Fused Teeth: A Review of the Treatment Options

E. Bahar Tuna, DDS, PhD *Mine Yildirim, DDS*
Figen Seymen, DDS, PhD *Koray Gencay, DDS, PhD*
Mehmet Ozgen, DDS, MPH, PhD

ABSTRACT

Fused/geminated teeth may cause esthetic, spacing, periodontal, eruption and caries problems. The present study describes two clinical cases of similar dental fusion and compromises different and individualized treatment methods based on the proper treatment needs of a patient. In the first case the fused tooth was separated and the supernumerary tooth was extracted intraorally. In the second case, due to the union structure of a fused tooth up to the apex, extraction and extraoral separation was considered a better alternative than the separation of the fused tooth intraorally. Clinical and radiographic controls of the two cases revealed that the teeth were symptom-free and all clinical and radiographic findings were within normal limits after the long term follow-up periods. Following careful clinical and radiographic examination and diagnosis, extraoral hemisection and immediate replantation may be considered as an alternative treatment in appropriate cases where a permanent tooth is fused with a supernumerary one.
(J Dent Child 2009;76:109-16)

Received April 24, 2008; Last Revision September 5, 2008; Revision Accepted Septermber 5, 2008.

KEYWORDS: FUSION, TREATMENT, DENTAL MANAGEMENT, HEMISECTION

Dental anomalies can be related to either the morphology or the number of teeth and are associated with both the primary and permanent dentitions.[1-3] Abnormalities in tooth size, shape, and structure are caused by disturbances during the morphodifferentiation stage of development.[4-8] The anomaly of conjoined teeth has been described in several different terms, including fusion, gemination, double tooth and twinning.[9]

Fusion (synodontia or false gemination) is defined as the union of 2 or more separate developing tooth germs at the dentinal level, yielding a single large tooth during odontogenesis, when the crown is not yet mineralized.[1,5-22] Geminated teeth (twinning) is a similar dental anomaly that demonstrates 2 crowns or 1 large partially separated crown usually sharing a single root or root canal. In geminated teeth, division is usually incomplete and results in a large tooth crown that has a single root and a single root canal.[5,7,8,15,17,23] It is hard to differentiate fusion and gemination, especially if the supernumerary tooth bud is fused with the adjacent one.[2,5,11,14,15,22,24]

To help distinguish between fusion and gemination, it has been suggested that the teeth in the arch be counted with the anomalous crown counted as 1. A full complement of teeth indicates gemination, while 1 tooth less than normal indicates fusion.[18,20,24] It is difficult to differentiate the terms "fusion" and "gemination," especially in cases of fusion between a regular and a supernumerary tooth or in combination with hypodontia.[20,22] Hence,

Drs. Tuna and Yildirim are research assistants and Drs. Seymen and Gencay are professors, all in the Department of Pediatric Dentistry, Faculty of Dentistry, Istanbul University, Istanbul, Turkey; and Dr. Ozgen is an associate professor of orthodontics in private practice, Istanbul.
Correspond with Dr. Tuna at ebtuna@istanbul.edu.tr

the term "double tooth" has been introduced by some authors.[22,25] This terminology, however, is very vague, as it disregards the etiology of the different tooth abnormalities and is rejected by other authors.[11,24]

Although the etiology of these anomalies is still unknown, it is believed that some physical force or pressure/trauma causes the contact of developing teeth, thus pro-ducing necrosis of the epithelial tissue that separates them and leads to fusion.[1,2,4-6,18,26] The possible causes of this tooth anomaly include trauma and environmental factors such as thalidomide embryopathy, fetal alcohol exposure, or hypervitaminosis.[6,17] In addition, several authors suggest that dominant autosomal heredity may be one of the etiologic factors.[2,6,19]

The incidence of these anomalies is more common in the anterior region. Approximately 0.1% occurs in permanent and 0.5% in primary dentition, with an equal distribution in females and males among Caucasians. In both dentition, fused/geminated teeth may cause esthetic, spacing, periodontal, eruption, and caries problems.[2,4-6,14,22,24,26] These anomalies may also result in orthodontic anomalies, including diastema, disturbances in maxillary and mandibular dental arch lengths and occlusions, and crowding or protrusion as a result of larger tooth crown size.[12,26,27] These problems might complicate orthodontic treatment planning.[28] Fused teeth in the primary dentition, however, require no treatment of any kind.[6]

