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An investigation into dentists' management methods of dental trauma to maxillary permanent incisors in Victoria, Australia

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Abstract – Trauma to anterior teeth in children could become a long-term problem to dental health. To a large extent, the management actions of the dentists involved will determine the clinical outcome and, in turn, these actions will be related to their levels of knowledge. The aim of this study was to investigate dentists' knowledge of managing traumatic injuries to maxillary permanent incisors in children. A self-completion questionnaire containing 19 questions on management methods of treating dental trauma was mailed to 693 dentists in Victoria, Australia. The response rate achieved was 61%. This survey found that some of the respondents had adequate management knowledge for the different types of traumatic injuries, while others did not have the correct information. Approximately half the dentists considered milk as the preferred extraoral storage medium of choice for avulsed teeth and a period of 7–10 days splinting after replantation. A large proportion of dentists showed inadequate knowledge with regard to understanding the biological mechanisms causing replacement root resorption (61%) and external inflammatory root resorption (74%). Overall, the respondents to this survey demonstrated only a moderate level of knowledge in management of traumatic injuries to maxillary permanent incisors in children. Continuing professional development programmes may be a means of improving this deficient knowledge base.

Epidemiological studies have demonstrated that approximately 50% of school children have suffered trauma to their permanent teeth prior to leaving school (1). One Australia-wide study attempted to analyze all trauma patients that presented to members of the Australian Society of Endodontology over a 2-year period (2). The limited number of trauma cases reported in that study (313 patients over 2 years), could indicate that participation by dentists was low, or that many patients or parents did not seek dental treatment after minor trauma, or that the true incidence of dental trauma is low in Australia (3). The prevalence of dental trauma in Australia has been reported to be around 6% (4), and the dental trauma incidence to the anterior permanent teeth in 6- to 12-year-old children was 1.7 patients per 100 children per year, while involving 2.1 teeth per 100 children per year (5). Consequently, the limited number of new dental trauma cases per year may not provide sufficient experience for dentists to develop and maintain their clinical skills and knowledge (6).

Furthermore, generally very little research has been conducted on dentists' knowledge of trauma management (7). The study by Kostopoulou et al. (8) showed that dentists' overall knowledge of managing dentoalveolar trauma was inadequate. This confirmed the findings of Hamilton et al. (9), demonstrating that dentists in the primary care sector had insufficient knowledge to treat dental trauma. The emergency treatment, repair and maintenance of traumatized anterior permanent teeth require good clinical skills, adequate diagnostic knowledge of the problem, excellent emergency management and long-term follow-up. A recent study indicated that the main barrier to treatment of dental trauma in Victoria, Australia was an uncooperative child but other possible barriers involved the factors of time, costs, management, patient and/or parents (10). Any strategy that attempts to improve the care of dentally injured patients in the primary care sector should address the issue of the dentists' knowledge base of management of dental trauma (9).

The aim of this study was to investigate dentists' knowledge of managing traumatic injuries to permanent maxillary incisors in children in the age group of 6–16 years of age, which may influence the standard of care provided by dentists.

Materials and methods

The details of the questionnaire have been reported elsewhere (10). The criteria for inclusion included currently practising general dentists in the state of Victoria and who were registered with the Victorian Dental Practice Board. Ethics approval from The University of Melbourne Ethics Committee was obtained

prior to pre-pilot, pilot and mailing of the postal survey questionnaires. A simple letter using the University of Melbourne letterhead was used, and the importance and confidentiality of the study were emphasized. In order to maximize the response rate, a three-stage mailing process was employed. The sample size required for this study was calculated to be 693 general dentists (11). Stratification of the sampling frame was carried out to differentiate between metropolitan and rural areas using postcode zones from Australia Post (12). Within each stratum, systematic sampling was carried out and every third dentist on the sampling list was selected. The questionnaire was subjected to a pre-pilot survey and pilot survey of dentists in Victoria.

The questionnaire consisted of a series of statements using a six-point Likert scale graded from 'always', 'very often', 'often', 'sometimes', 'almost never' to 'never'. The original questionnaire comprised three sections: section A on demographic information, section B on perceived barriers to treating dental trauma and section C on management methods of dental trauma. The survey findings on the demographic information about the dentists and perceived barriers to treating dental trauma have been reported separately (10). Two further closed-ended questions asked preference of extra-alveolar storage medium, and splinting period for avulsed teeth. The findings of the 19 questions in total relating to the management methods of dental trauma are reported in this paper.

