



Management of oral and maxillofacial radiology clinics in Taiwan's dental schools

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Objectives: To investigate management of Taiwanese dental school Oral and Maxillofacial Radiology (OMFR) clinics and to suggest alternative management strategies.

Methods: A management questionnaire was designed for the faculty responsible for teaching the Oral and Maxillofacial Radiology curriculum.

Results: Data from all seven Taiwanese schools indicated inadequate supervision of the prescription of radiological examinations in the absence of guidelines. Most schools are understaffed and not properly equipped. There is a significant shortage of trained dentists in the field of OMFR. In some schools no dentist is involved in the management of OMFR clinics. Some aspects of quality assurance procedures should be enhanced. An average of 21.4% of films were reported lost, with the highest rate at 40%, demonstrating serious problems in image archiving. Clinician satisfaction with clinic management averaged 74.3%, with a minimum of 50%.

Conclusion: A set of standards is recommended by the Taiwanese OMFR Association after reviewing the survey findings. Prescription for OMFR examination should be supervised by licensed clinicians, and there is a need for guidelines. Trained and dedicated personnel should be assigned for the management of OMFR clinics. More quality assurance procedures should be performed. A computer-based image archiving system is desirable.

Keywords: radiography, dental; critical pathways; models, educational; practice guidelines

Introduction

The quality of the Oral and Maxillofacial Radiology (OMFR) service is strongly related not only to the quality of radiological interpretation and diagnosis but also to clinic management. It is not uncommon to encounter administrators who have limited information about dental school administration and a lack of successful management models.^{1,2}

There are seven dental schools in Taiwan with a 6-year curriculum for students who have finished their high school education. Three of the dental schools are independent, and the other four are part of medical colleges. All except one of the dental school clinics are within a general hospital setting and classes vary between 20 and 80 students per year. The clinical training varies between schools, but generally students

spend half of their fifth year and all the sixth year in clinical training sessions.

The aim of this study is to describe how OMFR clinics are managed in Taiwan's dental schools, and to recommend alternative management models.

Background

Management of an OMFR clinic consists of prescribing and performing radiological procedures, quality assurance, and archiving of images. Each of these activities may be described briefly as follows.

1. Prescribing radiological procedures

OMFR clinics in Taiwan traditionally conduct examinations based on clinicians' requests. In most schools, patients might visit the basic assessment clinic first for screening, or they might visit the specialty

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clinics directly. The clinicians working in dental school clinics can be divided into four categories: visiting staff working in the basic assessment clinics, visiting staff in specialty clinics, dental residents in clinical training, and intern dentists in their last year of their 6-year dental school education. These clinicians prescribe the OMFR examinations. There are differences among schools as to who is responsible for the prescriptions, and such information has not been available until now.

Ideally prescribing guidelines for dental radiological examinations should be used internationally³ but only a few countries use them routinely.⁴⁻⁷ In Taiwan, prescription guidelines have not been established or widely discussed in the dental schools. Thus, reporting on the existing criteria for OMFR examinations provides useful information that could be used to facilitate change.

2. Performing examinations

Dentists, licensed radiology technologists, and dental students are eligible to perform radiological procedures. Variability in the management among the different school clinics is expected to lead to different operator patterns in providing radiographic examinations. Information on the allocation of personnel and equipment in different schools could be valuable for administrators to improve care.

3. Quality assurance (QA)

Since QA is an important activity, at least one person in each clinic should be appointed with that responsibility.⁵ Assessing basic tasks, such as maintaining dark room processing solutions, could be used as indicators of successful QA programs in dental schools.

4. Archiving of images

Image archiving is a major task for the OMFR clinics management with considerable differences seen between schools where images may be stored centrally or distributed among many clinics or sites. A common international practice is for dental school clinics to maintain their own charts containing images.

Another important managerial issue is the problem of lost films in most radiology clinics,⁸ but the severity of this problem has not been reported.

Material and methods

A questionnaire divided into nine sections (see Appendix) was designed to collect data on clinic management, including areas such as prescription of radiological examinations, the number of examinations, quality assurance, and archiving of images. The faculty member responsible for the Oral and Max-

illofacial Radiology curriculum in the school or their designate filled out the questionnaires.

Results

The collected questionnaire reply data are summarized in Table 1.