TREATMENT CONSIDERATIONS

Several treatment methods have been described in the literature regarding different types and morphologic variations of fused and geminated teeth.[11,12,18,22] The treatment of fused teeth may be complex and contain various treatment protocols that may include interdisciplinary endodontic, surgical, and periodontal interventions.[3,29,30] Some studies advocate extraction of the anomalous tooth, followed by orthodontic management to achieve ideal esthetics and occlusion.[14] There are 2 major situations when this is recommended:

1. When a permanent tooth and a supernumerary tooth fuse, the fused tooth will have 2 completely separated roots. In such cases, more arch length is required and crowding or even impaction of a neighboring tooth may result. In cases with esthetic, functional, and orthodontic problems, surgical separation (hemisection) is recommended if the tooth shows 2 separate roots. After hemisection, orthodontic closure of the space and reshaping of the teeth is proposed.[6,11,22] If the pulp chambers are connected, endodontic treatment of the remaining part of the fused teeth may be necessary.[11]

2. When 2 permanent teeth have fused, there is a single pulp chamber with independent root canals. In this situation, endodontic treatment of both canals is indicated, with double chamber aperture and root canal sealing followed by crown sectioning to separate the teeth and crown restoration.[6] This resulting dental structure occupies less space than 2 single teeth, which may result in diastema, loss of proximal contact, and orthodontic problems.[11]

Some authors state that selective grinding of the fused teeth for the reduction of the crown's width is another possibility for the reconstruction of the sectional margins and crown shape.[5,22] Siqueira et al choose extraction and prosthetic reconstruction. Occasionally, leaving the fused teeth untreated is proposed as an alternative treatment.[20] The choice of treatment for a fused tooth should be determined by the patient's orthodontic, periodontal,

Figure 1. (a) Preoperative view of the facial aspect of the fused tooth, showing an oversized crown. (b) Preoperative radiograph of the fused tooth.

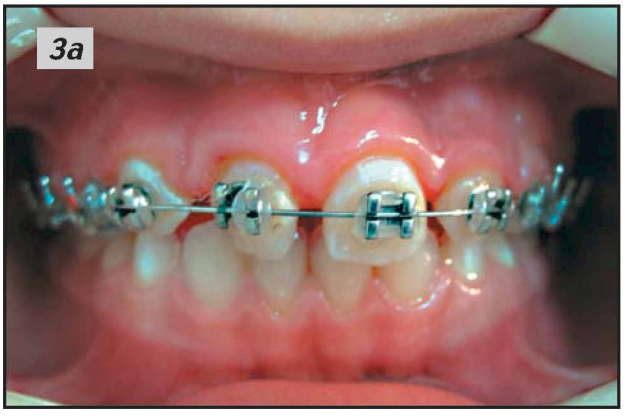
esthetic, and functional requirements.[5,14,18-20] Usually a multidisciplinary approach is needed due to the abnormal crown shape, root formation, endodontic considerations, malalignment, and esthetics.[7,14,18,23,24]

The purpose of this paper was to describe treatments for fused teeth and dental surgical procedures with revision of the relevant literature. In the first case following, a standard treatment option is presented. The second case describes a new approach based on the patient's specific needs.

CASE 1

A 10-year-old girl was referred to Istanbul University Faculty of Dentistry Department of Pediatric Dentistry with complaint of the permanent maxillary central incisor of much greater than normal size. There was no significant medical history and no family history of dental anomalies. Intraoral investigations showed a macrodontia in the maxillary right incisor region (Figure 1a). The patient was in the mixed dentition stage, with a Class I molar relationship. Periapical and panoramic radiographic examination confirmed that the permanent maxillary right central incisor had 2 independent roots with 2 pulp chambers (Figure 1b). Clinical and radiographic evaluation showed that there was a tooth fusion between the permanent maxillary right central incisor and a supernumerary tooth.

Treatment was recommended to separate the fused teeth for restorative and esthetic reasons. The surgical procedure was carried out under local anesthesia. A mucoperiosteal flap was raised, and the fused tooth was separated line under irrigation as deeply as possible using a thin, high-speed diamond bur (no. 010, SS White Burs Inc, Lakewood, NJ) through the root line. The tooth's distal portion was slightly elevated and extracted. Following surgical treatment, the remainder of the crown was restored with composite resin material (3M ESPE Filtek, Supreme XT, 3M Corp, St. Paul, Minn) and splinted with a round 0.016 inch Ni-Ti arch wire. Systemic antibiotics were administered and mouthwash with chlorhexidine was recommended.