The data from the questionnaires were entered into Microsoft® Excel spreadsheets. The variables assessed were categorical and their analysis was carried out using the chi-squared (χ^2), Fisher's exact and Gamma tests for each question. A level of $P < 0.05$ was accepted as statistically significant. For the Likert scale analysis, the responses were also dichotomized into 'higher' (always, very often, often) and 'lower' (sometimes, almost never, never) categories.

Results

Management methods of dental trauma

The response rate achieved was 61% (371 usable responses from 605 eligible respondents). The data collected are presented in Table 1. This table contains the total number or frequency of each possible response for metropolitan and rural combined. In the cross-tabulation results for location (metropolitan *or* rural), the only significant differences between the responses were as follows.

For Question 28, significantly more rural dentists (89.2%) chose the 'lower' categories when compared with metropolitan dentists (78.1%) (Fisher's exact test, $P = 0.03$). For Question 31, significantly more rural dentists (59.0%) chose the 'lower' categories, compared with metropolitan dentists (44.8%) (Fisher's exact test, $P = 0.02$).

When the combined metropolitan *and* rural data were dichotomized into 'more frequent' (higher categories) and 'less frequent' (lower categories), significantly more dentists responded with 'more frequent' to Question 27 (59.1%) than to Question 28 (19.4%) (Fisher's exact test, $P < 0.001$). In addition, significantly more dentists responded with 'more frequent' to Question 30 (71.3%) than to Question 31 (52%) (Fisher's exact test, $P < 0.001$).

A large proportion of respondents (46%) indicated that milk was the preferred extra-alveolar storage medium for avulsed teeth and no dentists in this survey would consider using tap water (Table 2). There were no significant differences between metropolitan and rural dentists concerning their choice of storage medium.

Most respondents (52.5%) believed that the appropriate duration of splinting for a reimplanted permanent incisor to be 7–10 days. Only a small percentage of dentists (4%) would consider splinting for more than 30 days, and the range was 5–8 weeks (Table 3). Significantly more metropolitan dentists than rural dentists would splint for shorter periods: less than 7 days ($\chi^2 = 5.5$, 1 DF, $P = 0.02$), or 7–10 days ($\chi^2 = 4.73$, 1 DF, $P = 0.03$).

Discussion

The knowledge questions in this questionnaire survey pertained to treatment methods of dental trauma, covering some of the more common trauma entities. Only certain clinical trauma scenarios were considered because of the very many variations possible with individual cases of trauma. Furthermore, in the pre-pilot and pilot questionnaires, more involved and detailed questions were perceived by the respondents to be reminiscent of an examination, and they consequently were less likely to want to complete the questionnaire. Importantly, it is possible that some of the questions in the survey may have been worded in a manner that may have biased the responses. However, the pre-pilot and pilot studies conducted would have considerably reduced the chance of questionnaire bias.

Complicated crown fractured incisors

Complicated crown fracture is a fracture involving enamel, dentine and exposure of the pulp (13). If the pulpal exposure is small and treated within 24 h, direct pulp capping may be applicable. If the area of pulpal exposure is large with bacterial contamination, and exposed to the environment for over 24 h, then a partial pulpotomy is usually indicated (14). The decision to perform endodontic treatment may, to a certain extent, depend on the stage of tooth development, and is the treatment of choice for complicated crown fractures of mature teeth (15). When asked the preferred treatment option for a complicated crown fracture, 38% of dentists more frequently preferred partial pulpotomy, 48% of dentists more frequently preferred direct pulp capping and 54% of dentists more frequently believed the need for endodontic treatment was dictated by the size of the pulp exposure. The findings suggested that most dentists (86%) were more likely to attempt vital pulp therapy for complicated crown fractures compared to performing pulpectomy. In comparison, Kostopoulou et al. (8) reported that 93% of general dental practitioners (GDPs)

