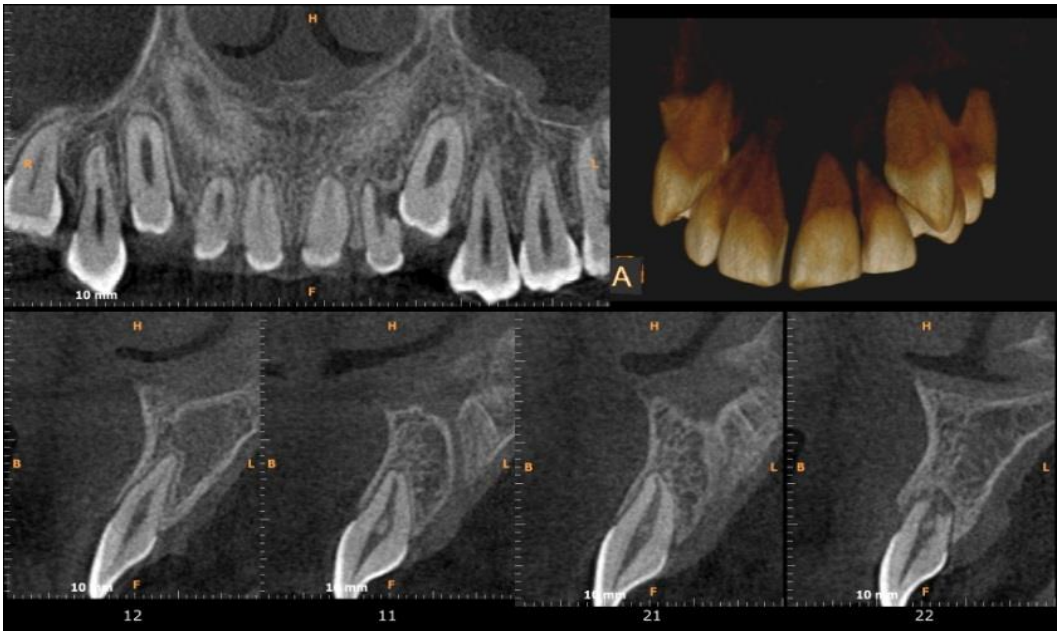

Figure 1: Male patient aged 10 years. CBCT demonstrates root resorption of maxillary incisors, most advanced in the tooth no. 22

Quantitative evaluation of alveolar process of anterior mandible by means of CBCT

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Introduction: Evaluation of morphology of anterior mandible is indispensable before orthodontic treatment as well as implant placement and numerous methods are applied for this purpose. The objective of the research is to study usefulness of Cone-Beam Computed Tomography (CBCT) for evaluation of morphology of anterior mandibular alveolar process.

Material and methods: The material consisted of 100 consecutive CBCT scans taken by means of the Gendex GXCB-500 device in 61 women and 39 men aged from 18 to 71 years. There were performed linear measurements of compact and spongious bone thickness on the labial and lingual sides of the mandible in the area from the right to left lower canine at the level of root apex, 3 and 6 mm above the apex as well as in the middle of the distance between CEJ and root apex. Moreover there were measured the angles of curvature of vestibular side of alveolar process, inclination of a tooth in relation to mandibular body as well as tooth rotation. Statistical comparisons between the linear measurements and angles were performed using Statistica for Windows version 10.

Results: Increase in curvature of labial alveolar process of mandible is correlated with greater thickness of lingual spongious bone and does not influence the thickness of lingual compact bone as well as measurements on the labial side (Fig. 1). Higher inclination of a tooth in relation to mandibular body is related to lower thickness of lingual cortex at central incisors, lingual spongious bone at incisors and canines as well as higher thickness of vestibular spongious bone at lateral incisors and canines. Tooth rotation did not influence the results of measurements.

Conclusions: CBCT was found to be useful in quantitative evaluation of morphology of anterior mandible.

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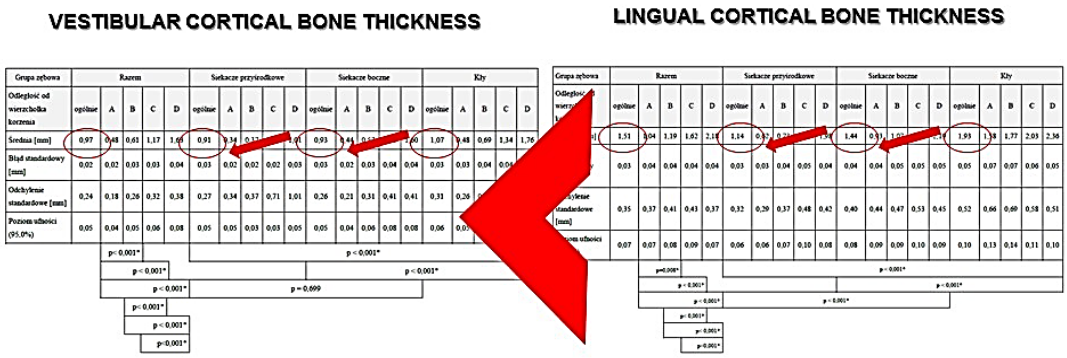

Figure 1: Vestibular and lingual cortical bone thickness

Low-energy fracture of mandibular condyle misdiagnosed as TMJ disorder – a case report

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The objective of the study was to present a case of a female patient with impaired mandibular mobility underlining the possibility of misdiagnosis based only on the clinical examination. The patient underwent left mandibular third molar extraction with subsequent complications: lockjaw, increased body temperature and an abscess in the parotid-masseteric region. Despite abscess drainage and antibiotic therapy the lockjaw persisted during the next 7 months when the patient registered an abnormal acoustic symptom (a click) and felt pain in the left TMJ lasting for several days. Following a temporary improvement, in March 2015 the patient noticed occlusal separation of the right posterior teeth. The patient's medical history and the clinical examination resulted in initial diagnosis of displacement of the left articular disc of the TMJ without reduction.

Radiology: In the retrospective analysis of the panoramic radiograph taken four months earlier fine osteolytic foci in the left mandibular ramus and irregular outline of its posterior edge were found (Fig. 1). Based on the clinical examination including dysfunctional mandibular mobility a preliminary diagnosis was made: displacement of the left articular disc without reduction. In order to evaluate the position of the condylar heads of the TMJ and to control the osteolytic foci in the left mandibular ramus, TMJ X-ray was taken in full mouth opening and closing. The radiograph showed a pathological left condyle fracture (Fig. 2). The patient was further treated surgically: the left condylar and coronoid processes were resected.

Final diagnosis: Histopathology revealed bone sequestra and chronic inflammatory cell infiltration.

Discussion: Impaired mandibular mobility is not always related to functional masticatory system disorders and thorough imaging diagnostics must be performed in order to avoid misdiagnosis of morphological lesions.

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Figure 1: Cropped panoramic radiograph demonstrating osteolytic foci in the left mandibular ramus and irregular outline of its posterior edge

Figure 2: Cropped tomographic radiograph on the left TMJ in closed mouth position demonstrates pathological fracture of the left condylar neck

Third molar maturity index in assessing the age of majority in the Polish population

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Introduction: Third molars are the only teeth under development from late adolescence to early adulthood and can therefore be used in the determination of the age in the majority of cases. One of the methods of its assessment is the modified Cameriere's approach basing on quantitative evaluation of third molar development. The so-called third molar maturity index (I_{3M}) is calculated and a cut-off value is used to discriminate adults (> 18 years) and minors (< 18 years). The aim of the study is to determine whether the third molar maturity index can be applied in the Polish population.

Material and methods: The material consisted of 689 consecutive panoramic radiographs taken in patients aged from 15 to 24, including 435 females and 254 males. All radiographs were obtained by means of the VistaPano (Duerr Dental, Germany) panoramic machine. Selection criteria included: good technical radiograph quality, all teeth in the right lower jaw present, no obvious dental pathology in the lower jaw. For each radiograph there was measured the I_{3M}, which is the ratio of the width of the open root apex in a single-rooted tooth or sum of widths of both open apices in multi-rooted teeth, and length of tooth. If the apex is closed, I_{3M} equals 0. The cut-off value of I_{3M} = 0.08 was used according to literature. Statistical analysis was performed.

Results: Sensitivity of the test was 0.82 (0.79 in females, 0.87 in males). Specificity equalled 0.91 in the whole group and ranged from 0.89 in males to 0.92 in females. Positive predictive value was estimated at 0.97 and negative predictive value at 0.61.

Conclusions: I_{3M} can be used for assessing age of majority in the Polish population.

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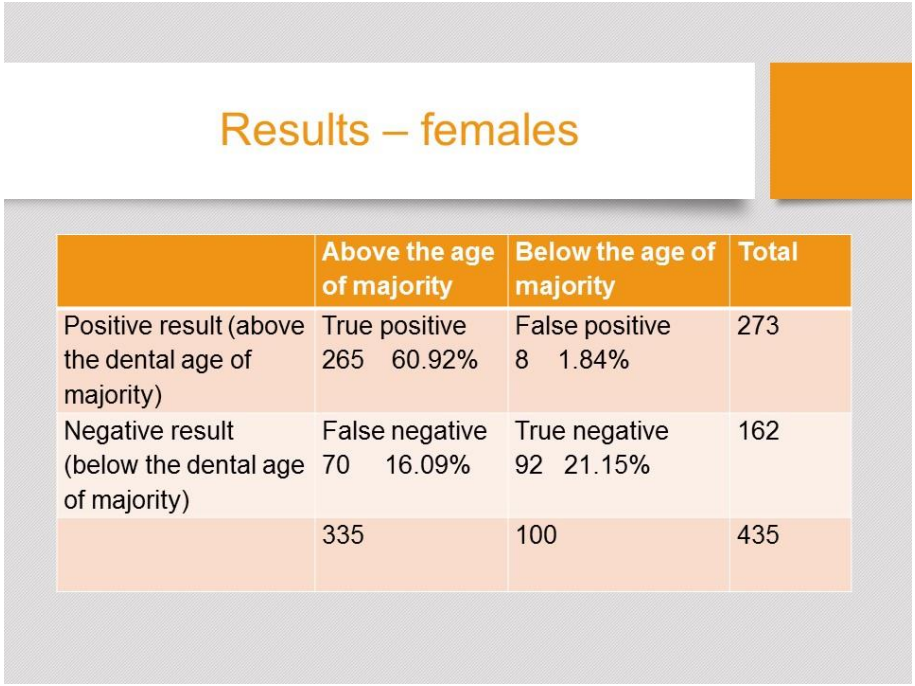
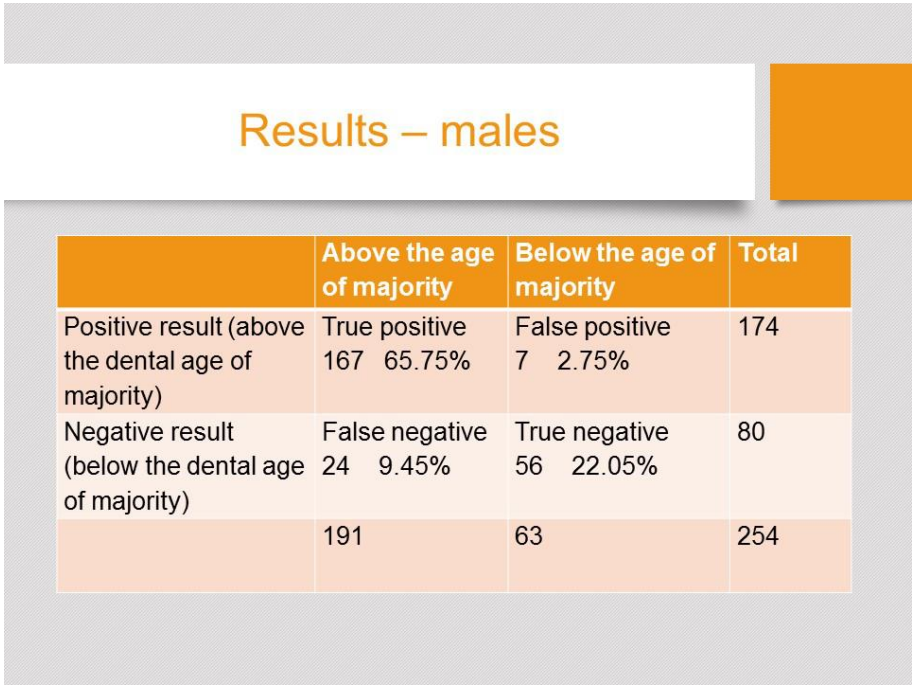