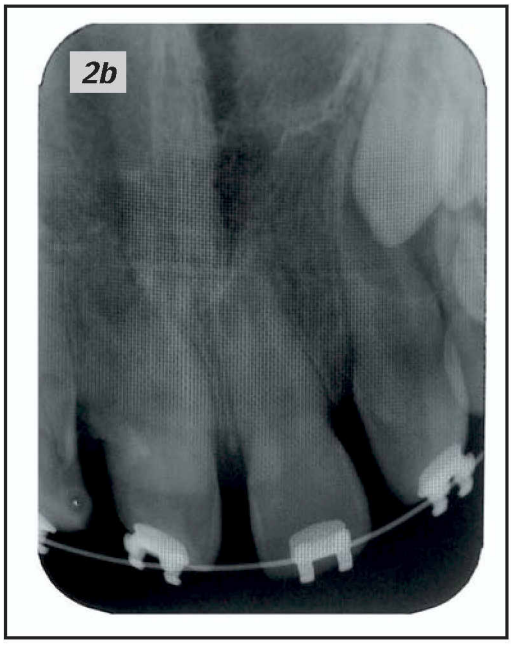


Figure 2. (a) Postoperative view after 3 months. (b) Periapical radiograph after 3 months.

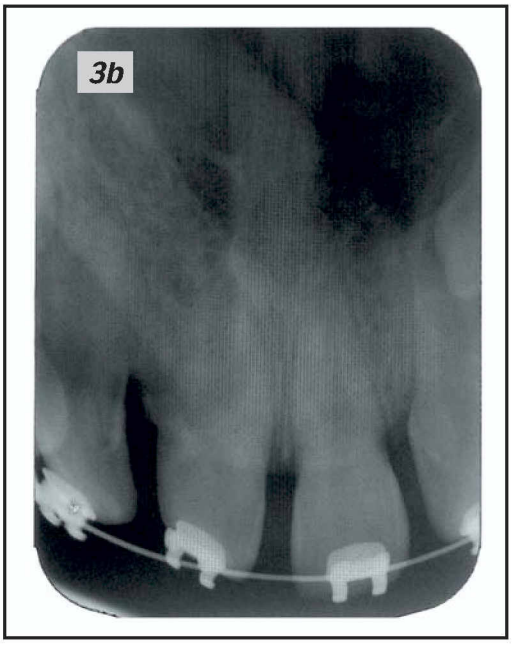


Figure 3. (a) Clinical appearance 6 months after hemisection. (b) Postoperative periapical radiograph after 6 months.

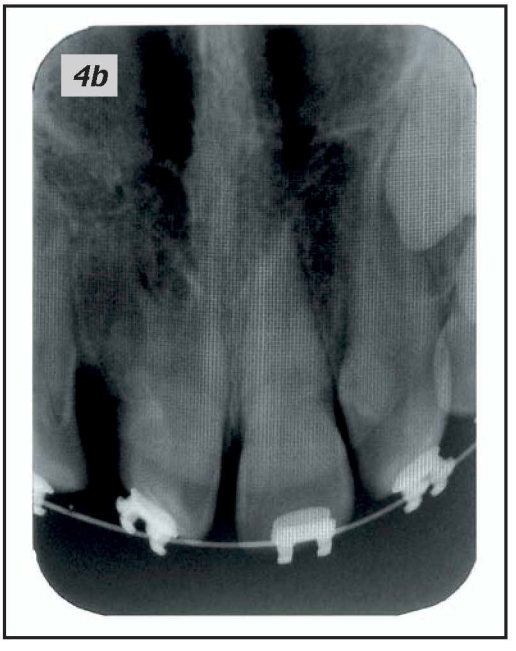


Figure 4. (a) Postoperative clinical photograph after 12 months. (b) Postoperative control radiograph after 12 months.

Postoperative controls within the third (Figure 2a and b), sixth (Figure 3a and b), and 12th (Figure 4a and b) months, respectively, showed no evidence of pulpal necrosis or root resorption in the resected tooth. The tooth was asymptomatic, clinical and radiographic findings were within normal limits, and the pulp was evaluated through a lack of symptoms.