Table 1. Management methods of dental trauma – response details

Questions		Always	Very often	Often	Sometimes	Almost never	Never	Total
1. Direct pulp capping is the preferred treatment option for a complicated crown fracture (with pulp exposure).	N	15	83	81	145	34	13	371
	%	4.0	22.4	21.8	39.1	9.2	3.5	100.0
2. Partial pulpotomy is the preferred treatment option for a complicated crown fracture (with pulp exposure).	N	17	67	56	173	53	5	371
	%	4.6	18.1	15.1	46.6	14.3	1.3	100.0
3. For crown fractured teeth, the need for endodontic treatment is dictated by the size of the traumatic pulp exposure.	N	31	80	88	120	45	7	371
	%	8.4	21.6	23.7	32.3	12.1	1.9	100.0
4. For lateral or extrusive luxation injuries, the decision on whether to progress to endodontic treatment primarily depends on radiographic signs.	N	6	51	55	155	86	18	371
	%	1.6	13.7	14.8	41.8	23.2	4.9	100.0
5. For lateral or extrusive luxation injuries, the decision on whether to progress to endodontic treatment primarily depends on the response to pulp tests.	N	24	90	59	106	74	18	371
	%	6.5	24.3	15.9	28.6	19.9	4.9	100.0
6. For intrusive injuries (with open apex), the tooth will re-erupt spontaneously.	N	8	108	103	126	25	1	371
	%	2.2	29.1	27.8	34.0	6.7	0.3	100.0
7. A better alternative for intrusive luxation (with open apex) is to reposition the tooth using forceps.	N	10	30	32	89	132	78	371
	%	2.7	8.1	8.6	24.0	35.6	21.0	100.0
8. For intrusive injuries (with closed apex), spontaneous re-eruption is unlikely.	N	37	88	83	105	48	9	370
	%	10.0	23.8	22.4	28.4	13.0	2.4	100.0
9. Replantation of an avulsed tooth preferably should be managed at the site of injury.	N	125	93	45	69	29	8	369
	%	33.9	25.2	12.2	18.7	7.9	2.2	100.0
10. Replantation of an avulsed tooth preferably should be managed at the dental office.	N	36	82	75	129	36	13	371
	%	9.7	22.1	20.2	34.8	9.7	3.5	100.0
11. Pulp necrosis of the avulsed tooth can lead to replacement resorption.	N	10	115	99	104	31	10	369
	%	2.7	31.2	26.8	28.2	8.4	2.7	100.0
12. If an avulsed tooth is diagnosed with pulp necrosis, the root canal should be initially medicated with calcium hydroxide rather than Ledermix paste.	N	78	77	47	67	60	42	371
	%	21.0	20.8	12.7	18.1	16.2	11.3	100.0
13. Inflammatory root resorption of an avulsed tooth primarily depends on the viability of the periodontal ligament cells.	N	75	116	82	55	31	12	371
	%	20.2	31.3	22.0	14.8	8.4	3.2	100.0
14. Apical third horizontal root fractures, in the absence of concomitant periodontal ligament injury, do not require splinting.	N	49	129	59	75	42	17	371
	%	13.2	34.8	15.9	20.2	11.3	4.6	100.0
15. Middle and coronal third root fractures must be splinted to ensure the long-term stability and prognosis of the tooth.	N	117	121	67	48	12	5	370
	%	31.6	32.7	18.1	13.0	3.2	1.4	100.0
16. Teeth with horizontal root fractures will always require endodontic treatment.	N	32	54	74	184	21	6	371
	%	8.6	14.6	19.9	49.6	5.7	1.6	100.0
17. In horizontal root fractures, any endodontic treatment is carried out to both coronal and apical fragments.	N	22	27	35	93	117	77	371
	%	5.9	7.3	9.4	25.1	31.5	20.8	100.0

Table 2. Extra-alveolar storage media reported by respondents for avulsed permanent maxillary incisors

	Total	Rural dentists	Metropolitan dentists
	n (%)	*n* (%)	*n* (%)
Milk	171 (46)	43 (25)	128 (75)
Child mouth/saliva	106 (29)	18 (17)	88 (83)
Saline	70 (19)	16 (23)	54 (77)
Glad wrap (polyethylene film)	12 (3)	0 (0)	12 (100)
Hanks Balanced Salt Solution	12 (3)	3 (25)	9 (75)
Tap water	0 (0)	0 (0)	0 (0)
Total	371 (100)	80 (21.5)	291 (78.5)

Table 3. Duration for splinting reported by respondents of avulsed permanent maxillary incisors in the age group of 6–16 years of age

	Total	Rural dentists	Metropolitan dentists
	n (%)	*n* (%)	*n* (%)
7–10 days	195 (52.5)	52 (27)	143 (73)
11–20 days	67 (18)	17 (25)	50 (75)
21–30 days	55 (14.5)	10 (18)	45 (82)
<7 days	33 (8.5)	2 (6)	31 (94)
5–8 weeks	14 (4)	0 (0)	14 (100)
Should not splint	7 (2.5)	1 (14)	6 (86)
Total	371 (100)	82 (22)	289 (78)

and 69% of community dental officers (CDOs) would carry out direct pulp capping for recent, minimal exposure on teeth with an open apex, whereas, 78% of dentists (GDPs and CDOs) would perform pulpotomy for old, large exposures with an open apex. For teeth presenting with old, large exposures and closed apices, 81% of respondents would perform root canal treatment.