	Above the age of majority	Below the age of majority	Total
Positive result (above the dental age of majority)	True positive 265 60.92%	False positive 8 1.84%	273
Negative result (below the dental age of majority)	False negative 70 16.09%	True negative 92 21.15%	162
	335	100	435

Figure 1: Results in the group of females



	Above the age of majority	Below the age of majority	Total
Positive result (above the dental age of majority)	True positive 167 65.75%	False positive 7 2.75%	174
Negative result (below the dental age of majority)	False negative 24 9.45%	True negative 56 22.05%	80
	191	63	254

Figure 2: Results in the group of males

Imaging characteristics of maxillofacial lesions – a CT and MRI study

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Introduction: Cross-sectional imaging often plays a key role in establishing a diagnosis and guiding tumour management, with CT and MR imaging both providing useful and complementary data by separating benign and malignant tumors.[1] This study was taken up to evaluate the CT and MR imaging characteristics of oral and maxillofacial lesions on detecting bony involvement, delineation of surrounding soft tissue structures like muscle and fat, vessel encasement and involvement of neuro-vascular bundles.

Materials and methods: Over a period of 2 years, 12 histopathologically confirmed cases of the oral and maxillofacial region were evaluated for above mentioned parameters by CT and MRI. Among 12 patients two were ameloblastomas of the mandible, one was a cementifying fibroma of the maxilla, one was an odontogenic myxofibroma of the maxilla, one was squamous cell carcinoma of the mandible, one was an osteosarcoma of mandible, one was myxo-fibrosarcoma of maxilla, one was mucoepidermoid carcinoma of parotid gland, one was maxillary sinus carcinoma, one was nasopharyngeal angiofibroma, one was rhabdomyosarcoma of the mandible and one was arterio-venous malformation of mandible.

Results: Patient's age ranged from 10 to 60 years, seven were male and five were female. In all the cases CT gave valuable information on cortical involvement or bone destruction, tumor calcification and periosteal reaction. MRI, in addition to revealing soft tissue extension and soft tissue calcifications also revealed intramedullary extension. MRI clearly depicted origin, contents, muscle displacement and neurovascular bundle involvement. Although the extent of the lesion was depicted on both CT and MRI, the size of the lesion was more accurate with exceptional resolution in MRI compared to CT, providing better delineation of the borders.

Conclusions: CT provided excellent detection of tumour calcification, cortical involvement, and in most instances, soft-tissue and intramedullary extension. MRI was even more effective in demonstrating the intramedullary and extra osseous tumour components on both T1- and T2-weighted images and thus helped not only in better preoperative assessment but also post-operative follow up.

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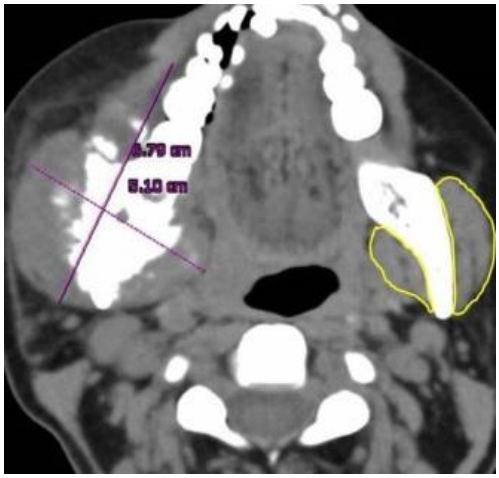

Figure 1: CCT-axial-soft tissue window revealing a massive lesion involving ramus with surrounding soft tissue mass involving the pterygomasseteric sling; multiple hyper dense foci within and around the lesion suggestive of ossification. Note the normal ramus and adjacent masseter and medial pterygoid muscles on left side

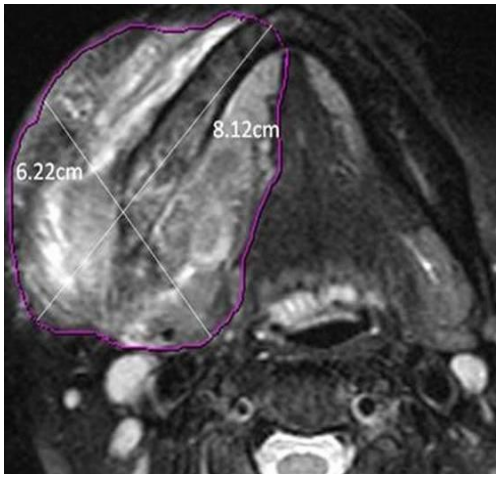

Figure 2: MRI axial T2 (b) weighted image revealing evidence of a heterogeneous mixed intensity destructive mass lesion of right mandible. The surrounding subcutaneous tissue is hyperintense with displacement of muscles of cheek. Marrow infiltration of the alveolus was noted on right side. Multiple enlarged lymph nodes were noted

Determining the cost of incidental findings in small FOV CBCT scans

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Introduction: CBCT is increasingly used during surgical extractions of third molars, implant planning and endodontics. Incidental findings (IF) have been a focus of recent literature in Radiology. Secondary costs of IF have not been previously reported. This study investigated the cost of small field of view CBCT, taking into account the cost of IF found during imaging.

Materials and methods: This retrospective study retrieved scans from June 2016 to October 2016 obtained on Kodak 9000C 3D unit using 5 × 3.7 cm FOV. Patient medical records were reviewed for reason of scan and were revisited for IF, need for follow-up and need of additional imaging or surgical procedures. Costs were determined using the Healthcare Bluebook.

Results: A total of 103 scans were included in this analysis comprised of 57 males and 43 females with ages ranging from 13- to 65 years (mean: 32.8 years). Thirty four scans (33.01%) were noted to have IF. Eleven (10.7%) scans needed monitoring and 12 scans (11.6%) had clinically significant IF recommended for follow-up procedures. The mean cost of CBCT increased from $ 450 to $ 1262.25 per patient (180.5%), when IF was included (Table 1).

Conclusion: The true cost of small volume CBCT is likely 180% greater than baseline cost when subsequent evaluation of IF is included and should be accounted in future cost-analysis studies.

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Table 1: Basic cost of CBCT and cost of IF on CBCT

	No. of pts	Total cost of CBCT alone	Total cost of CBCT per pt	Total cost of IF	Total cost of IF per pt	Total cost (basic cost + additional procedure)	Total cost per pt
Entire cohort	103	$ 20188	$196	$ 15147	$147	$ 35335	$ 343
Patients without IF	69 66.99%	$ 13524	$196	N/A	N/A	$13524	$ 196
Pts with IF requiring additional procedure	12 11.65%	$2352	$196	$15147	$1262	$17499	$1458
Monitoring	11 10.68%	$ 2156	$196	N/A	N/A	$ 2156	$196

The impact of a new method of patient instruction on the frequency of patient position errors in digital panoramic radiographs taken by dental students

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Introduction: Patient position errors reduce the diagnostic potential of panoramic radiographs by either hiding or mimicking pathology. The tongue not against the palate is the most common panoramic image patient position error and the end result is the palato-glossal air space (PGA). The traditional method (TM) of patient instruction "hold the tongue on the roof of the mouth" is often not understood by most patients.[1–3] The simple breathing technique (SBT) was developed, based upon the physiology of respiration and used with all patients including those with disabilities.

Methods: A retrospective, randomly selected, double-blinded study of 200 matched digital panoramic radiographs (DPR) taken by students and staff at Sydney Dental Hospital. Ten common patient position errors including the PGA and overall quality assessment were compared. The PGA was measured by a new criteria based classification assessment of PGA severity the PGAA.

Results: Student use of the new SBT patient instruction method significantly reduced the severity and incidence of the palatoglossal ($p = 0.003$) and the pharyngeal airway spaces ($p = 0.002$). Special care patients also showed significant PGA reduction ($p = 0.001$).

Conclusions: The new simple breathing technique of patient instruction improved the diagnostic potential of digital panoramic radiographs taken by students. The SBT reduced the incidence and severity of the palatoglossal airway space and improved patient outcomes by the reduction of radiation dose. The new PGAA provided another quality assurance measure to encourage the student or clinician to consider the diagnostic affect of the PGA error.

