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內文：

Introduction

- Autotransplantation:

1. aviable method for replacing teeth lost due to trauma,
2. particularly when the patient requires orthodontic treatment involving the extraction of immature premolars

- Success:

1. a standardized surgical technique under aseptic conditions
2. its degree of root development,
3. preparation of the recipient alveolus,

- pre-autotransplantation examination: intra-oral periapical radiographs (Andreasen et al.1990a)

1. the donor germ → degree of root development
2. the recipient area→ good bone support

- where a root development of 1/2 to 3/4 (between 7 and 9 mm long, with a wide open foramen) resulted in a success rate of 89.5%
- few studies have monitored pulp and periodontal healing in autotransplants for a follow-up observation period of more than 10 years

Methods

Study sample

- 12 patients (seven girls and five boys)
- 12 premolars autotransplanted to the maxillary central incisor following traumatic loss of a central incisor

Table 1 Autotransplant root development, pulp and periodontal healing follow-up

Patient No (ys)	Root stage	Pulp sensibility (+–)/Periodontal healing (+–)/Root development (mm)				
		Initial	6 mth	1 ys	10 ys	14 ys
1 (11 ys)	1/2 R	$+^{a}/+^{b}/15.5^{c}$	$+^{a}/+^{b}/16.7^{c}$	$+^{a}/+^{b}/17.2^{c}$	$-^{a}/+^{b}/21^{c}$	–
2 (11 ys)	3/4 R	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.5^{c}$	$-^{a}/+^{b}/20^{c}$	$-^{a}/+^{b}/21.5^{c}$	$-^{a}/+^{b}/21.5^{c}$
3 (10 ys)	3/4 R	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.5^{c}$	$-^{a}/+^{b}/20^{c}$	$-^{a}/+^{b}/20.5^{c}$	–
4 (11 ys)	3/4 R	$-^{a}/+^{b}/19.5^{c}$	$-^{a}/+^{b}/20^{c}$	$-^{a}/+^{b}/20.5^{c}$	–	–
5 (11 ys)	3/4 R	$-^{a}/+^{b}/18.5^{c}$	$-^{a}/+^{b}/19.3^{c}$	$-^{a}/+^{b}/20^{c}$	$-^{a}/+^{b}/22^{c}$	$-^{a}/+^{b}/22^{c}$
6 (13 ys)	R c	$-^{a}/+^{b}/20^{c}$	$-^{a}/SR^{b}/20.5^{c}$	$-^{a}/+^{b}/20.5^{c}$	$-^{a}/+^{b}/21^{c}$	$-^{a}/+^{b}/21^{c}$
7 (9 ys)	1/2 R	$-^{a}/+^{b}/18.5^{c}$	$+^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/20^{c}$	$-^{a}/+^{b}/21.5^{c}$	$-^{a}/+^{b}/21.5^{c}$
8 (10 ys)	3/4 R	$-^{a}/+^{b}/19^{c}$	$+^{a}/+^{b}/20^{c}$	$-^{a}/+^{b}/21^{c}$	$-^{a}/+^{b}/22^{c}$	$-^{a}/+^{b}/22^{c}$
9 (9 ys)	1/2 R	$-^{a}/+^{b}/18^{c}$	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.6^{c}$	$-^{a}/+^{b}/21.5^{c}$	$-^{a}/+^{b}/21.5^{c}$
10 (10 ys)	3/4 R	$-^{a}/+^{b}/18.5^{c}$	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.5^{c}$	$-^{a}/+^{b}/20.5^{c}$	$-^{a}/+^{b}/20.5^{c}$
11 (10 ys)	3/4 R	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.5^{c}$	$-^{a}/+^{b}/20^{c}$	$-^{a}/IR^{b}/21^{c}$	–
12 (10 ys)	1/2 R	$-^{a}/+^{b}/18^{c}$	$+^{a}/+^{b}/18.5^{c}$	$-^{a}/+^{b}/19.8^{c}$	$-^{a}/+^{b}/22.5^{c}$	–

[a]: autotransplant pulp sensibility *(+–)*; [b]: adequate (+) *or* inadequate (–) autotransplant periodontal healing; [c]: autotransplant root development *(mm);* wk, weeks; mth, months; ys, years; Rc, root length complete and open apex; 3/4 R, root length %; 1/2 R, root length V2; SR, surface resorption; IR, inflammatory resorption and extraction.

Surgical protocol

1. performed under sedation, supplemented with nitrous oxide analgesia.
2. penicillin for 4 days, the first dose being administered by the intramuscular route 1 h before the intervention.
3. performed in the first 15 days following loss of maxillary incisors
4. A mucoperiosteal flap was raised in the area to expose the alveolar bone
5. alveolar bed for the autologous tooth was prepared using a contra-angle handpiece at 1000–10 000 rpm, with a bone drill and under saline irrigation
6. 2 mm deeper, 1 mm wider
7. plugged with gauze
8. Donor tooth: incision around →luxating it with diamond forceps(mainly rotatory movements)→inserted into the prepared alveolar bony crypt(infra-occlusion.)→sutured in place with triple-zero suture silk
9. Six months after transplantation, all patients received orthodontic treatment

Post-surgical follow-up protocol

- Six months after transplantation: orthodontic treatment
- Post-surgical follow-up (10–14 years) :started 1 week after the intervention, when the first radiographic check-up was performed and the two sutures removed.
- From then on, postoperative monitoring for potential pulp necrosis or root resorption involved successive clinical and radiographic examinations conducted after 3 weeks, 3 and 6 months and then periodically up to 14 years.