Extrusive and lateral luxation injuries

Both extrusive and lateral luxation generally damage both the pulp and the periodontal ligament (PDL), and optimal repositioning of the tooth subsequent to trauma is important for PDL healing and pulpal revascularization (16). In this survey, 30% of dentists were more likely to progress with endodontic treatment based on radiographic signs, and 47% of dentists would more frequently base their decision on the response to pulp tests for extrusive and lateral luxation injuries. However, a negative response to pulp testing soon after luxation injuries may not necessarily signify a necrotic pulp, but rather a disruption of the blood supply to the tooth (13) and the presence of a radiolucency around the root may not necessarily represent apical periodontitis due to an infected root canal system but rather a transient apical breakdown, resulting in a loss of marginal bone support seen radiographically (17). It would seem reasonable to suggest that observation for an extended period of time of these luxation injuries should include, but not be solely based on, both radiographic examination and pulp sensibility testing in order to diagnose healing complications such as pulp necrosis (PN) or pulp canal obliteration (PCO) (13). However, in order to prevent non-response due to question complexity, this questionnaire survey did not specify whether the extruded or lateral luxated teeth were open or closed at the apex and this may influence the dentist's treatment of choice.

Intrusive luxation injury

Intrusive luxation occurs when the tooth is forced into the socket and locked in position in bone (13), and is considered to be the most serious form of luxation injury (14). Dentists were significantly more likely to wait for spontaneous re-eruption of intruded teeth with open apices than to reposition them with forceps ($P < 0.001$). This finding is in agreement with Andreasen et al. (18) who reported that active repositioning of teeth with incomplete root formation had a negative effect upon healing.

For teeth presenting with closed apices, 56% of dentists agreed that an intruded tooth is unlikely to re-erupt spontaneously, suggesting they would consider active repositioning of the tooth. The remaining 44% of dentists disagreed with this statement and presumably would prefer to wait and monitor this type of injury. This is surprising considering there is a high frequency of PN, and the stage of root development at the time of injury appears to be the significant prognostic factor (19). However, the question did not specify a time frame, so it is possible that an observation period may only be brief. Again, in the interests of keeping the survey simple, more detailed questions were avoided.

Avulsion injuries

Avulsion occurs when the tooth is displaced totally out of its socket and clinically, the socket is found to be empty or filled with coagulum (13). Dentists agreed significantly more to replantation of the avulsed tooth at the site of the injury rather than the dental office ($P < 0.001$). This indicates that the majority of dentists believe that immediate replantation is better for avulsed teeth when compared with delayed replantation of the tooth. The time factor is critical for optimal healing (ranging from 5 to 20 min dry storage), and an immediate replantation approach is indicated at the scene of the injury (20). Essentially, the shorter the time the tooth is out of its socket, the better the prognosis (16). However, almost half the respondents felt that replantation would be best done in the dental office. Specific reasons were not sought in this survey but it could be due to the possibility of incorrectly replanting of the tooth by non-dentally trained individuals, who are generally poorly educated in the correct emergency management of avulsed teeth (21).

It has been suggested in certain trauma management guidelines (13, 16, 22), that calcium hydroxide paste ($Ca(OH)_2$) should be placed into the root canal as the first intracanal medicament after 7–10 days of splinting, whereas others advocate the use of Ledermix paste (23). More than half the respondents (55%) more frequently medicated the root canal of an avulsed tooth with calcium hydroxide paste, although 45% of dentists would use Ledermix paste (Lederle Pharmaceuticals, Wolfratshausen, Germany). The relative merits of both are equivocal (24) and this was demonstrated in the finding that the number of dentists using either calcium hydroxide or Ledermix paste was similar.

A large proportion of dentists showed inadequate knowledge with regards to the biological mechanisms causing replacement root resorption (RRR) and external inflammatory root resorption (IRR). This was demonstrated by the finding that some 61% of dentists more frequently agreed that pulp necrosis can lead to RRR (which actually primarily depends on the viability of the periodontal ligament cells). Furthermore, 74% of dentists more frequently agreed that IRR depended on the viability of the periodontal ligament cells, which actually primarily depends on infection of the root canal system (21).