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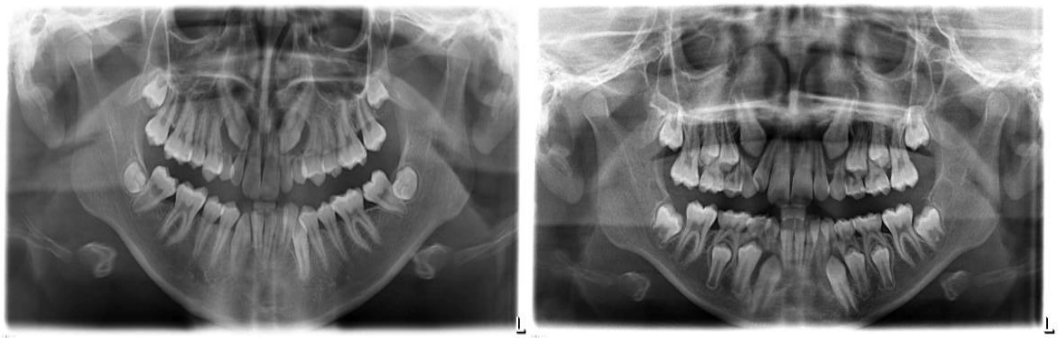

Figure 1: Panoramic radiographs of child using the traditional method & simple breathing technique

PROPELLER technique can reduce motion artifacts on MR images in the oral and maxillofacial regions

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Introduction: The periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) technique enables the motion correction by using data acquired at the k-space center by every blade[1], and it has been widespread in the clinical use for the brain or the abdominal area. Although we sometimes encounter patients who have involuntary movements of jaws, mouth, or tongue such as oral dyskinesia in clinical practice, the movements produce motion-induced ‘‘ghosting’’ artifacts, and they reduce sufficient diagnostic image quality in the oral and maxillofacial regions. The aim of this study was to compare fat-suppressed T2-weighted PROPELLER (T2W-PROPELLER) sequence with fat-suppressed T2-weighted fast spin-echo (T2W-FSE) sequence in the oral and maxillofacial regions, with an evaluation of the presence of motion artifacts caused by mandibular movements.

Materials and methods: Fifty-six healthy adult volunteers (34 males, 22 females; median age, 27 years; age range, 24–50 years) were enrolled in this prospective study. All subjects were examined by using a 1.5 T MR imaging scanner (Signa HDxt 1.5 T; GE Healthcare, Milwaukee, Wisconsin) equipped with an 8-ch neurovascular array coil. The fat-suppressed T2W-PROPELLER sequence was matched to a fat-suppressed T2W-FSE sequence in regard to sequence parameters. The subjects were examined, running repeatedly their mandibular movement such as open-close or lateral movement throughout MR scanning. Motion artifacts including ghosting or pulsation artifacts, and overall image quality were independently evaluated using 5-point scale by two oral and maxillofacial radiologists. The score graded by the two observers were averaged. Inter-observer agreement was evaluated using the quadratic weighted Cohen’s kappa value.

Results: Inter-observer agreement was almost perfect for all evaluated items ($\kappa \geq 0.81$). T2W-PROPELLER images showed significantly less motion artifacts including ghosting or pulsation artifacts and better overall image quality than T2W-FSE images ($P < .01$, Fig. 1).

Conclusion: The PROPELLER technique is effective to reduce the motion artifacts caused by mandibular movements on fat-suppressed T2W MR images in the oral and maxillofacial regions.

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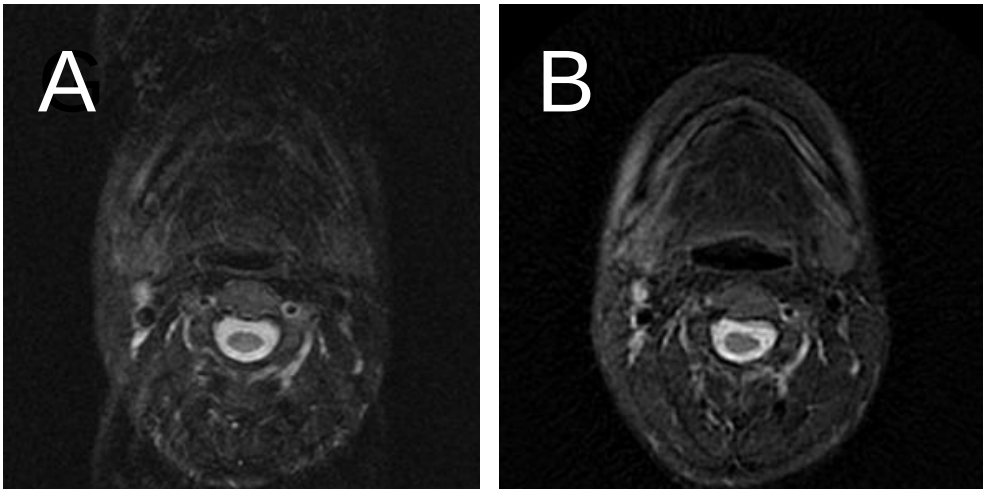

Figure 1: Examples of the acquired MR images: (A) T2W-FSE image; (B) T2W-PROPELLER image

Diagnostic dilemma of a lingual osseous choristoma: A case report

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Clinical: A 17-year-old Thai female was referred from orthodontist regarding an incidental finding of radiopaque regions within panoramic radiograph. Initially, the patient reported no abnormal symptom, while basic clinical examination revealed no obvious related sign.

Radiology: There is a sharp, non-corticated, oval, homogeneous, radiopaque area at the left angle of mandible. Another similar radiopaque area with less well-defined margin and slightly less density is shown beyond impacted tooth 48 below inferior alveolar canal. The size of both regions is 1.5 × 1 cm. Faint radiopaque band is observed above the second region of interest. CBCT was prescribed for exact nature and location, while post-hoc clinical examination revealed a lump at tongue base region, and patient admitted to slight discomfort while swallow.

Final diagnosis: The final diagnosis was osteoma of the tongue.

Discussion: Lingual osseous choristoma or soft tissue osteoma is a rare disease. The most common involvement sites[1] are reported on skin and various area of the tongue as posterior tongue, tongue base, circumvatte papillae, and posterior to circumvallate papillae, foramen caecum, mid third or lateral tongue. Various symptoms were reported ranging from none to asymptomatic lump, gaging, dysphagia, throat irritation or foreign body sensation. Due to its benign nature, radiographic incidental finding is quite common. Panoramic radiograph is a common modality with unique characters, of which double real and ghost images are among them. Posterior midline structures common presenting as double or triple real images are cervical spines or hyoid bones. Defined as shadow of objects outside the image layer that are not entirely excluded from the image,[2] ghost can be recognized by its opposite location at higher level and same but blurring appearance to the real object. Therefore, midline or slightly off-midline lingual osteoma can create a dilemma to clinicians due to its illusion of bilateral lesions, and radiographic interpretation on panoramic radiograph must be carefully done with basic knowledge of image formation in mind.

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Figure 1: Pre-orthodontic panoramic radiograph showing abnormal radiopaque structure bilaterally

A CBCT study of normal, variant, and pathologic findings of the clivus

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Introduction: The clivus is a portion of the cranial base formed by the union of the sphenoid and occipital bones. Although usually not a structure of concern in dental practice, it is visualized on large field of view cone beam computed tomography (CBCT) volumes. Variations of normal anatomy and pathoses of the clivus are included in radiology reports. The present study looks at prevalence of these in a dental school patient population.

Materials and Methods: After an IRB approval, eight calibrated examiners reviewed existing CBCT volumes where the Clivus was completely visualized. The examiners reviewed normal anatomy, variations and abnormalities limited to the Clivus. The data was recorded using MS Excel spreadsheet.

Results: A total of 303 volumes were reviewed. There were 163 (53.8%) females and (140) 46.2% males, mean age was 53.8 ± 18.34. Out of 303 volumes, there were 46 (15.2%) that presented with variations of the clivus, while 18 (5.9%) had pathological findings of the clivus in their CBCT volume. T-test for pathological findings was statistically significant p=.027. Mean age for having a lesion was 61±12.7 years for 95% CI. Variant findings include canalis basilaris medianus, Tornwaldt's cyst, persistent Rathke's pouch, and variations in size and shape of the clivus. Pathoses include effects of trauma, tumors, dystrophic changes, and spheno-occipital synchondrosis beyond skeletal growing age.

Conclusions: Although anatomic variations and pathologic conditions of the clivus were infrequent findings, they may have clinical significance. It was reported that usually, clival disease is asymptomatic or clinically nonspecific. Therefore, imaging is the only modality to establish a diagnosis. Even if of no direct significance to the dentistry, these findings can have significance to the patient's overall well-being.

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Figure 1: Canalis Basilaris Medianus is an uncommon anatomical variant of the basiocciput. Due to its potential association with meningitis, it should be recognized and reported to avoid potential complications

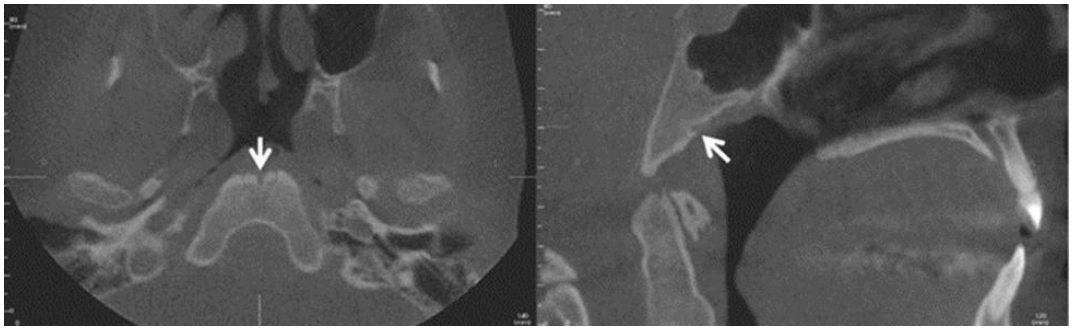

Figure 2: Fossa navicularis magna is an anatomical variant that appears as a notch-like defect in the basiocciput. Studies using computed tomography (CT) and magnetic resonance imaging have reported that this osseous defect may be filled with lymphoid tissue of the pharyngeal tonsils

Detection of proximal caries: comparison between visual examinations and radiographic examinations

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Introduction: Proximal caries is difficult to diagnose clinically due to its location. We investigated the visual detectability of proximal caries which was observed in panoramic radiography.

Material and methods: Panoramic and visual examinations were performed on a total of 202 patients. All radiographic images were evaluated by two oral and maxillofacial radiologists and 181 teeth with proximal caries were radiographically diagnosed under agreement. Both examiners were blind to the results of the visual clinical examination. ***Gradings of interproximal caries:*** Proximal caries observed in panoramic radiography were classified by 4 grades. Caries with grade I had radiolucency visible in the outer ½ of the enamel. Caries with grade II had radiolucency visible to the inner ½ of the enamel. Caries with grade III had radiolucency limited to the outer ½ of the dentin. Caries with grade IV had radiolucency to the pulpal ½ of the dentin. ***Tracking visual diagnosis:*** All of the charts of patients with radiographic proximal caries were reviewed and clinical evaluations followed. We determined whether the interproximal caries confirmed by radiological examination were also visually present. ***Visual detectability:*** The percentage of teeth detected by visual examination was determined based on the diagnosis made on the radiographs. Visual detectability of proximal caries was examined according to each grade and tooth position (Figs.1,2).

