
Novel aesthetic treatment of bilateral gemination of maxillary central incisors

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The fusion of adjacent tooth buds and the formation of a single tooth or the gemination of a single tooth are rare and occur less often bilaterally in the permanent dentition.

Following a brief literature review, this case report describes the multidisciplinary treatment of an adolescent patient who presented with the bilateral gemination of the permanent central incisors. It was planned to restore the teeth using porcelain laminated veneers after the completion of orthodontic treatment.

The wide crown of the geminated incisors was restored, to mimic the morphology of two teeth, comprising a wider central and a narrower lateral incisor.

In carefully selected cases, this conservative treatment option preserves the physiologic function of the teeth and the periodontal ligament.

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Introduction

Fusion and gemination are developmental anomalies in the size, shape and structure of the teeth. Dental fusion is defined as the union of two or more different tooth buds during their development and is characterised by partial or complete merging of the dentine and/or enamel. The deciduous teeth are more commonly affected and supernumerary teeth may also be involved in the fusion process. The pulp chamber and root canal may be joined or separated, depending on the developmental stage at which the fusion occurs. Clinically, a broad crown with a vertical groove extending toward the gingival sulcus is seen.¹ A less severe form of the disorder, involving the union of two developing tooth germs at the cemental level, is called concrescence. These teeth always have separate roots and separate coronal pulps.²

It is suggested that physical force or pressure leading to prolonged contact of the adjacent tooth follicles could cause the fusion of developing buds.³ Dental trauma is also hypothesised to be involved in the pathogenesis

of this anomaly.⁴ Although a genetic predisposition may also be evident, environmental factors could possibly contribute to aberrant formation in some cases.⁵ These factors include thalidomide embryopathy, foetal alcohol exposure and hypervitaminosis A in the pregnant mother.^{1,6}

Gemination or twinning is defined as an unsuccessful attempt of a tooth bud to divide, resulting in a less complete separation of roots and/or crowns. In some instances, it is difficult to differentiate between fusion of a permanent tooth with a supernumerary tooth and gemination of a single tooth. For that reason, there is little clinical interest in the differential diagnosis of these two anomalies but, rather, focus is placed on functional and aesthetic implications and on overall dental health.⁷⁻⁹ It has therefore been suggested that all permanent successors that are joined or fused together by dentine should be considered as fused or 'double' teeth.^{7,10,11}

The aetiology of gemination is uncertain but is suggested to result from trauma occurring during tooth

development. However, the hereditary factor needs to be considered in familial cases of autosomal recessive or autosomal dominant inheritance with reduced penetrance.^{12,13}

Fusion and gemination occur more frequently in the deciduous dentition, with prevalence figures of 0.5–1% / 0.1%, respectively, in self-identified European patients and 1.5% / 0.4% in Asian populations. The most affected teeth are the maxillary incisors and canines and there is no gender predilection.^{14–18} Geminated teeth are usually found in the maxilla, but cases of fusion are more frequently found in the mandible.¹ Bilateral occurrence is more rare and its prevalence ranges from 0.01–0.05%.^{17,19}

Fused teeth may compromise aesthetics and cause a loss of arch length, caries along the line of fusion, periodontal problems, eruption abnormalities and occasionally sensitivity.^{4,8,9,12,20,21}

The management of fused permanent teeth remains a major challenge, and a multidisciplinary approach is required in order to balance patient needs with treatment possibilities and limitations. Treatment objectives should aim to preserve pulpal vitality, maintain hard tissue integrity and meet aesthetic and occlusal requirements.¹⁰ If these objectives are not achievable, the extraction of the involved tooth may be preferred. In this circumstance, treatment alternatives for prosthetic rehabilitation²⁰ include autogenous transplantation^{22,23} or orthodontic movement of an adjacent tooth into the extraction space.^{24,25} The hemisection of the fused tooth is the treatment approach chosen by most clinicians, either with or without prior endodontic treatment. If no pulp exposure occurs, endodontic treatment should not be required.^{10,26} Some clinicians avoid endodontic treatment even in cases of pulp exposure after hemisection. An exposed pulp chamber is simply allowed to heal²⁷ or is sealed with mineral trioxide aggregate (MTA).⁹ In the latter case, the pulpal exposure should be minimal and the root apex still open. Moreover, an alternative method has been described in which sterile calcium hydroxide and zinc oxide eugenol / zinc phosphate paste is placed over the exposed pulp of vital roots.^{28–30}