Extra-alveolar storage media for avulsed teeth

The stage of root development at the time of injury, the duration of the extra-alveolar time and the storage medium are significant prognostic factors in reimplantation of an avulsed tooth (19). When asked which extra-alveolar storage medium is appropriate for permanent avulsed incisors (Table 2), the first choice was milk (46% of dentists). The respondents in this survey recorded a lower percentage to using milk in comparison to previous studies that have demonstrated some 60–99% of dentists knew that the best storage medium for the avulsed tooth was milk (8, 9, 25). Overall, 75% of respondents in this survey would either use milk or saliva as a storage medium and this demonstrates adequate management knowledge by dentists in handling avulsion injuries. A positive finding from this study is that no respondents considered using tap water, which is recognized as being an unsuitable storage medium (21). Only a few respondents in this study would choose Hank's Balanced Salt Solution as an appropriate storage media. Although this

specialized storage medium may be able to sustain the viability of PDL cells for a longer period of time than milk, it is not practical because it is unlikely to be easily obtained at the site of dental injury (21).

Splinting period for avulsed teeth

Flexible splinting presently is assumed to assist periodontal healing, but this effect is unproved (13). A flexible splint should be placed to allow the replanted tooth some physiological and functional movements (16). More than half the dentists (52.5%) in this study would splint for 7–10 days (Table 3). This is a higher percentage than previous studies that reported only 20–30% (8, 9). In addition, significantly more metropolitan dentists than rural dentists would splint for shorter periods, i.e. up to 10 days. This finding may indicate a deficiency in the diffusion and dissemination of trauma knowledge in rural areas, where access to continuing education programmes is more limited (26).

Horizontal root fracture

Horizontal root fractures involve dentine, cementum and the pulp, and they can be further classified according to the displacement of the coronal fragment (13). This present survey found that 64% of dentists more frequently agreed that apical third horizontal root fractures, in the absence of concomitant PDL injury, do not require splinting. This is supported by the literature (27). The vast majority (82%) of dentists more frequently believed that middle and coronal third root fractures must be splinted to ensure the long-term stability and good prognosis for the tooth. This was again supported by the literature which indicates that horizontal root fractures should be splinted for a period of 3–4 weeks (22), and the prognosis is improved with quick treatment and close reduction of the root segments (15).

A large proportion of the respondents (45%) more frequently agreed that teeth with horizontal root fractures would always require endodontic treatment. This is a surprising finding because Andreasen et al. (28), in a retrospective study of 400 root fractures demonstrated a good prognosis for mid root fractures, with the overall healing rate reported to be around 80%, and 30% of these cases healed with hard tissue formation between the fractured segments. However, approximately 80% of dentists would only perform root canal treatment of the coronal fragment. This is a positive finding because the chance of disrupting the apical pulpal circulation is minimal (15). Cvek et al. (29) concluded that at present, root canal treatment of only the coronal fragment with calcium hydroxide dressing followed by root canal filling appears to be the treatment of choice, and obturating both the coronal and apical fragments will result in failure.

Conclusion

This survey has demonstrated deficiencies in the knowledge base of dentists in the management of dental trauma. This included aspects of the biological basis of the consequences of trauma. Therefore, based on the results of this survey, a significant expansion in undergraduate and postgraduate education in dental traumatology is needed. With only a limited number of new dental traumatic injuries occurring annually, dentists may not be competent in providing appropriate care. Thus, continuing dental education will be of benefit to dentists in keeping current with the theoretical and management issues concerning dental traumatology.