Results and discussion: Only 84 of 181 teeth which were found to have proximal carious lesions in panoramic radiography were confirmed by visual examinations. There was no significant difference between the grade of caries and visual detectability of proximal caries (Figs. 1,2). No significant difference was observed between tooth position and visual detectability of proximal caries. These results imply that clinical diagnosis of proximal caries is difficult and radiographs should be taken to detect it.

Conclusion: Proximal caries is difficult to be detected by visual examinations. Therefore, detection of proximal caries should be performed with aid of radiographs.

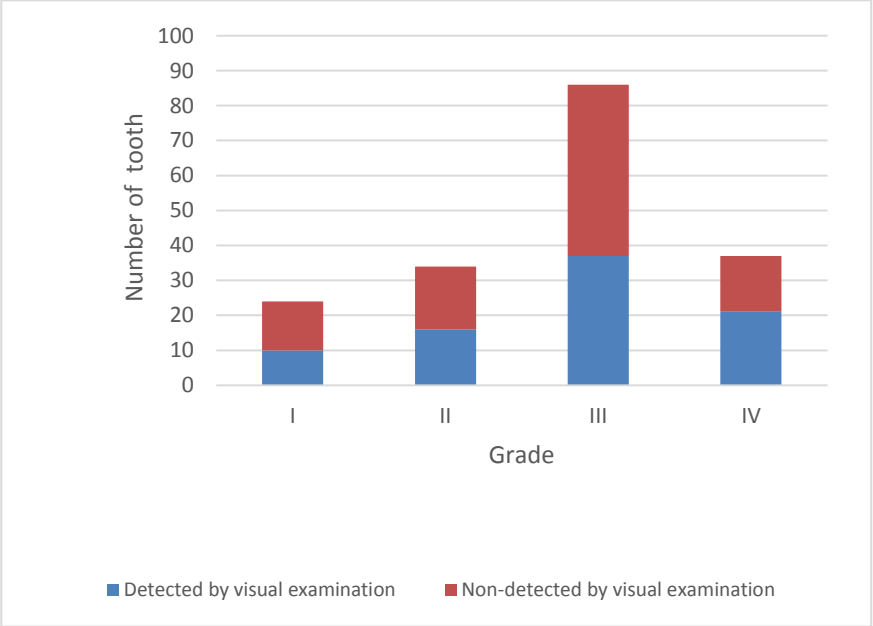

Figure 1: Classification of proximal caries by grade of caries

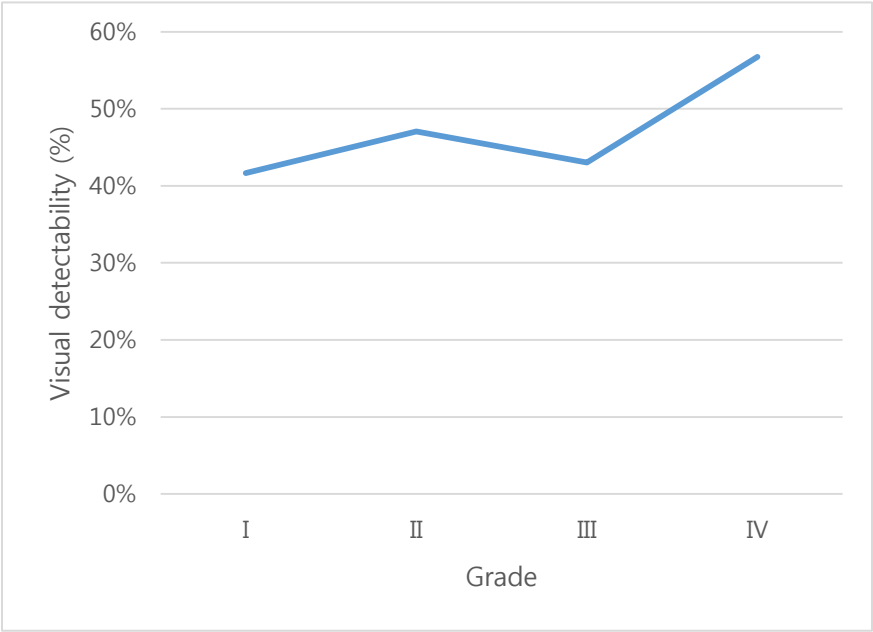

Figure 2: Visual detectability by grade of caries

Patient movement characteristics and the impact on CBCT image quality and observers' ability to report

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Introduction: Patient head movements may produce artefacts in CBCT images.[1] The objective of this study was to assess the impact of patient movement characteristics on CBCT image quality (IQ) and observers' ability to report. Impact of metal/radiopaque materials in the field-of-view (FOV) was also assessed.

Materials and methods: One-hundred-sixty-two CBCT examinations (6x6 cm FOV, 0.13 mm voxel size) were performed in 134 patients (age average: 27.2 years; range: 9–73). An accelerometer-gyroscope system (AG) registered patient's head position during examination. Thresholds for defining movement were set at ≥ 1 mm (Th1) and ≥ 2 mm (Th2) movement distance based on AG registrations. Movement complexity was defined as uniplanar/multiplanar. Three observers scored: the presence of stripe artefacts (absent/"enamel stripes"/"metal stripes"/"movement stripes"), overall unsharpness (absent/present), and ability to report (able/unable) on the diagnostic question. Kappa statistics assessed interobserver agreement. Chi-square tests defined if movement distance (Th1 and Th2), movement complexity, and metal/radiopaque material in the FOV were risk factors that an observer was unable to report. Relevant factors ($p \leq 0.20$) were entered into a multivariate logistic regression analysis with "unable to report" as the outcome.

Results: Interobserver agreement for ability to report was good (average: 0.65). Movement distance and presence of metal/radiopaque materials, but not movement complexity, influenced IQ and ability to report. Regression analyses (Th1) showed an increased risk (OR 3.58; CI 95% 0.83–15.83) that an observer was unable to report on a case with patient movement, compared to a case without movement. At Th2, the increased risk (OR 3.72; CI 95% 1.33–9.70) was statistically significant ($p \leq 0.05$) for all observers. Metal/radiopaque material was also a significant ($p \leq 0.05$) risk factor, both at Th1 (OR 3.63; CI 95% 1.34–9.49) and Th2 (OR 4.10; CI 95% 1.46–11.57).

Conclusions: Patient movement ≥ 2 mm and metal/radiopaque material in the FOV significantly affected CBCT IQ and observers' ability to report.

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Table 1: Multivariate logistic regression analyses (162 CBCT examinations) for the impact of movement distance (at two thresholds, Th1 and Th2) and presence of metal/radiopaque material in the field-of-view on the variable "unable to report" (outcome). Variables in parentheses served as reference

Variables	1-mm threshold, Th1			2-mm threshold, Th2		
	P	OR	CI-95	P	OR	CI-95
Movement (absent, n = 63 for Th1/n = 121 for Th2)						
Present	0.116	2.15	0.83–5.61	0.006	3.71	1.46–9.43
Metal/radiopaque material (absent, n = 114)						
Present	0.002	3.99	1.68–9.49	0.001	4.66	1.88–11.57

Application of advanced MRI in head and neck

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Introduction: Multi-parametric MRI including H-MRS, DWI-MR DCE-MR[1] can be useful in establishing a differential diagnosis for diseases affecting the head and neck region.

Material and methods: H-MRS, DWI-MR, DCE-MR[1] with a 1.5T MR unit. The localization for single-voxel H-MRS[1] was used by a point-spectroscopy(PRESS) at echo time of 144 ms, and Cho was considered as a criterion to assess the MALT lymphoma. The mean ADC from both b values (500s/mm^2 and 1000s/mm^2) were calculated from DWI-MR. TTP, TTS, SI_{start}, SI_{max} , SI_{ending} and ISI, RWO were seperately calculated from DCE-MR, and the types of TICs were analysed.

Discussion: Significantly statistical difference was found in the morphological findings between benign and malignant lesions, but no single morphological sign can independently differentiate malignancy. Advanced MR imaging provide specific functional information. However, single functional criteria for a differential diagnosis may also result high false positive rate. When morphological findings indicate a benign diagnosis, multiple positive findings in advanced MR imaging can support a malignant diagnosis and usually a low grade malignancy.

Conclusions: Functional imaging characteristics, such as TIC and ADC, are beneficial for establishing a differential diagnosis. Morphological criteria combined with advanced MR imaging can effectively improve the diagnostic accuracy. When morphological findings indicate a benign diagnosis, multiple positive findings in advanced MR imaging can support a malignant diagnosis and usually a low grade malignancy.

References

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Malignant Criteria	Sensitivity	Specificity	Correctly Identified
Conventional MR	65%	84.5%	77%
Conventional MR + 2 Positive advanced MR results	81%	89%	87%
Conventional MR + 3 Positive advanced MR results	99%	98%	99%

Additional advanced MR could increase the diagnostic ability of adopting conventional MR alone

Variable	Cases (n)	Benign (%)	Malignant (%)
Morphology (-) ADC(+)	6	3 (50)	3 (50)
morphology(-) TIC(+)	6	4 (67)	2 (33)
morphology(-) MRS(+)	3	2 (67)	1 (33)
morphology(-) ADC(+)&TIC(+)	14	5 (36)	9 (64)
morphology(-) TIC(+)&MRS(+)	11	4 (36)	7 (64)
morphology(-) MRS(+)&ADC(+)	10	3 (30)	7 (70)
morphology(-) MRS(+),ADC(+),TIC(+)	7	1 (14)	6 (86)

These tables list the results of the cases with negative morphological findings and positive findings for DWI, TIC or MRS

3D analysis of CBCT datasets of the upper airway to understand breathing disorders

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Introduction: The upper airway is a complex anatomical system where several breathing abnormalities can be located. One of these abnormalities is obstructive sleep apnea (OSA), which is a sleep-related breathing disorder. Excessive daytime sleepiness, snoring, and reduction in cognitive functions are among the common symptoms of OSA. As a result, there is increased cardiovascular morbidity, neurocognitive impairment, and overall mortality. Obstructive sleep apnea is a major public health problem affecting approximately 4–8% of the general population, of which probably 80–90% remains undiagnosed.

Nowadays, a wide variety of three-dimensional (3D) imaging modalities is available to evaluate the upper airway of OSA patients, such as cone beam computed tomography (CBCT) and CT. We performed several studies to establish the accuracy and precision of CBCT 3Ddatasets, measurements of the upper airway and computational fluid dynamics (CFD) modelling in OSA patients and controls.

Materials and methods: We obtained 3D datasets using CBCT and MDCT devices from OSA-patients and non-OSA patients as controls. We also developed and created a human phantom with tissue equivalent material based on a real CBCT dataset to serve as the golden truth (Fig. 1). These datasets were used to calculate CFD-models.