If an extensive exposure of pulp tissue is expected to occur, the endodontic treatment of the fused tooth unit is performed prior to hemisection.³¹ The separation of the fused tooth may be done in situ, immediately after root canal obturation³¹ or extra-orally,⁸ as a two-step procedure. When the patient is completely without

symptoms after the endodontic treatment, the double tooth is extracted, hemisected and subsequently the required segment of the tooth is replanted. This procedure is preferred for teeth that are fused so far apically that they cannot be sectioned without disturbing a major part of the attachment apparatus on the root. Extra-oral preparation ensures smooth contours of the replanted tooth; however, ankylosis invariably occurs with replanted teeth.⁸ In both methods of hemisection, failure to completely remove the furcation-like area may result in incomplete healing and the persistence of inflammation because of plaque retention.³² Orthodontic movement of teeth with slight or moderate trauma and an intact periodontal ligament can be initiated with a prognosis comparable to that of uninjured teeth after an observation period of at least four to five months.³³ Successful orthodontic treatment has been reported three or six months after extra-oral or in situ hemisection, respectively.^{4,32}

An alternative but more conservative treatment plan includes mesiodistal trimming of the involved teeth, six months after the completion of root canal therapy. The teeth may be restored with anterior resin composites in order to re-establish aesthetics.^{4,21} If orthodontic space closure is intended in these cases, root divergence should always be considered.

The present paper reports a case of bilateral gemination of the maxillary central incisors in an adolescent patient and discusses the orthodontic and prosthetic/restorative treatment performed.

Case description and results

A male adolescent patient, aged 13 years, presented in the orthodontic practice of an author with a chief complaint related to the unaesthetic appearance of the upper anterior teeth. An initial clinical observation revealed that both upper central incisors had wide and bifid crowns (Figure 1). The family dental history revealed that this anomaly had not occurred in other family members or in his deciduous dentition. No history of dental trauma was reported. An extra-oral clinical evaluation revealed a symmetrical mesofacial face with a straight profile. The incisal display on smiling was adequate (80%). An intraoral and dental cast examination demonstrated a molar Class I malocclusion in the later stage of the mixed dentition accompanied by a 7 mm overjet and 5 mm overbite (50%). A model analysis revealed mild crowding of



Figure 1. Initial frontal extra-oral photograph. Both upper central incisors had wide and bifid crowns.



Figure 2. Initial intra-oral photograph revealing the 'double' incisors.

2 mm in the lower anterior teeth and a deep curve of Spee (2 mm) (Figure 2). Each central incisor possessed a large geminated crown (mesiodistal width: right 15 mm and left 13 mm). The distal portion of the left central incisor and the mesial part of the right central and lateral incisors were rotated labially. Additionally, the right lateral incisor was located above the distal part of the right central incisor. The total upper arch length discrepancy was 9 mm. The initial radiographic evaluation included a panoramic, a lateral cephalometric and two periapical radiographs, which demonstrated that both incisors had two separate roots, each with one distinct canal system, geminated at least up to the middle third (Figures 3, 4). A lateral cephalometric radiograph revealed a Class I skeletal relationship and a balanced vertical facial pattern. The upper anterior teeth were normally inclined and the lower incisors slightly retruded (Figure 5). Since this patient did not present any skeletal discrepancy, the main treatment objective was to establish an aesthetically pleasing and functional occlusion. A non-extraction treatment plan was chosen, aimed at relieving the crowding and establishing a Class I molar and canine occlusion. Treatment alternatives included the extraction of the geminated teeth, hemisection, and trimming with or without



Figure 3,4. The initial panoramic and periapical radiographs. Both incisors had two separate roots, each with one distinct canal system, geminated at least up to their middle third.

composite/prosthetic restorations. The patient was referred to an endodontist and a prosthodontist as well as a restorative specialist for further evaluation and the patient's preference influenced the final decision to restore the central incisors with porcelain laminate

veneers (PLV) after the completion of orthodontic treatment. Orthodontic treatment was provided with fixed appliances over a period of 24 months.