I. Prescribing radiological procedures

1. *Prescribing the examinations* Clinicians in basic assessment clinics are responsible for prescribing radiological examinations. In two of the seven schools, visiting staff members of the specialty clinics are responsible for the prescription. Interns in most schools can independently prescribe the examinations without the supervision of the attending dentists, although the interns are given lower priority ratings.

2. *Guidelines for prescribing examinations* Radiological examinations are prescribed mostly according to a clinician's preferences.

3. *Delivery of examination prescription* Only one school uses a consultation form while the others use an informal method based upon the findings from the patient's physical examination. Most schools use the radiography ordering slip to keep track of where the images are.

II. Performing radiographic procedures

1. *Radiographers* There is no consensus regarding who performs the radiographic procedures. Radiography technologists in two schools perform most procedures. Interns perform a major proportion of the procedures in another school, while interns and technologists evenly divide most of the procedures in two schools. One school provides more clinical radiographic training of fifth year dental students than the others. Graduates from two schools might have very limited experience in performing clinical radiographic procedures. Schools vary in terms of who performs most of the X-ray exams. Some schools rely heavily on technologists, whereas some other schools use mostly senior dental students. Only two schools have dedicated faculty members responsible for the OMFR clinics, which indicates a need for more trained faculty members in the OMFR field.

2. *Staffing* In three of the seven schools no designated dentist controls the radiology clinic with the day-to-day management being performed by radiography technologists. In one school clinic, no radiology technologist is employed, and in the same school all the OMFR clinics are managed by junior dentists with less than 4 years of clinical experience.

Table 1 Survey results

Questionnaire number	School 1 (30 students per year)	School 2 (30)	School 3 (80)	School 4 (35)	School 5 (80)	School 6 (70)	School 7 (20)
(I) I 1.	2, 1, 3, 4	2, 1, 3, 5, 4	1, 2, 3, 4	1, 2, 3	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4, 5
I 2.	1	2, 1, 3, 4	1	1, 2, 3, 4	1	1	1, 2, 3
I 3.	3	3, 4, 2, 5, 1	3	1: single film 4: FM	5 consultation sheet	3	3, 4, 1
(II) II 1.							
1	2%	0%	5%	0%	5%	0%	1%
2	5%	1%	15%	0%	15%	0%	1%
3	10%	9%	75%	5%	40%	50%	9%
4	23%	0%	5%	0%	5%	0%	0%
5	60%	90%	0%	95%	40%	50%	89%
6	0%	0%	0%	0%	0%	0%	0%
II 2.							
1	1	0	0	0	0	0	0
2	2.5	3	0	1	2	1	2
3	5	0	2 (rotation residents)	1	6 (part time faculty)	0	0
II 3.							
1	9	4	2	2	7	2	2
2	3	1	1	1	3	1	1
3	2	1	1	1	3	1	1
4	3	3	1		2	1	2
5	2 tomographic units, digital	digital		digital	digital	digital	
(III) III 1.	2	2	1	2	2	2	2
III 2.	1, 2	1	1	2	1	1	1
III 3.	2	2	1	2	2	2	2
(IV) IV 1.	2 and perio, ortho	3 (perio, endo, os, ortho, pedo)	3 (omfr, endo, perio, os)	1	1 (some PA with chart)	1	1
IV 2.	1 (last 2 digits)	1 (in numerical order)	1 (last 2 digits)	1 (last 2 digits)	1 (last 2 digits)	1	1 (last 2 digits)
IV 3.	2	2	1, 2	2	1, 2	1	2
IV 4.	1, 2 (IMACS)	1, 2 (PACS for CT and MRI)	2	1	1	1	2 (verbal)
IV 5.	1, 2	1	2	1	1, 2	2	1, 2
IV 6.	2	1	1	1	1	1	1
IV 7.	1, 2	3 clinic assistant	2	1	2	2	1
IV 8.	1, 2	3	2	1	3, no	1	3 no
IV 9.	Yes	Yes	No	No	No	No	No
IV 10.	30%	20%	20%	10%	20%	10%	40%
IV 11.	70%	80%	70%	90%	70%	90%	50%

3. *Equipment* The number of intra-oral X-ray units varies from two to nine. Most school clinics have only one panoramic and one cephalometric unit. Only one school clinic has tomographic units. Digital devices are available in five schools.