Results: The studies showed that the intra- and inter-observer reliability and the accuracy of the three-dimensional measurements of the upper airway based on 3D CBCT imaging are adequate for identifying anatomical characteristics related to OSA (Fig. 2). The current possibilities of 3D printing offer new opportunities of manufacturing anthropomorphic phantoms, which show the shape and dimensions of the upper airway more accurately than simple geometric models. Based on these models we could perform CFD modelling and identify the most relevant airflow characteristics in the upper airway of OSA patients and controls (Fig. 3).

Conclusions: The CBCT and MDCT 3D images were accurate and the measurements were reliable.The 3D datasets make it possible to apply computational fluid dynamics (CFD) to show the airflow characteristics in the upper airway and assess the effects of OSA treatment interventions. A narrower upper airway was the most relevant anatomical characteristic and higher airway resistance during expiration was the most relevant aerodynamic characteristic in the pathogenesis of OSA.

Acknowledgement: Part of this work is based on studies performed by Dr. Hui Chen, DDS, Orthod.

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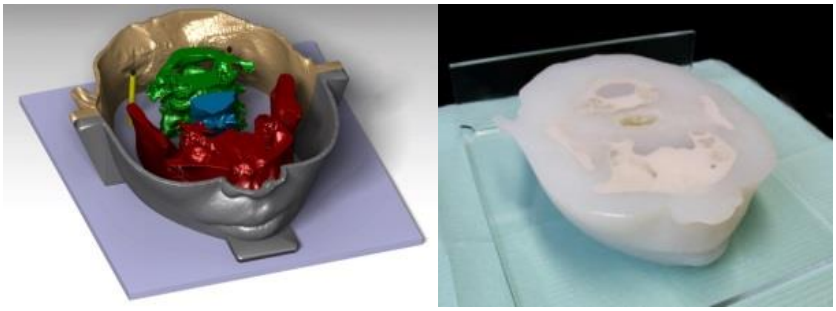

Figure 1: The anthropomorphic phantom of the upper airway, based on a CBCT 3D dataset. Left: the STL image; right: the phantom

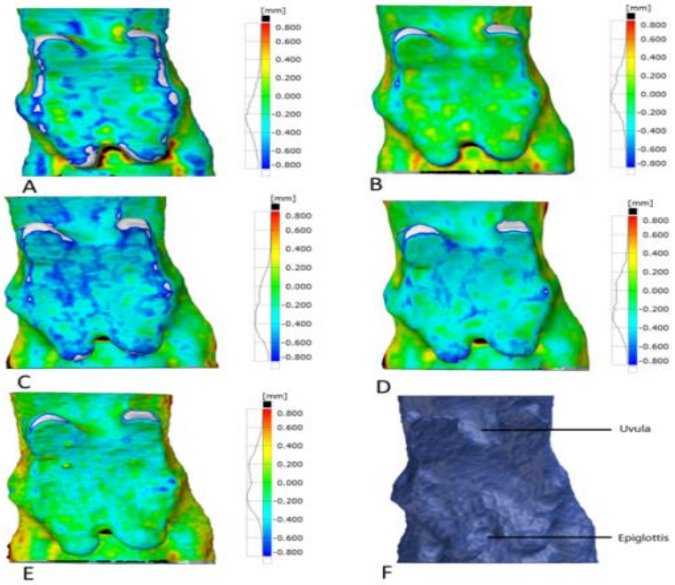

Figure 2: Heat plots showing the accuracy of 3D images of the upper airway obtained by various CBCT and MDCT machines. Red is positive deviation, blue is negative deviation

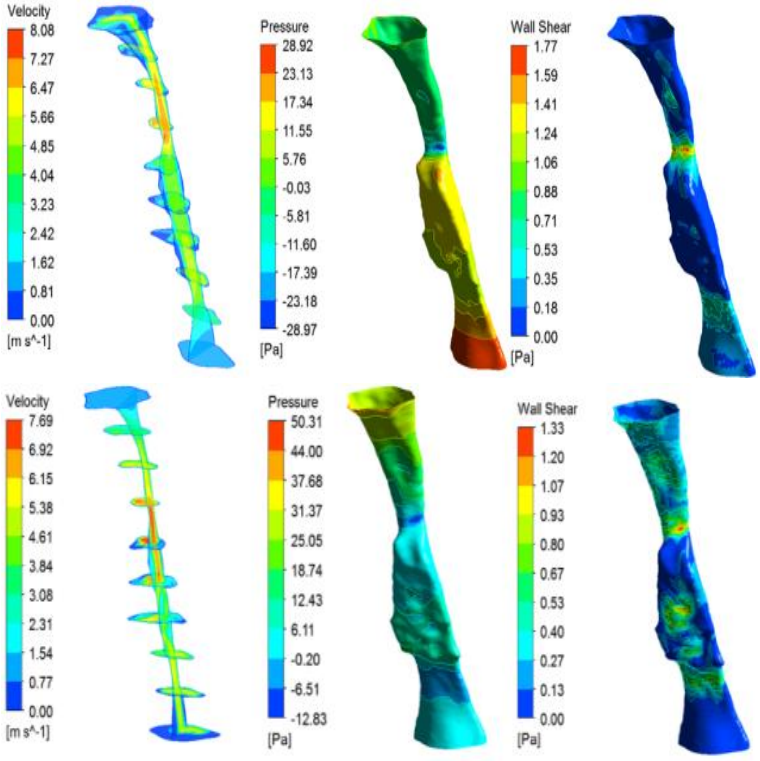

Figure 3: CFD airflow model of OSA patients during inspiration (top) and expiration (bottom). From left to right: velocity, pressure and wall shear

Current knowledge of the Belgian dentist on 2D and 3D dental imaging: the importance of continuing education in decision making

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Introduction: Recently, radiation dose has been once again the main topic in public health media, given the increasing annual background radiation. Sensitization campaigns can be very effective but may not always reach their target. The purpose of this study was to investigate the current knowledge of Belgian dentists on 2D and 3D imaging techniques, their decision making pattern and the influence of continuing education. The role of certain demographic factors in this knowledge was also assessed.

Materials and methods: An interactive cloud-based platform (Mentimeter Am, Stockholm, Sweden) was used during a continuing education course on dental radiology to interact with a group of 400 Belgian dentists. Online voting through smartphones occurred using a personalized, secure link and was first tested through a non-blinded series of random questions. Practitioners were exposed to a series of multiple choice questions, prior and right after the course. Demographic information (age, sex, profession, workplace, and equipment), basic radiology knowledge and decision making patterns were the three assessment categories.

Results: The audience consisted of slightly more females (60%), and 80% were between 25 to 55 years old. The majority worked in private practice (80%), were general dentists (80%), and had intra-oral (96%) or panoramic X-ray technology (80%) in their office. There was a lack in knowledge on Panoramic and CBCT doses for approximately 50% of the audience. For 3D imaging, 65% of the audience claimed to know exactly this technology. These results were not gender related but seemed to be age and specialization dependent. 8% had a CBCT unit, and merely 20% of the audience claimed to use 3D frequently. After the course, a 50% change of answers was perceived for the dose-related questions and 10-30% for those on modality choice.

Conclusions: Compared to a previous Belgian study, digitalization and knowledge on dental radiology seems to advance but still needs improvement. Several factors may influence knowledge or the decision making process on 2D and 3D imaging techniques in dentistry. Continuing education offered new perspectives for the majority of the group.

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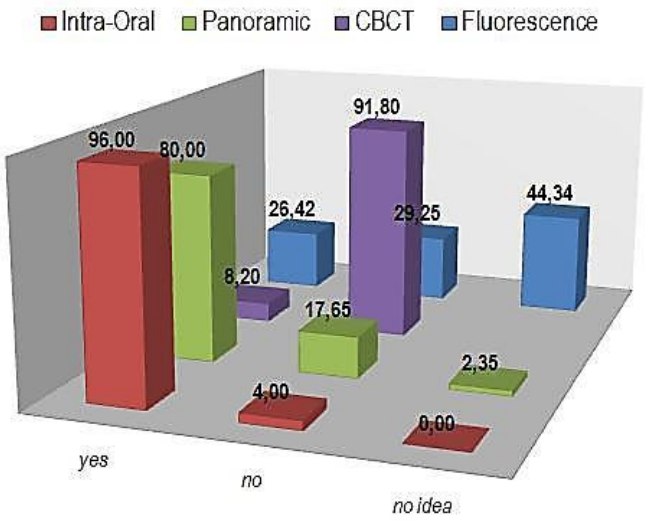

Figure 1: Presence of dental diagnostic modalities in the work environment of Belgian dentists

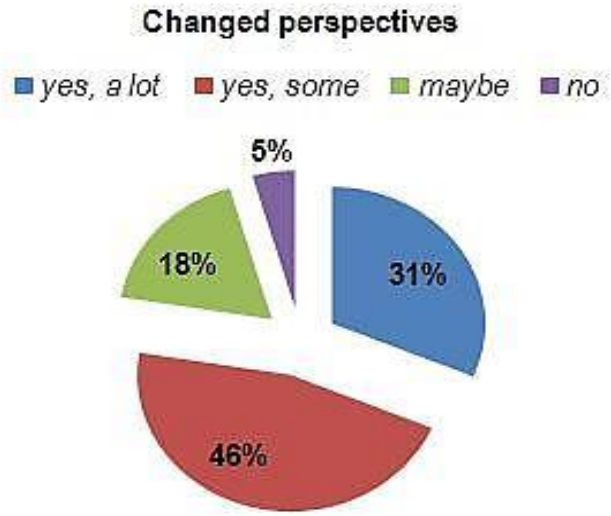

Figure 2: Pie chart depicting the percentages of new perspectives adoption by the audience after the CE course

Solid variant of keratocystic odontogenic tumors: a report of three cases

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Clinical: The clinical manifestation of the solid variant of keratocystic odontogenic tumor was a painless swelling with facial asymmetry.

Radiology: One case showed a unilocular radiolucent lesion and two cases were multilocular. The multilocular cases showed foci of radiopaque calcifications and fine, thin septa. One case was ill-defined and the cortical continuity interrupted.

Pathology: Histological features of the lesion included multiple keratin-packed cysts of various sizes forming a solid neoplasm.

Final diagnosis: Solid variant of keratocystic odontogenic tumor (multiple tiny cystic spaces and some scattered firm tissue were detected in the cut surface of the entity).

Discussion: The cystic and solid variant share similar clinical features. No obvious different imaging features were found between the solid and cystic variant of KCOT because of the limited numbers and lacking in CT data. There is not enough evidence suggesting the solid variant of KCOT is more aggressive than the cystic variant.