CASE 2

An 8-year-old girl was referred by her parents for the treatment of her teeth. Her main complaint was the unaesthetic appearance of her anterior teeth. Clinical examination revealed that her permanent maxillary left lateral incisor was fused with a supernumerary tooth (Figure 5a and b). The patient was in the mixed dentition stage with an anterior open-bite and severe crowding in the maxillary anterior arch. Periapical X ray evaluation confirmed that the maxillary left lateral incisor was fused with a supernumerary tooth. The fused teeth had 2 separate roots, including 2 pulp chambers and 2 root canals (Figure 6).

The fused teeth was extracted under local anesthesia and separated using a physiodispenser and a high-speed bur (no. 010, SS White Burs Inc) with water spray longitudinally throughout the root conjunction line (Figure 7). The tooth's remaining distal portion was then replanted into the socket. Once the tooth was properly seated, it was checked for alignment and Ni-Ti arch wire was used for initial leveling of the maxillary arch. A periapical X - ray was obtained to confirm proper positioning of the replanted tooth. Systemic antibiotics were administered, oral hygiene instructions were given, and mouthwash with chlorhexidine was recommended twice daily for 1 week.

Clinical and radiographic controls were performed at the following intervals: 1, 2, and 6 months. After the 1-year recall appointment, the tooth was symptom-free, all clinical findings were within normal limits, and bone healing appeared to be improved (Figure 8a and b).

The tooth is still in functional use, and a 4-year follow-up showed that the tooth is placed in the proper occlusion. It responded positively to electrical pulp testing and shows a good esthetic result, and its periodontal and periapical health is preserved (Figure 9a and b).

DISCUSSION

Both types of tooth shape anomalies may result in esthetic problems and, thus, may require endodontic, restorative, surgical, and orthodontic treatments. They can also cause psychological problems, especially in children.

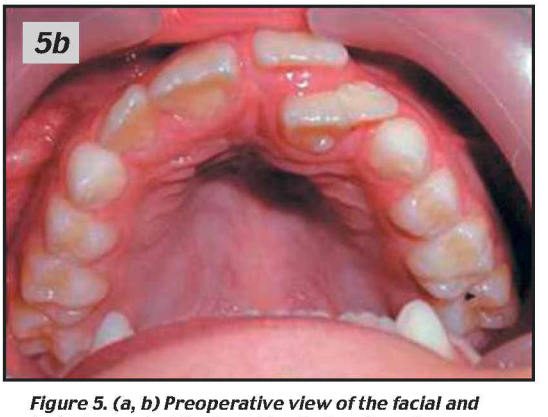


Figure 5. (a, b) Preoperative view of the facial and incisal aspect of the fused teeth showing a large crown and a large enamel projection.

Many different multidisciplinary approaches in the therapy of fused/geminated teeth were suggested, depending on whether there are independent pulp chambers and canals or 1 pulp chamber and 2 canals. Hemisection is recommended if the fused tooth possesses 2 separated roots. If the pulp chambers are connected, endodontic treatment of the remaining part of the fused tooth is necessary.[12,15,31] In some cases, connection of the pulp chambers and the need for root canal treatment only become evident after the hemisection procedure.[12,31] After hemisection, the remainder of the crown requires restoration with either a crown or composite materials followed by orthodontic treatment.[11]

In the first case, malpositioning of the tooth was due to insufficiency of the dental arch. Treatment was planned to surgically separate the fused teeth with the extraction of the distopalatinally part of the tooth as a standard procedure. In the second case, the treatment plan included extraction of the fused teeth and separation in the extraoral environment to preserve the periodontal ligament (**PDL**) and development of a better hemisection line remaining for the tooth. After the hemisection, the tooth was replanted in the socket in less than 5 minutes. This procedure may be considered an autotransplantation because the tooth was treated after extraction and replanted in the same location based on the patient's needs.

Tsukiboshi noted that autotransplantation includes 3 separate procedures:

1. transplantation in which a tooth is extracted from one location and replanted in a different location;
2. surgical repositioning of the tooth within the same tooth socket; and
3. intentional replantation in which a tooth is extracted and, if it can be suitably treated, replanted in the same location.