Clinical parameters

- Pulp sensibility testing: pulp tester, scale was graduated from 0 to 10, triplicate

- Periodontal healing and colour parameters

1. tooth mobility: scale of 0–4(0: physiological tooth mobility; 1: abnormal horizontal mobility of less than 1 mm; 2: abnormal horizontal mobility of more than 1 mm; 3: abnormal horizontal and axial mobility; 4: no mobility).
2. probing pocket depth: six sites(Pockets more than 3 mm deep at any one site were considered pathological)
3. percussion sound: diagnose potential ankylosis(A high-pitched percussion sound compared to the contralateral tooth was rated positive for ankylosis.)
4. colour: scale of 0–2 (0: normal crown colour; 1:minor discolouration [light yellow]; 2: major discolouration [dark yellow])

- Radiographic parameters: 70 kV, 7 mA and 0.16 s(Dentsply Rinn's XCP Instrumentation Kit, Elgin, USA)

Results

Pulp sensibility

Periodontal healing and root resorption:

- stable and satisfactory for the first 6 years.
- The highest success rate occurred in teeth transplanted at stage 3 of root development Autotransplant root development
- The two transplants that suffered inflammatory resorption were performed at stage 4
- secondary discolouration was noted in most of the autotransplants.

Autotransplant root development

- Progressive root growth was observed in all transplanted teeth

Pulp healing

- progressive pulp obliteration was seen in every case where pulp revascularization occurred, and from year 2 onwards, in only the two teeth transplanted at stage 3 (28.75%), was obliteration of the apical third of the root canal not observed

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3 (10 ys)	3/4 R	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.5^{c}$	$-^{a}/+^{b}/20^{c}$	$-^{a}/+^{b}/20.5^{c}$	–
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9 (9 ys)	1/2 R	$-^{a}/+^{b}/18^{c}$	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.6^{c}$	$-^{a}/+^{b}/21.5^{c}$	$-^{a}/+^{b}/21.5^{c}$
10 (10 ys)	3/4 R	$-^{a}/+^{b}/18.5^{c}$	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.5^{c}$	$-^{a}/+^{b}/20.5^{c}$	$-^{a}/+^{b}/20.5^{c}$
11 (10 ys)	3/4 R	$-^{a}/+^{b}/19^{c}$	$-^{a}/+^{b}/19.5^{c}$	$-^{a}/+^{b}/20^{c}$	$-^{a}/IR^{b}/21^{c}$	–
12 (10 ys)	1/2 R	$-^{a}/+^{b}/18^{c}$	$+^{a}/+^{b}/18.5^{c}$	$-^{a}/+^{b}/19.8^{c}$	$-^{a}/+^{b}/22.5^{c}$	–

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Table 2 Autotransplant tissue pulp reaction follow-up

Root stage	Autotransplants	Pulp reactions (% cases)				
		6 mth (%)	1 ys (%)	2 ys (%)	6 ys (%)	10 ys (%)
1/2 R	4	ChO (100)	1/3O (100)	2/3O(100)	T (100)	T (100)
3/4 R	7	ChO (100)	1/3O (100)	2/3O (71.4)	T (71.4)	T (71.4)
				1/3O (28.6)	N (14.3)	N (28.6)
					1/3O (14.3)	
R c	1	ChO (100)	1/3O (100)	2/3O (100)	T (100)	T (100)

ChO, pulp cavity obliteration; 1/3O, 1/3 radicular pulp obliteration; 2/3O, 2/3 radicular pulp obliteration; N, pulp necrosis; T, total pulp obliteration.

Discussion

1. increasing root development is followed by a progressive decrease in electrometric sensibility levels(Andreasen et al.1990)
2. compared with the one that remained in the same quadrant, root growth similar to that of the non-transplanted premolar (Czochrowska et al. 2002)
3. arrested root growth in 19% of cases in a longitudinal radiographic study of 118 autotransplants. (Paulsen & Andreasen 1998)
4. the best success rate :donor teeth→ 1/2 to 3/4 stage of root development (Andreasen et al. 1990b,c, Czochrowska et al. 2000, Kallu et al. 2005).
5. total pulp obliteration was observed in all transplants carried out at Moorrees' stage 3, which is at 1/2root development.
6. It is generally agreed that progressive pulp obliteration = success
7. no relationship between discolouration and autotransplant success.
8. it is not clear why pulp necrosis or inflammatory resorption occurred many years after normal healing.
9. Bacterial products→dentinal tubule, causing inflammatory changes for years (Love 2002)
10. the bacterial infection of dentinal tubules: lesser in older patients, possibly because of increased tubular constriction (Kakoli et al. 2009).
11. resorption can only be detected if more than 10–20% of the root surface is involved (Andersson et al. 1984)
12. success rate: approximately 80% (Czochrowska et al. 2000, Tsukiboshi 2002, Jonsson & Sigurdsson 2004, Kallu et al. 2005, Andreasen et al. 2009)
13. The results showed overall success rates of 83% for pulp and periodontal healing after 10 years and of 80% after 14 years

Conclusions

- Autotransplantion: as a suitable longterm treatment option for replacing lost teeth, provided that the intervention is performed with a partially developed root (Moorrees' stage 3 or 4)
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題號	題目
1	有關牙體再植術何者正確? (A) 牙根尖已成熟的牙齒完成再植術後應在兩周後開始進行根管治療 (B) 開放性根尖孔的牙齒應在術後兩周之內進行根管治療 (C) 牙根尖已成熟的牙齒,可在手術時順便完成根管治療 (D) 開放性根尖孔的牙齒大都沒有機會可以產生血管再形成
答案(A)	出處：當代口腔顎面外科學 p.654
題號	題目

2	重新植入的牙齒（牙根未成熟），須多久的固定時間？ (A) 48～72小時 (B) 7～10天 (C) 3～4週 (D) 2～3個月
答案(C)	出處：當代口腔顎面外科學 p.645