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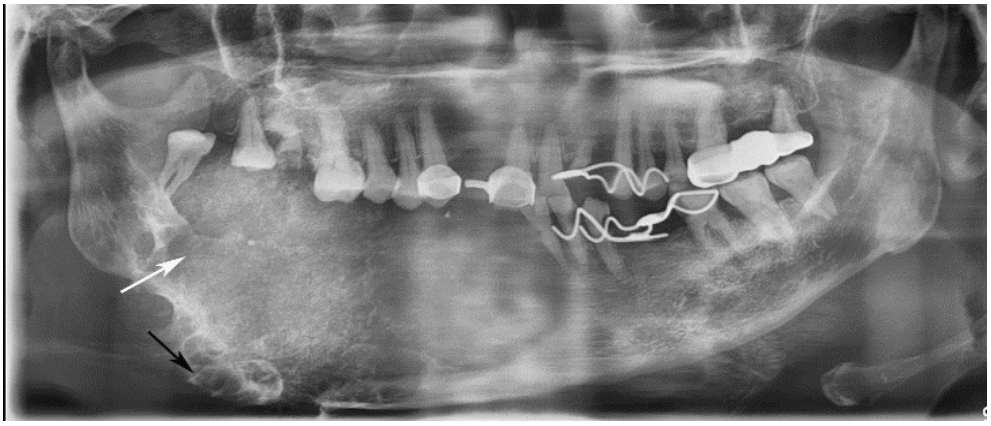

Figure 1: The panoramic view reveals an ill-defined radiopaque lesion. Scattered radiopaque calcifications (white arrow) and thin septa (black arrow) can be seen in the lesion. The teeth involved were displaced without resorption. The mandibular canal is not visible

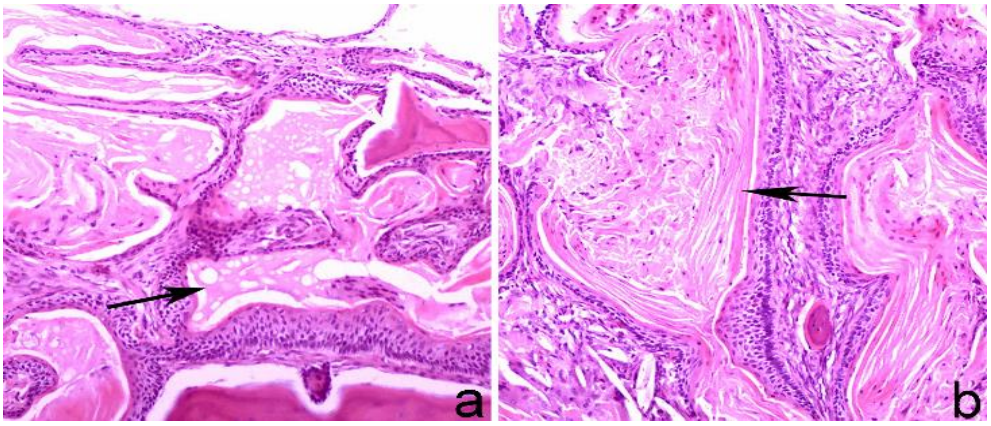

Figure 2: Microscopically the neoplasm was a solid lesion characterized by irregular odontogenic epithelial bands/islands (a), with multiple cystic spaces filled with concentric layers of parakeratin (a, b) (black arrows). Some residual bone tissue can be discovered in the tumor (hematoxylin and eosin stain)

Progressive systemic sclerosis manifested with resorption of ramus and irregular destruction of coronoid: a case report

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Clinical: A 53-year-old woman asked for prosthetic evaluation. She was married and had a daughter. Reviewing the history, she was diagnosed with systemic sclerosis since 14 years old with regularly follow-up in our Rheumatologic department. The associated symptoms and signs were dry mouth at midnight, trismus, difficulty in swallowing, severe taut skin, resorption of digital tuft, claw hand with multiple recurrent ulcers, erosive gastritis, erosive esophagitis and hiatus herniation, severe restrictive ventilatory defect lung function, pulmonary fibrosis and Lt pleural adhesion.

Radiology: Radiologic examinations showed advanced periodontitis and dramatic mandibular deformity including bilateral ramus and angle resorption and thinning of right coronoid, but irregular destruction and osteophyte-like formation in left coronoid process which was rare found in past literature. Osteoarthropathy and osteolytic lesion in right humeral shaft was noted in her chest radiography.

Final diagnosis: Progressive systemic sclerosis (PSS) or scleroderma with resorption of ramus and coronoid process.

Discussion: PSS is a rare connective tissue disease (prevalence about 15–20 per 1 million) with diffused abnormal collagen deposition with skin, subcutaneous and multiple internal organs affected. Its etiology is uncertain, about 10% PSS patient had overlap syndrome, such as sicca syndrome, lupus erythematous. Renal, cardiac and pulmonary involvement changes the prognostic to the worse. Considering the both unfavorable prognosis in medical treatment and dental reconstruction, comprehensive preventive dental care was highly emphasized.

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Figure 1: Clinical profile of the PSS patient. Trismus and papilla atrophy of tongue, severe taut skin, resorption of digital tuft and claw hands were noted

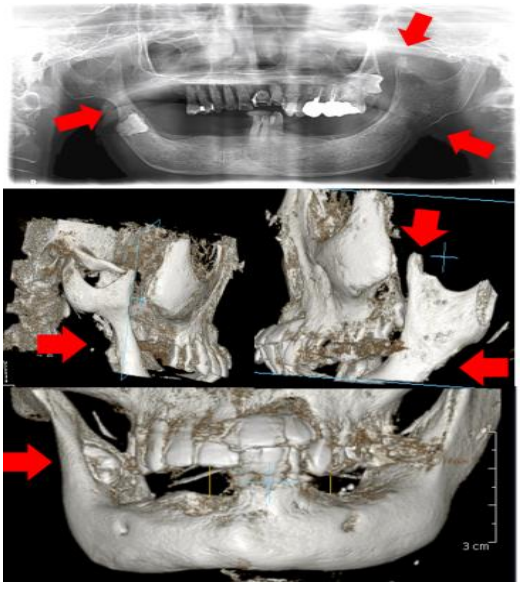

Figure 2: Radiographic characteristics of the PSS patient

Dark room to augmented reality: Technological rise of oral radiology

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Background: Radiology continuously evolved on par with the technology, from back in the days of the dark room to a future of augmented reality (AR). The future seems to be heading towards the augmented reality and thus innovations should be incorporated for the better understanding of the radiological/ complex cross sectional structures. AR allows visualizing and manipulation of 3-dimensional objects in virtual space.

Objectives: The purpose of this study is to introduce augmented reality to the world of the maxillofacial radiology. For illustrative purposes animated videos depicting impacted teeth were created to demonstrate the application of AR technology.

Materials and methods: AR models were created utilizing the CBCT DICOM. Using the software the segmentation was performed. A 3D modeling was created. These models were ported into maya software and converted into animations. Then, the animations were finally ported into HoloLens (Microsoft Inc.), for visualization of the models. These models could be manipulated 3-dimensionally for a better understanding of the concepts.

Preliminary results: Animations provided a better understanding of the complex concepts with 3D models. It will enhance interaction and understanding by creating virtual presence of real objects using the augmented reality application. The preliminary demonstration gained immense popularity and proved to be very effective.

Future directions: We anticipate developing a repository of multiple AR models for educational purposes. We propose that it will effectively improve radiological reasoning, knowledge and three-dimensional appreciation.

Demonstration of extraction of impacted tooth using HoloLens-Virtual Reality

Demonstration of extraction of impacted tooth using HoloLens-Virtual Reality

American position guidelines on cone-beam CT and teleradiology

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Introduction: Cone-beam CT (CBCT) has become an important imaging modality in oral and maxillofacial diagnosis and entire dental practice. This is the result of its multiplanar and three-dimensional capabilities, and relatively low radiation exposure to the patient, when compared to conventional medical computed tomography.

Materials and methods: The key note oral presentation updates CBCT applications and American Position Guidelines in dental implants, endodontics, orthodontics, and teleradiology.

Results: In modern dental practice, CBCT has been widely used in pre-osseous assessment and guided-surgery for dental implants, treatment planning for endodontic and orthodontic patients, third molar extractions, temporo-mandibular joint assessment and nasal pharyngeal space evaluations. However, most CBCT machines are purchased and used by a general dentist or a non-radiology dental specialist. In addition, there are limited oral and maxillofacial radiologists available in some parts of the United States, lacking image interpretations, missing important incidental findings (Fig. 1), and misdiagnosing lesions are not uncommon. Also, there is a tendency among some practitioners to abuse this technology. They lack sufficient knowledge of this three-dimensional imaging modality, are ignorant of radiation exposure to their patient, or have a motivation of financial gain.

Conclusions: National guidelines for CBCT applications are quite important in the United States and other parts of the World for the sake of protecting our patients and minimizing the legal liability for dental practitioners.

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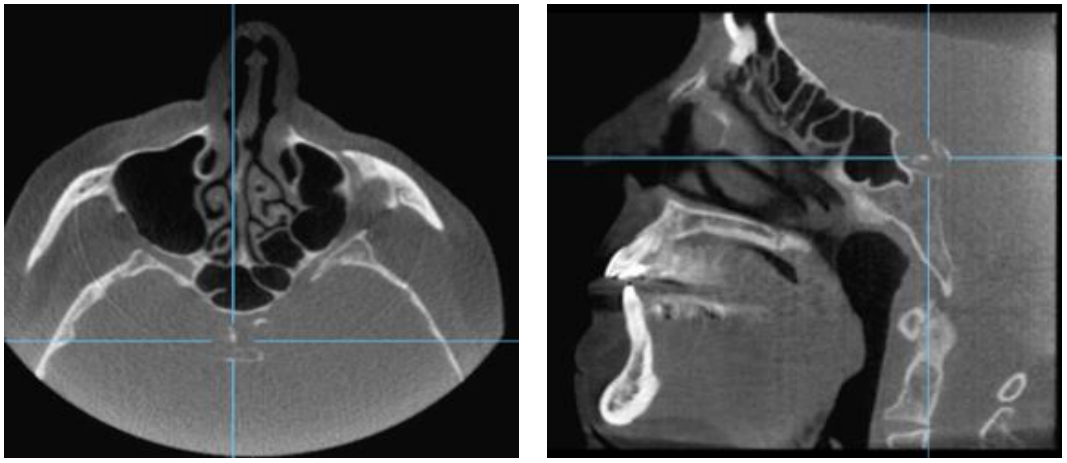

Figure 1: Incidental finding in a dental implant patient. Axial and sagittal reformatted images show a calcification in the sella turcica. There is bone resorption of the dorsum sella. Further medical evaluation confirmed as a craniopharyngioma in the sella turcica

The important of surface disinfectan on oral-maxillofacial radiology unit

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Introduction: In an oral-maxillofacial radiology unit, bacteria is consistently transferred via the fingers from a dental film in a patient's mouth to hand-contact surfaces, such as X-ray sensor, panel control, door handles and the switch button.[1,2] In terms of reducing bacteria and preventing the nosocomial infection the use of disinfectant is important especially as devices surface protect agent.