Tsukiboshi indicated that the tooth survival rate is 90% and the success rate of autotransplantation teeth is 80%.[32]

Several authors have reported fused teeth on the anterior region showing 2 separated roots. In these cases, treatment was usually performed by separating the fused teeth surgically and extraction of the supernumerary tooth as a routine procedure. One part of the fused tooth was removed, then the crown of the remaining tooth was restored. It was reported that the hemisectioned tooth maintained vitality after postoperative periods.[1,6,11,12,14,19,24,31]

In the second case presented here, due to the union structure of a fused tooth up to the apex, extraction and extraoral separation was considered a better alternative than the separation of the fused tooth intraorally.

Figure 6. Preoperative periapical radiograph of the teeth showing 2 separate roots and canals.

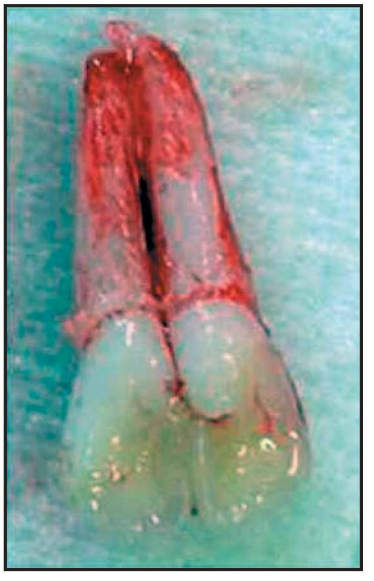


Figure 7. Palatinal view of the fused teeth.

Otherwise, an irregular fractured root surface may remain at the root's apical region. In addition, we concluded that atraumatic extraction would cause less PDL damage than a deep hemisection operation.

The most critical factor related to periodontal healing is the extraoral time.[21] A longitudinal study has shown that PDL regeneration was evident in 73% of the cases of immediately replanted teeth. PDL regeneration is the best possible result for a replanted tooth. Therefore, immediate replantation after hemisection for fused teeth is important for healthy PDL function. According to Andeasen et al, a success rate of 87% to 93% for transplants and a tooth survival rate of 90% to 98% were found.[33] Tsukiboshi also reported a survival rate of 100% and a success rate of 95% for transplantation to extraction sockets with existing periodontal ligaments.[32]

Due to a frequent occurrence of external root resorption, it is not possible to guarantee long-term retention of a replanted tooth. In young permanent dentition, however, a replanted tooth prevents horizontal and vertical bone loss and facilitates later alternative treatments like orthodontic closure, premolar transplantation, or dental implants. A number of factors have been shown to be associated with complications after replantation. The success of the replantation procedure is undoubtedly related to the length of the time that elapses between the tooth's loss and its replacement in the socket, the root development stage, and root surface contamination.[7,21,33] The condition of the tooth and periodontal ligament tissue remaining on the root surface are also important factors that influence the replantation's success.[7]

A tooth has the best prognosis if replanted immediately—within 5 minutes. The risk of ankylosis increases significantly with an extraoral dry time of 15 minutes.[21,34] In cases with avulsed teeth with more than 60 minutes extraoral dry time, resorption and subsequent ankylosis

Figure 8. (a) Postoperative photographs after 12 months. (b) Postoperative radiographs 12 months after hemisection showing no periapical pathosis.

Figure 9. (a) Postoperative view of the patient's final occlusion after 48 months. (b) Postoperative radiographs 48 months after hemisection showing no periapical pathosis.

is commonly expected.[34,35] We conclude that the high rate of vitality after the extraoral hemisection procedure is related to correct diagnosis of the tooth and also careful consideration of acceptable timing for replantation.

A few case reports in the literature describe postoperative complications such as hypersensitivity, irreversible pulpitis, and external root resorption after fused teeth separation.[19,26,34,36] Particularly, replacement resorption occurs after trauma in which there is significant periodontal ligament injury such as luxation or avulsion after 4 to 8 weeks.[33,37] The cases discussed in this paper have been monitored for development of any signs or symptoms of root resorption, periapical inflammatory disease, and periodontal lesions. Postoperative complications or periapical pathosis were not detected.

A prerequisite for endodontic treatment of anomalous teeth is a careful examination of radiographs from various angles. The unique morphology generates difficulties when accessing the pulp canal systems, determining working length(s), and managing large foramina during the filling of the root canal. Some authors described very complex internal anatomies and stressed the importance of familiarity with the root canal morphology before starting endodontic treatment.[13,38]

In some of the cases presented in the literature, endodontic treatment had to be performed because the pulp systems of both teeth were connected in a common pulp chamber or because communication existed between the 2 root canals. This treatment was followed only by recontouring the crowns.[14,39] The majority of such teeth may be asymptomatic, and, for most cases, no endodontic treatment is necessary. In teeth replanted within 3 hours, endodontic treatment is postponed until pulp necrosis is evident.[21] Therefore, our presented cases were treated with hemisection; the remaining tooth's vitality was maintained because of the evidence of the 2 independent roots and canals. We watched closely for pulp necrosis, but even after a long follow-up period there

was no evidence for it. If there is any sign of necrosis, such as inflammatory root resorption, endodontic treatment should be started immediately.