After debonding (Figures 6, 7, 8), the restorative specialist was re-consulted and a diagnostic wax-up was performed in order to establish the most appropriate tooth proportions. It was decided that each geminated incisor should resemble two teeth after its restoration: a mesial wider one, approaching the morphology of a central incisor, and a distal smaller one, resembling a lateral incisor. Minor recontouring affecting only the enamel structures of the labial surfaces of the central incisors was necessary before final prosthetic rehabilitation (Figures 9, 10). The post-treatment radiographic evaluation included a panoramic and a lateral cephalometric radiograph (Figures 11, 12). Three years after the end of active orthodontic treatment, tooth alignment and the PLVs remained stable (Figures 13, 14).

Discussion

The incisor anomalies observed in the present case were likely initiated during the first months after birth and continued throughout crown calcification, until



Figure 5. The initial lateral cephalometric radiograph revealed a Class I skeletal relationship and a balanced vertical facial pattern.



Figure 6, 7, 8. Pre-prosthetic extra- and intraoral frontal photographs.



Figure 9, 10. Final extra- and intraoral frontal photographs with the porcelain laminate veneers.

the formation of the middle third of the root, at about the age of seven years.³⁴ Hence, the identification of the exact time of the occurrence of a phenotype is difficult. Equally difficult is the differential diagnosis between gemination and fusion in this patient. It is highly unlikely that the buds of both central incisors fused with two supernumerary incisors, since the number of supernumerary teeth usually observed is one.³⁵

Orthodontic treatment was commenced immediately after consultation for aesthetic reasons. The decision related to the prosthetic rehabilitation of the involved



Figure 11, 12. The post-treatment radiographic evaluation included a panoramic and a lateral cephalometric radiograph.

teeth was based on multidisciplinary team discussion and the patient's preference. The extraction of the geminated teeth was excluded, since the patient was young. Differential premolar or upper lateral incisor extractions may have improved the Bolton ratio and the arch length discrepancy, but these options were also discarded because the patient presented with an acceptable profile and a molar Class I malocclusion. The upper and lower lips appeared slightly retruded relative to the aesthetic plane in the pretreatment lateral cephalometric radiograph and this finding worsened in the final lateral cephalometric radiograph due



Figure 13, 14. Extra- and intraoral frontal photographs three years after the end of active orthodontic treatment. Alignment and PVLs remained stable.

to nose and chin growth. An alternative treatment plan regarding the geminated teeth included hemisection and prosthetic/composite restorations of the remaining segments of these teeth. In this circumstance, the endodontic treatment prior to hemisection would have been indicated. Although this plan could have achieved near-perfect aesthetic results, it was problematic since the fusion areas of both incisors were so far apical. Consequently, an extensive area of the periodontal ligament would have been damaged during the hemisection, which was considered as an extra-oral procedure in order to achieve smooth contours of the replanted tooth.⁸ Hemisection could have been avoided if extensive recontouring of the crown had been performed, in order to approximate the morphology of a central incisor. Unfortunately, orthodontic treatment would not have been able to close the remaining space due to root hyperdivergence.

As a result of these concerns, a less invasive treatment plan was chosen, which included the orthodontic alignment of the geminated teeth for future prosthetic rehabilitation with porcelain laminate veneers. The veneers transformed each central incisor into two teeth, a wider central and a narrower lateral incisor. The Bolton discrepancy in the anterior region was maintained during the orthodontic treatment phase, resulting in a slightly increased but acceptable overjet (4 mm).

The treatment plan followed in this patient was conservative, in comparison with those described in the literature. It preserved not only pulp vitality of the fused teeth but also proper function of the periodontal ligament.

Summary

A male adolescent patient, aged 13 years, presented with the aesthetic concern of the upper anterior teeth. A molar Class I malocclusion with a 7 mm overjet, 5 mm overbite (50%), a severe upper arch length discrepancy, mild crowding in the lower anterior teeth and a deep curve of Spee were apparent. A clinical examination revealed that both upper central incisors were fused. After extensive interdisciplinary discussion, it was decided to restore the teeth using porcelain laminate veneers, following orthodontic treatment.

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