Objective of study: To determine the number of bacterial colonies between, before and after using surface disinfectant in oral-maxillofacial radiology unit.

Materials and methods: Four hand contact surfaces were studied i.e. a X-ray sensor, control panel, door handles and the switch button (Fig. 1). Bacteria were isolated from all surfaces using a cotton swab before and after applying surface disinfectant. They were then cultured on bacteriological agar and incubated for 24 hours at 37℃. The number of bacterial colonies was counted using bacterial colony counter. For the morphology of the bacteria, Gram staining was performed and examined under the light microscope (× 100 magnification and oil immersion).[3]

Results: The result of colony counting before and after the use of disinfectant is presented in Table 1. The results showed that applying surface disinfectant can reduce the number of bacterial colonies. The coccus in staphy, rod in strepto, rod in spread was found mostly on devices before applying disinfectant (Fig. 2). This study demonstrated a need for defining standard operational procedures for cleaning and disinfection of devices and their environment, and also continued training on disinfection and universal precaution for all dental radiography healthcare personnel.

Conclusions: Applying a surface disinfectant on oral-maxillofacial radiology units can reduce the number of bacterial colony growth.

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Figure 1: The locations in which bacteria were isolated. A: CBCT unit; B: X-ray sensor, C: Control panel; D: Door handle; E: Switch button of CBCT unit

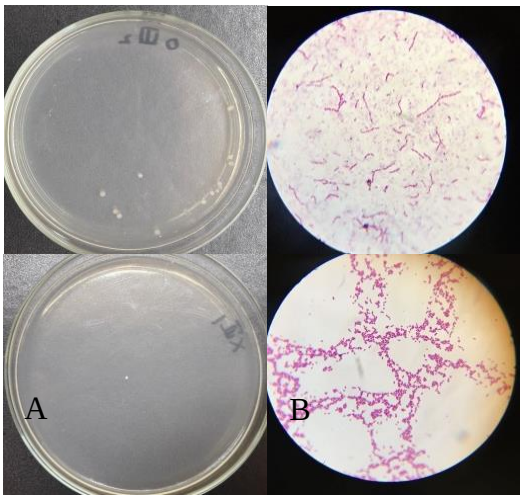

Figure 2: Bacteria found on CBCT device. A: Colony morphology, B: Bacterial gram staining

Table 1: The number of bacterial colony growth isolated from radiology devices

Surfaces	Colony number			
	Before disinfectant used		After disinfectant used	
	O1	O2	X1	X2
I	0	0	0	1
II	13	12	1	1
III	23	8	0	0
IV	1	2	0	1

Note: Surface I – X-ray sensor, II - control panel, III - door handle and IV - switch button of CBCT unit

Maxillary sinus imaging anatomic evaluation in dental implant

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Introduction: The maxillary sinus is a challenging structure in the middle of the face. When implant planning is done, consideration must be given to its existence and relative changes. The maxillary sinus cannot be ignored and it is important to understand it clearly.

Materials and methods: The radiographs of patients consisting of maxillary sinus septum, antracoele, gas-liquid phase of the maxillary sinus, mucosal thickening, calcification and multifarious cyst. Some cases include the imaging both before and after the implant procedure (Figs. 1,2), which show the changes more visual.

Results: There are three types of radiographic views: Physiological structures (normal structures associated maxillary sinus, such as a large sinus or septa in the sinus - Fig. 3 – and an artery in the wall of the sinus); secondly pathologic changes (such as maxillary sinus effusion, thickening of the maxillary sinus mucosa - Fig. 4, or calcifications on the floor of the sinus); lastly, post-operative changes (such as bleeding - Fig. 5, infection, implant displacement into sinus or the surrounding tissue).

Conclusions: Dentists should be acquainted with the different radiological appearances of the maxillary sinus in order to place implants successfully and avoid medical risks.

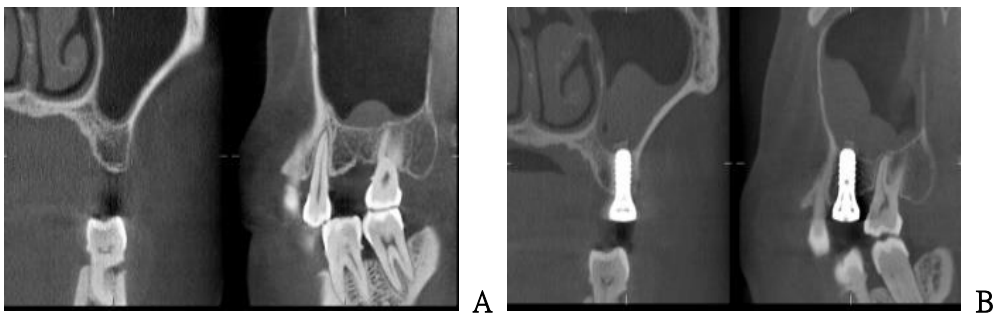

Figure 1: Coronal, sagittal and axial view (female, 45 years old). A: before implant, note the small cyst in the sinus before the sinus lifting procedure. B: The same patient after 3 months, the image shows the "cyst" is enlarging after the sinus lifting procedure

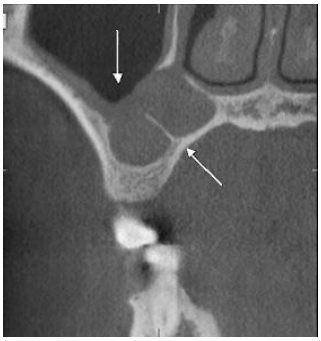

Figure 2: Coronal view (male, 50 years old). White arrows show the sinus septum and antracoeles

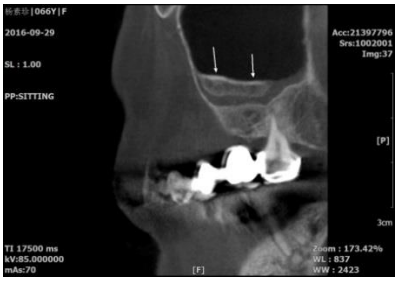

Figure 3: Calcification of maxillary sinus mucosa

Figure 4: Sagittal view (male, 49 years old). Note the mucosal thickening before the sinus lifting procedure (male, 49 years old)

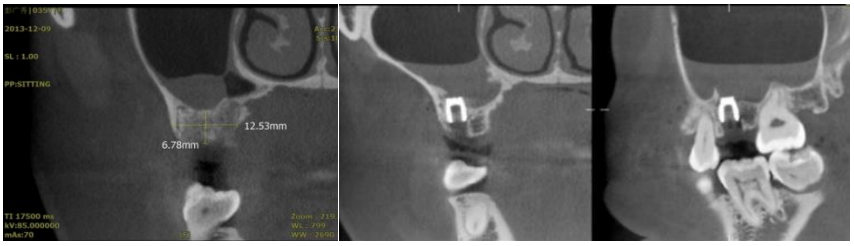

Figure 5: Before implant (left figure). After implant (middle, left figures). The view shows the bleeding phenomenon after the implant operation (female, 35 years old)

Evaluation of prevalence and location of mandibular lingual foramina using CBCT

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Introduction: The aim of this study was to assess the amount and regional frequency of mandibular lingual foramina (MLF).

Materials and methods: A retrospective study was conducted by selecting images of the mandible from 567 patients, in the Department of Oral Radiology, West China hospital of Stomatology of Sichuan University, from January to September 2016.

Results: In total, 1203 MLFs were found. The research indicated that MLF can appear in any position at the mandible (Fig. 1). The highest regional frequency was recognized in the midline area (97.88%), Followed by premolar area (38.27%) and canine area (10.41%).

Conclusions: CBCT examination easily demonstrates the presence of the lingual foramina and their vascular canals. Clinicians should pay attention to the position of MLF and its possible implications.

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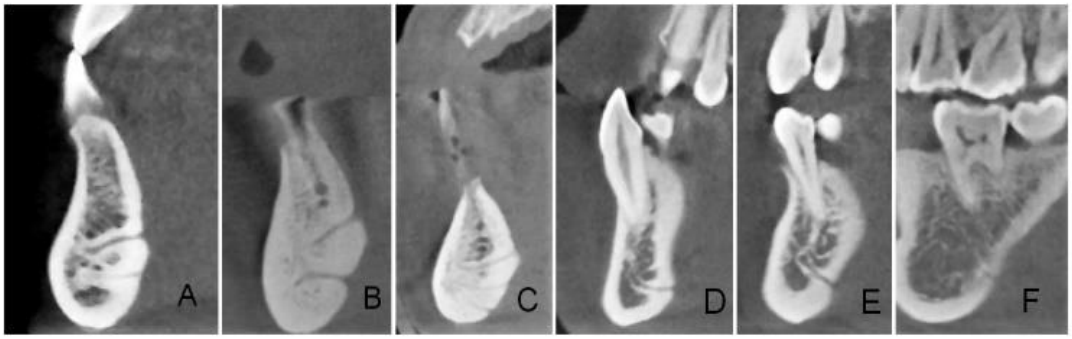

Figure 1: A-F Sagittal view shows MLF in different patients

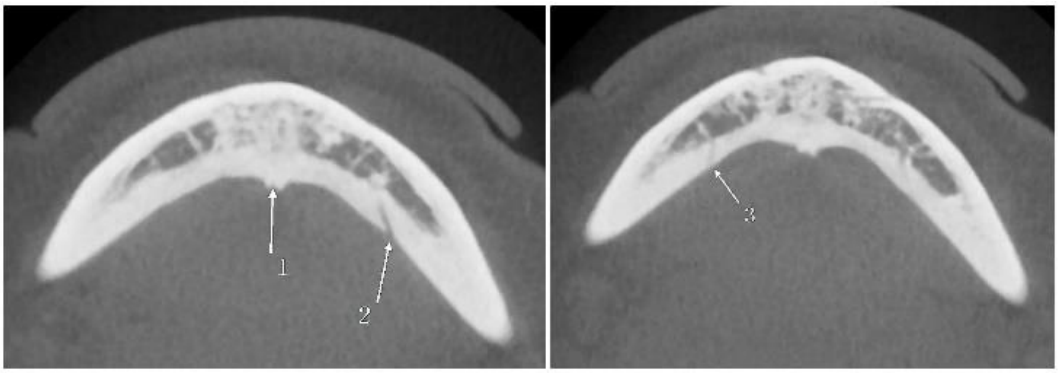

Figure 2: Coronal view, white arrows show MLF (male, 46 years old)

Virtual monochromatic imaging in dental cone-beam CT

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Introduction: Virtual monochromatic imaging was studied for dental cone-beam CT imaging. It is based on the combination of kVp-switching X-ray source and corresponding dynamic filtration for each kVp beam. The quality of virtual monochromatic images is evaluated by head phantom experiments and clinical trials, in terms of beam-hardening correction, metal artifact reduction, contrast and noise optimization and radiation level.