Valesco et al. stated that intentional extirpation of the pulps or pulpotomy in both roots must be performed before hemisection to prevent subsequent exposure of the root canals and tissue necrosis.[1] In the cases presented here, however, pulp vitality was still positive even after the long-term follow-up period. In our second case, we considered this method for treatment to provide better separation and PDL healing and to minimize the need for dental intervention. This case showed excellent functional and esthetic results even after a 4-year follow-up period.

CONCLUSIONS

Tooth shape anomalies in general dental practice may be rare, but the dentist should be aware of the nature of the problems encountered and the specific treatment needs, particularly concerning surgical separation, shaping, and canal filling. The esthetic criterion is the determining factor when choosing therapy. Following careful clinical and radiographical examination, extraoral hemisection and immediate replantation may be another alternative in cases where a permanent tooth is fused with a supernumerary tooth. This treatment method can be selected as a treatment protocol based on a patient's special need.

ACKNOWLEDGMENTS

This work was supported by the Research Fund of Istanbul University, Istanbul, Turkey (project no. UDP-2340/10042008).

REFERENCES

1. Velasco LFL, Araujo FB, Ferreira ES, Velasco LEL. Esthetic and functional treatment of a fused permanent tooth: A case report. Quintessence Int 1997; 28:677-80.
2. Ballal NV, Kundabala M, Acharya S. Esthetic management of fused carious teeth: A case report. J Esthet Restor Dent 2006;18:13-8.
3. Ertuğrul F, Sezer B. Fusion in the primary dentition followed by hyperdontia in the mixed dentition: Report of a case. Balk J Stomatol 2001;5:228-230.
4. Santos LM, Forte FDS, Rocha MJC. Pulp therapy in a maxillary fused primary central incisor: Report of case. Int J Paediatr Dent 2003;13:274-8.
5. Garattini G, Crozzoli P, Brenna F. Bilateral dental fusion of the upper central incisors: A multidisciplinary approach. J Esthet Dent 1999;11:149-154.
6. Olivan-Rosas G, Lopez-Jimenez J, Gimenez-Prats MJ, Piqueras-Hernandez M. Considerations and differences in the treatment of a fused tooth. Med Oral 2004;9:224-8.
7. McDonald RE, Avery DR, Hartsfield JK. Acquired developmental disturbances of the teeth and associated oral structures. In: McDonald RE, Avery DR, eds. *Dentistry for the Child and Adolescent.* 7th ed. St. Louis, Mo: Mosby Inc; 2000:108-110.
8. Laskaris G. *Color Atlas of Oral Disease in Children and Adolescents.* Stuttgart, Germany: Thieme; 2000:4-6.
9. Tomizawa M, Shimizu A, Hayashi S, Noda T. Bilateral maxillary fused primary incisors accompanied by succedaneous supernumerary teeth: Report of a case. Int J Paediatr Dent 2002;12:223-7.
10. David HT, Krakowiak PA, Pirani AB. Nonendodontic coronal resection of fused and geminated vital teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83:501-5.
11. Hülsmann M, Bahr R, Grohmann U. Hemisection and vital treatment of a fused tooth: Literature review and case report. Endod Dent Traumatol 1997; 13:253-8.
12. Cetinbas T, Halil S, Akcam MO, Sari S, Cetiner S. Hemisection of a fused tooth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;104:120-4.
13. Kremeier K, Pontius O, Klaiber B, Hülsmann M. Nonsurgical endodontic management of a double tooth: A case report. Int Endod J 2007;40:908-15.
14. Karacay S, Güven G, Koymen R. Management of a fused central incisor in association with a macrodont lateral incisor: A case report. Pediatr Dent 2006;28:336-40.
15. Pereira AJA, Fidel RAS, Fidel SR. Maxillary lateral incisor with two root canals: Fusion, germination, or dens invaginatus? Braz Dent J 2000;11:141-6.
16. Bazan MT. Fusion of maxillary incisors across the midline: Clinical report. Pediatr Dent 1983;5:220-1.
17. Mochizuki K, Yonezu T, Yakushiji M, Machida Y. The fusion of three primary incisors: Report of case. J Dent Child 1999;66:421-5.
18. Nunes E, Moraes IG, Novaes PMO, Sousa SMG. Bilateral fusion of mandibular second molars with supernumerary teeth: Case report. Braz Dent J 2002; 13:137-41.
19. Önçağ Ö, Candan Ü, Arikan F. Comprehensive therapy of a fusion between a mandibular lateral incisor and supernumerary tooth: Case report. Int Dent J 2005;55:213-6.
20. Siqueira VCF, Braga TL, Martins MAT, Raitz R, Martins MD. Dental fusion and dens evaginatus in the permanent dentition: Literature review and clinical case report with conservative treatment. J Dent Child 2004;71:69-72.
21. Jacobsen I., Andreasen JO. Traumatic injuries: Examination, diagnosis, and immediate care. In: Koch G, Poulsen S, eds. *Pediatric Dentistry: A Clinical Approach.* 1st ed. Copenhagen, Denmark: Munksgaard; 2001:374-9.