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References

1. Andreasen AF. Dental trauma: quo vadis. Endod Dent Traumatol 1989;6:78–90.
2. Davis GT, Knott SC. Dental trauma in Australia. Aust Dent J 1984;29:217–21.
3. Bastone EB, Freer TJ, McNamara JR. Epidemiology of dental trauma: a review of the literature. Aust Dent J 2000;45:2–9.
4. Burton PL, Rob M, Lawson JS. Traumatized anterior teeth amongst high school students in northern Sydney. Aust Dent J 1985;30:346–8.
5. Stockwell A. Incidence of dental trauma in the Western Australian School Dental Service. Community Dent Oral Epidemiol 1988;16:294–8.
6. Jackson NG, Waterhouse PJ, Maguire A. Management of dental trauma in primary care: a postal survey of general dental practitioners. Br Dent J 2005;198:293–7.
7. Yeng T, Parashos P. Dentists' management of dental injuries and dental trauma in Australia: a review. Dent Traumatol 2008 (in press).
8. Kostopoulou MN, Duggal MS. A study into dentists' knowledge of the treatment of traumatic injuries to young permanent incisors. Int J Paediatr Dent 2005;15:10–19.
9. Hamilton FA, Hill FJ, Holloway PJ. An investigation of dento-alveolar trauma and its treatment in an adolescent population. Part 2: dentists' knowledge of management methods and their perceptions of barriers to providing care. Br Dent J 1997; 182:129–33.
10. Yeng T, Parashos P. An investigation into dentists' perceptions of barriers to providing care of dental trauma to permanent maxillary incisors in children in Victoria, Australia. Aust Dent J 2007;52:210–5.
11. Dillman D. Elements of the tailored design method. In: Dillman DA, editor. Mail and internet surveys. The tailored design. New York, USA: John Wiley and Sons Inc; 2000. p. 203–13.
12. Australia Post. Post charges, September. Australia 2004.
13. Andreasen JO, Andreasen FM, Bakland LK, Flores MT. Traumatic dental injuries, a manual, 2nd edn. Oxford, UK: Blackwell Publishing Company; 2003. p. 12–5, 22–5, 28–51.
14. Dewhurst SN, Mason C, Roberts GJ. Emergency treatment of orodental injuries: a review. Br J Oral Maxillofac Surg 1998; 36:165–75.
15. Trope M, Chivian N, Sirgurdsson A, Vann WF Jr. Traumatic injuries. In: Cohen S, Burns R, editors. Pathways of the pulp, 8th edn. St. Louis, MO, USA: Mosby Inc; 2002. p. 603–49.
16. Dental Health Service Victoria. Management of trauma guideline number. Victoria, Australia: Dental Health Services Victoria; 2003 Effective September 2003.

17. Andreasen FM. Transient apical breakdown and its relation to colour and sensibility changes after luxation injuries to teeth. Endod Dent Traumatol 1986;2:9–19.
18. Andreasen JO, Bakland LK, Andreasen FM. Traumatic intrusion of permanent teeth. Part 3. A clinical study of the effect of treatment variables such as treatment delay, method of repositioning, type of splint, length of splinting and antibiotics on 140 teeth. Dent Traumatol 2006;22:99–111.
19. American Academy of Paediatric Dentistry. Guideline on management of acute dental trauma. In: 2002–2003 Reference Manual. American Academy of Paediatric Dentistry; 2003. p. 91–6.
20. Andreasen AF, Skeie A, Hjørting-Hansen E, Schwartz O. Effect of treatment delay upon pulp and periodontal healing of traumatic dental injuries, a review article. Dent Traumatol 2002;18:116–28.
21. Trope M. Root resorption due to dental trauma. Endod Top 2002;1:79–100.
22. American Association of Endodontists. Recommended guidelines of the American association of endodontists for the treatment of traumatic dental injuries. Chicago, IL 60611-2691: AAE; 2004. p. 1–6.
23. Bryson EC, Levin L, Banchs F, Abbott PV, Trope M. Effect of immediate intracanal placement of Ledermix Paste(R) on healing of replanted dog teeth after extended dry times. Dent Traumatol 2002;18:316–21.
24. Thong YL, Messer HH, Siar CH, Saw LH. Periodontal response to two intracanal medicaments in replanted monkey incisors. Dent Traumatol 2001;17:254–9.
25. Hu LW, Prisco CR, Bombana AC. Knowledge of Brazilian general dentists and endodontists about the emergency management of dento-alveolar trauma. Dent Traumatol 2006;22:113–7.
26. Parashos P, Messer HH. Uptake of rotary NiTi technology within Australia. Aust Dent J 2005;50:251–7.
27. Andreasen JO, Hjørting-Hansen E. Intraalveolar root fractures: radiographic and histologic study of 50 cases. J Oral Surg 1967;25:414–26.
28. Andreasen JO, Andreasen FM, Mejàre I, Cvek M. Healing of 400 intra-alveolar root fractures. 1. Effect of pre-injury and injury factors such as sex, age, stage of root development, fracture type, location of fracture and severity of dislocation. Dent Traumatol 2004;20:192–202.
29. Cvek M, Mejàre I, Andreasen JO. Conservative endodontic treatment of teeth fractured in the middle or apical part of the root. Dent Traumatol 2004;20:261–9.