Material and methods: Phantom experiments and clinical trials were carried out to study the applications of virtual monochromatic imaging in dental examinations. Virtual monochromatic images were synthesized on a Dual-energy cone-beam dental CT provided by Shanghai UEG Imaging Co., Ltd. in which 80 kVp and 110 kVp X-ray emited in turn during one CT scan. An image-based algorithm was employed to produce the virtual monochromatic image based on dual-kVp CT dataset. For comparison, both conventional dental CT imaging (single kVp scan) and monochromatic imaging (dual-kVp scan) were performed, and their delivered radiation dose was measured using iBA Multimeter MagicMsx-Universal.

Discussions: In our experiments, the beam-hardening artifacts in dental images were well suppressed by the virtual monochromatic imaging. However, for dense metal implants where photon starvation happens, it is not effective in metal artifact reduction where extra projection-based metal artifact reduction strategies are needed. A side-effect of the virtual monochromatic images is that the SNR is lower than conventional dental CT images. In UEG dual-energy dental CT, both monochromatic images and conventional images are simultaneously produced by a single scan which provides more information for dental examinations. The radiation dose delivered to patient in UEG dental CT is similar with conventional dental CTs.

Conclusions: Virtual monochromatic image at 130 keV synthesized from dual-energy cone-beam CT can well reduce beam-hardening artifacts, providing clearer images for dental examinations and without the incensement of the radiation. Combining the less-artifact monochromatic images and high-SNR

conventional images in a single scan, UEG dual-energy dental CT can support conventional dental applications and provide additional clear image reading.

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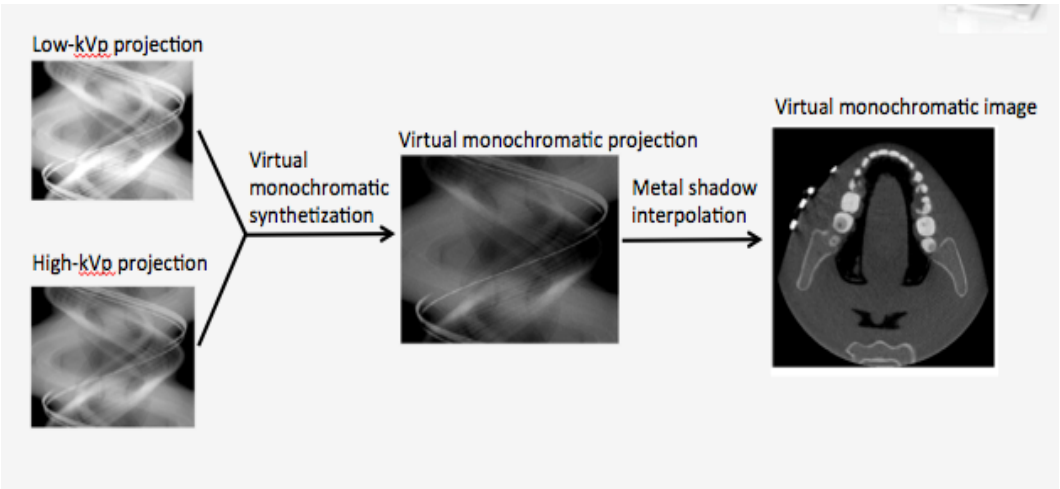

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POST-PREFACE OF 21ST ICDMFR, 2017

As an academic organization, we can shout now; we did it and it is accomplished! It had been a rather lengthy two-tier journey since the pre-Hiroshima conference in 2011 until the prodromal heat-up before April 23 of this year, 2017, after which the open ceremony kicked in, whereby 6 years of preparing for readiness came to final fruition.

During this family festivity, we proudly presented 42 well-rounded seminars featured by global presenters, along with more than 200 oral and poster presentations, collectively representing 400 overseas scholars and researchers from 36 countries. It would take time and space to recall details of the remarkable cascade of events that led to such successful launches of the world congress, my dear friends. Needless to mention the diligence and hard work of the folks involved in the planning before the event started, for example: i) the IADMFR board members assembled their business meeting as an introduction on April 24 (photo-1), ii) on the 25th, the pre-congress tour (photo-2) was featured by Prof. Arai's very fine lecture and a golf run-up (organized by Dr. YH Yin; photo-3), followed by a mouth-drooling buffet and two local attractions at Tainan (Chi-Mei Museum, as photo-2, & An-Ping Fortress) and iii) the congress staff moved into the hotel's head-quarters waiting for this big event to follow along. The first official evening was lightened up by a Welcome Party at the poolside restaurant, where delegates who just arrived-and-checked-in speedily departed their bags and luggage to joining in for greetings and friendly hugs, whereby the atmosphere was immediately filled and mingled with laughter, singing, spilled drinks and wonderful musical performances by local dental students. Oh! what a great start with friends!

Following the opening ceremony with the talented Aboriginal singing by an eminent vocal singer (photo-4) and a welcome remark addressed by Congress's honorary President/Prof. C.K. Liu (President of Kaohsiung Medical University; photo-5) in the morning of Apr. 26, we commemorated two special dedications to our IADMFR founding-father, Prof. Gregorio Faivovich and respectful Dr. Cheng-sing Kuo (President Lin's mother who passed away just weeks ago at the age of 106). This was followed by the introduction of the keynote speaker, Prof. R Jacobs, who was introduced by the Congress chairman President/Prof. Li-Min Lin. Her high-caliber scientific and professional seminar on "3-D bio-printing and imaging" (photo-6) set the tone for the entire presentations of the program once followed. At the same time, the scheduled poster presentations, numerous attendees, professional exhibitors and the snakes plus Starbucks Coffee, flushed the Exhibition Hall in the "Sky- Lounge" on the 20th floor of the Hotel, whose indoor layout and floor-touching glass-windows offered a spirit-hunt while prompted by relaxed poster viewing (photo-7) and a more than 180-degree sky-down view of the spectacular Love-River, a city-wide landmark of Kaohsiung.

The first day program was greatly embraced by the evening's hearty "Kaohsiung Night", where delicious Taiwanese delicacies in various styles (i.e., regular, vegetarian and koshered meals) were served, which penetrated the mouth of each guest, especially, the professional connoisseurs, with appraisal. Meanwhile, the evening was splendidly nourished by an official announcement of the 2017 ICDFMR's academic prizes (e.g.,

travel funds) for the Young Investigators (photo-8). Later, the cheerful, yet high-spirited and competitive folk music and traditional dances from the four bidding countries (e.g., Hungary, India, Korea and Turkey; Photos: 9-12) for the next ICDFMR conference in 2021 were quite memorable. Further to that, who could predict that the final decision for the 2021 bid announced during the General Assembly the next day, would simply transcend as an unbelievable memory?

On April 27 late afternoon, 200 international attendees went onto the "Kaohsiung Harbor Free-Tour" (photo-9), a cruiser trip to the harbor-based industrial zones, which was once amongst the top-three busiest harbors in the world (~mid 1980's-1990's). The tour was guided by professional personnel fluent in English, Japanese and other foreign languages for the historical and cultural translations, followed by overviews of the Kaohsiung harbor (once called "Takao" in the past). The next evening stepped in quickly for the pre-departing moods at the Gala Dinner on the 28th (photos: 13-14). All party-attendees were in their highest spirits. This was the best time and place where people shared greetings, thankfulness, appreciations and other nameless exchanges, and where the professional, academic and national boundaries seemed quickly distant, as our acquaintances drew closer. Who said we could not melt down barriers within the family of ICDFMR? With heart-touching witness at this most memorable night of the ICDFMR, we joyfully ever-heard the congress chairman, James (Prof. Li-Min Lin) sang a Chinese opera, and choired with lovable Jane (Lin's wife) for "Because He lives" to the delegates, magnificently. What a sweet-touch!

On 29th during the closing ceremony, President Li-Min Lin proudly introduced the local organizing committee and the staff members tasked with ICDFMR 2017 World Congress. Their tirelessness efforts and spiritual enthusiasm were highly awarded with cheerful and loud applauses at the closing ceremony. The IADFMR flag was officially passed to Prof. Jie Yang (photo-15), President of 22nd ICDMFR, who succeeded Prof Li-Min Lin as organizer (photo-16) of the next IADFMR conference to be held in Philadelphia city, Pennsylvania, USA, in Aug 2019.

As a small professional academy in the Orient, the TAOMFR diligently served its honorable duty by hosting the 2017 ICDMFR World Congress in Kaohsiung, Taiwan. From our hearts, we know that we as colleagues are closer than ever before and have moved forward in promoting friendly international and professional relations among all of us!

We thank you totally and cheerfully, our dear friends; and we shall meet again. So, we trust in the Lord.

Note: For all of the conference events, videos and photos, they have been uploaded to the FaceBook at https:// www.facebook.com/iadmfr2017/

by Prof. Ming-Gene Tu, DDS, MS, PhD
Secretary General, 21st ICDMFR, 2017
President of TAOMFR

Photographs at the glance of the conference events:

Photo-1: IADFMR Board members assembled for the business meeting on Apr. 24th, 2017.

Photo-2: The pre-congress tour at the Chi-Mei Museum, Tainan, on Apr. 25th, 2017.

Photo-3: The glance of the attending members at the golf run-up, as a part of the 2017 IADFMR.

Photo-4: An Aboriginal vocal singer performed at the Opening Ceremony on Apr. 26th, 2017.

Photo-5: At the opening ceremony, Apr. 26th, 2017, congress honorary chairman, President of KMU, Prof. C K Liu addressed to the audience.

Photo-6: A glance of the Keynote seminar held at the International Hall on Apr. 26th, 2017.

Photo-7: Conference Exhibition Hall at the 20th floor, Sky Lounge for the poster presentations.

Photo-8: Assembly of the Travel-Fund awardees for the Young Investigators, Apr. 26th, 2017.

Photo-9: Team of the Hungary, Apr. 26th, 2017.

Photo-10: Team of the India, Apr. 26th, 2017.

Photo-11: Team of the Korea, Apr. 26th, 2017.

Photo-12: Team of the Turkey, Apr. 26th, 2017.

Photo-13: Singing & dancing by the Aboriginal children at the Gala Dinner on Apr. 28th, 2017.

Photo-14: Choir performed by KMU students at the Gala Dinner on Apr. 28th, 2017.

Photo-15: A glance of the IADFMR flag passed onto the next leader groups at the closing ceremony on Apr. 29th, 2017.

Photo-16: Transcendence of next task between the two Presidents for 22nd ICDMFR at the closing ceremony on Apr. 29th, 2017.