22. Malcic A, Prpic-Mehicic G. Conservative treatment of fused teeth in permanent dentition. Acta Stomat Croat 2005;39:327-8.
23. Hernandez-Guisado JM, Torres-Lagares D, Infante-Cossio P, Gutierrez-Perez JL. Dental gemination: Report of case. Med Oral 2002;7:231-6.
24. Braun A, Appel T, Frentzen M. Endodontic and surgical treatment of a geminated maxillary incisor. Int Endod J 2003;36:380-6.
25. Lowell RJ, Solomon AL. Fused teeth. J Am Dent Assoc 1964;63:762.
26. Kayalıbay H, Uzamış M, Akalın A. The treatment of a fusion between the maxillary central incisor and supernumerary tooth: Report of a case. J Clin Pediatr Dent 1996;20:237-40.
27. Drummond BK, Holborow DW, Chandler NP. Guided tissue regeneration in managing an incisor with a labially fused supernumerary: Case report. Pediatr Dent 1995;17:368-71.
28. Altug-Ataç AT, Erdem D. Prevalence and distribution of dental anomalies in orthodontic patients. Am J Orthod Dentofacial Orthop 2007;131:510-4.
29. Danesh G, Schrijnemakers T, Lippold C, Schafer E. A fused maxillary central incisor with dens evaginatus as a talon cusp. Angle Orthod 2007;77:176-80.
30. Good DL, Berson RB. A supernumerary tooth fused to a maxillary permanent central incisor. Pediatr Dent 1980;2:294-6.
31. Stillwell KD, Coke JM. Bilateral fusion of the maxillary central incisors to supernumerary teeth: Report of a case. J Am Dent Assoc 1986;112:62-4.
32. Tsukiboshi M. *Autotransplantation of Teeth*. Chicago, Ill: Quintessence Publishing Co Inc; 2001:10-167.
33. Andreasen JO, Andreasen FM, Andersson L. *Textbook and Color Atlas of Traumatic Injuries to the Teeth.* 4th ed. Blackwell Munksgaard Co; 2007:447-71.
34. American Academy of Pediatric Dentistry. *Guideline on Management of Acute Dental Trauma.* Chicago, Ill: AAPD; 2007.
35. Flores MT, Malmgren B, Andersson L, Andreasen JO, Bakland LK, Barnett F, et al. Guidelines for the management of traumatic dental injuries: III. Primary teeth. Dent Traumatol 2007;23:196-202.
36. Blank BS, Ogg RR, Levy AR. A fused central incisor: Periodontal considerations in comprehensive treatment. J Periodontol 1985;56:21-4.
37. Heasman P. *Master Dentistry*. Vol 2. Oxford, UK: Churchill Livingstone; 2003:191-2.
38. Tsesis I, Steinbock N, Rosenberg E, Kaufman AY. Endodontic treatment of developmental anomalies inposterior teeth: Treatment of geminated/fused teeth—report of two cases. Int Endod J 2003;36:372-9.
39. Peyramo A, Zmener O. Endodontic management of mandibular lateral incisor fused with supernumerary tooth. Endod Dent Traumatol 1995;11:196-8.