III. Quality assurance

1. *Change of processing solutions* Most schools assign radiology technologists the task of changing the processing solutions. The same technologists are also responsible for QA.

2. *Period of change* In most cases, the processing solution is changed at fixed time intervals. Only two schools change the processing solution according to QA results.

3. *Who is responsible for QA* Radiology technologists are responsible for QA in most schools.

IV. Archiving images

1. *Where* There is no major consensus on whether the films are archived centrally or placed in different clinics. Respondents mention that Periodontics, Orthodontics, Endodontics, and Oral Surgery departments might store their own images.

2. *How* All schools archive the films on the basis of a chart number. Most schools use the last two digits of the chart number to archive the images, and one school archives the images in numerical order.

3. *Relationship with chart* Most schools put the patients' dental charts together with the rest of their medical records. This is natural because all dental schools were part of their respective medical colleges, and all except one dental clinic are part of a general hospital. Images are therefore placed apart from the whole medical record.

4. *Retrieval of images* Most schools use a memo slip as a record to retrieve the images. The OMFR Image Management and Communication System (IMACS) is available in one school.^{9,10} In one other school CT and MRI are retrieved via the PACS of the whole hospital.

5. *Who retrieves film* There is no consensus on who physically retrieves the images from the archive. The clinicians are responsible for doing this in some of the schools, while in other schools clerical personnel are responsible.

6. *Dedicated filing personnel* Most of the schools reported using dedicated personnel for the archiving of images.

7. *Returning the films* The schools are divided on who returns the films to storage. Almost half of the schools return the films by dedicated personnel, while the other schools do not have an active return mechanism.

8. *Delinquent return* Three of the seven schools do not have a delinquent return mechanism to retrieve the radiographs that fail to return. These schools also reported a higher estimated lost film rate (26.7%) than the other schools (17.5%).

9. *Use of computer for archiving* Only two schools use computers to handle image archiving. One of the two schools uses bar coding for film archiving control.

10. *Estimated rate of lost film* The estimated film loss rate averaged 21.4% and ranged between 10% to 40%. This demonstrates serious problems in image archiving.

11. *Satisfaction* Clinicians reported an average satisfaction rate of 74.3% with clinic management, and the level of satisfaction is not significantly related to the film-loss rate. The lowest level of satisfaction was 50%.

Discussion

1. Prescribing radiographical procedures

1. *Prescribing the examinations* For dental education purposes, the patients registered in dental school clinics should be selected on the basis of the appropriate difficulty of both the treatment plan and treatment itself. Therefore, a basic assessment clinic should be responsible for patient registration. The law in Taiwan

only allows licensed physicians and dentists to prescribe radiological examinations. Interns in dentistry are not licensed dentists. The attending dentists in this clinic should have chief responsibility for training interns how to prescribe radiological examinations. Interns should not be allowed to prescribe radiological examinations without supervision. Most school clinics do not have written guidelines for prescribing radiological examinations, which demonstrates a need not only for preparing such guidelines but also for promoting their use. The insurance reimbursement of radiological examinations is mainly based on the symptoms and signs. These reimbursement rules are believed to dictate the criteria for selection of radiological procedures. Unfortunately, these rules are not designed from the perspective of OMFR and are thus very different from the US FDA guidelines⁴ and FGDP guidelines.⁶ Although these guidelines might not be ideal for Taiwan, a standard-ized set of national guidelines is recommended.

2. *Performing radiological procedures* Although radiographical technologists can be responsible for some tasks in the OMFR clinics, they should not be responsible for all the OMFR duties. We recommended that at least one full-time dentist trained in the OMFR specialty be present in each dental school. The collected data demonstrates that graduates from some of the dental schools do not have proper training in performing the radiological procedures. There should be a recommendation at the national level on the minimum amount of OMFR procedures to be performed by dental students.

The number of OMFR technologists employed in each school might depend on the quantity of procedures performed. At least one technologist should be available for each clinic. As for the equipment, most schools should have more access to modalities besides the intra-oral, panoramic and cephalometric units. Equipment for tomographic procedures is recommended, based on the increasing number of dental implantations being performed.

3. *Quality assurance* Although all the school clinics have QA procedures, the protocols should be evaluated in a systematic manner. For instance, changing processing solutions in the darkroom is one of the most basic QA procedures, but most schools do it only according to a fixed time interval. Ideally objective sensitometric and densitometric methods should be employed. The fixed-interval QA schedule does not ensure image quality on a daily basis.

4. *Archiving of images* Where and how to archive the images depends on the preference of each school and most images are not conveniently filed with the charts.

Managing and archiving images is labor intensive. Computers are expected to significantly reduce the chance of error and the amount of labor, but at the present time, computers are being used for this purpose

in only two schools, and IMACS is available in only one school. Therefore, we would promote the use of computers for managing and archiving images through the continuing education courses of the Association.

The reported film loss rate, as high as 40% in one school, indicates that a significant percentage of images are found missing when they are needed, which may lead to serious litigation problems. The reason for such high film-loss rates are probably the lack of dedicated personnel or any kind of delinquent return mechanism.

In conclusion the quality of care in an OMFR clinic is not limited to radiological interpretation and diagnosis but is also strongly related to other managerial aspects of the clinics. Based upon the survey

findings, we recommend prescriptions for OMFR examination be supervised by licensed clinicians, and there is a need for guidelines. Trained and dedicated personnel should be assigned for the management of OMFR clinics. More quality assurance procedures should be performed. IMACS or at least a computer should be employed to archive images. It is not uncommon to find that the dental school administrators are under severe strain because they have only limited information on dental school administration and few successful management models. Therefore, this study reveals how OMFR clinics are managed in all the dental schools and recommends appropriate changes.

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Appendix

Survey on management of oral radiology clinics

Name of school

Name of clinic

Name of person who completed the questionnaire

I. Prescribing the examination (check all possible answers and prioritize)

I1. Who is most responsible for prescribing the radiological examinations?

- 1 Visiting staff of the basic assessment clinics
- 2 Visiting staff of the specialty clinics
- 3 Resident dentist
- 4 Intern
- 5 Other

I2. Is there a guideline for prescribing radiological examinations?

- 1 No general guideline
- 2 Follow the guideline of the department
- 3 Follow the guideline of the school
- 4 Others

I3. How is the order delivered to the personnel performing the exam?

- 1 Verbal
- 2 Chart
- 3 Ordering sheet, used as a record
- 4 Ordering sheet, not used as a record
- 5 Other

II. Performing the examination

II1. Who performs the radiographic procedures?

- 1 Visiting staff (%)
- 2 Resident dentist (%)
- 3 Intern (%)
- 4 Fifth year dental student (%)
- 5 Radiology technologist (%)
- 6 Other (%)

II2. Personnel (Full time)

- Dentists
Radiology technologists
Other

II3. Radiology equipment

- 1 Intraoral X-ray unit
- 2 Panoramic X-ray unit

- 3 Cephalometric X-ray unit
- 4 Automatic film processor
- 5 Others

III. Quality assurance

III1. Who is responsible for changing processing chemicals?

- 1 Dentist
- 2 Radiology technologist
- 3 Other personnel

III2. When are the processing chemicals changed?

- 1 Fixed intervals
- 2 According to QA results
- 3 Other

III3. Who is responsible for QA in the dark rooms?

- 1 Dedicated dentist
- 2 Dedicated radiology technologist
- 3 Dedicated other personnel
- 4 No dedicated personnel
- 5 No routine QA

IV. Archiving of images

IV1. Archiving of images:

- 1 Centralized, only one place
- 2 Centralized, more than one place
- 3 Distributed

IV2. How are the images filed?

- 1 According to chart number
- 2 According to ID number
- 3 According to name of the patient
- 4 According to image type
- 5 Other

IV3. Are the images filed together with charts?

- 1 Yes
- 2 No

IV4. How are images retrieved?

- 1 With a request sheet
- 2 Other

IV5. Who retrieves the images?

- 1 Dedicated personnel
- 2 Dentist

IV6. Are there dedicated personnel for filing images?

- 1 Yes
- 2 No

IV7. Who reviews the images?

- 1 Dedicated personnel
- 2 Clinicians

IV8. Are there dedicated personnel to handle delinquent return of images?

- 1 Yes
- 2 No

IV9. Are computers used to file the images?

- 1 Yes
- 2 No

IV10. Estimated rate of missing film:

10% 20% 30% 40% 50% 60% 70%

IV11. Satisfaction with current management:

0–100%