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Multidisciplinary Management of a Double Immature Permanent Tooth: A Case Report

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ABSTRACT

Fused or geminated teeth require complex and multi-faceted treatment to maintain their health, functionality, and appearance. The current paper describes the multidisciplinary/minimally invasive treatment of fused immature permanent teeth. A 9-year-old-girl with an abnormally large left permanent maxillary lateral incisor was referred to the Paediatric Outpatient Clinic. The treatment plan of the referring orthodontist included the extraction of left maxillary lateral incisor, which was fused to a supernumerary tooth, followed by subsequent orthodontic and prosthetic treatments. In the paraclinic evaluation, cone-beam computed tomography (CBCT) showed two separate roots and two root canals, with communication between the pulp chambers of the double teeth. The modified treatment plan was to section the geminated tooth, remove the supernumerary and save the lateral incisor. During the sectioning procedure, the pulp of the remaining tooth was inevitably exposed. Direct pulp capping with Biodentine™ was performed. Next, glass-ionomer cement was applied as a temporary restoration and the supernumerary tooth was removed. The distal surface of the tooth was restored two weeks later so as to re-establish the original shape of the lateral incisor. Clinical and radiographic control examinations revealed that the tooth was symptom-free. Follow-up appointments after 3, 6, 12 and 18 months included standard clinical examinations and sensivity tests including electric pulp testing, which showed a fully functional, healthy tooth with apical maturation. Careful clinical and radiographic evaluations/examinations are essential for determining the correct treatment of a double tooth. The proposed multidisciplinary and minimally invasive treatment of the double tooth using a bioactive cement may facilitate the maturation of immature teeth and result in a desirable aesthetics and function.

Keywords: Biodentine; Calcium Silicate-based Cement; Double Tooth; Immature Tooth; Supernumerary Tooth; Tooth Gemination

Introduction

Anomalies of permanent and deciduous dentitions are a result of odontogenic disorders; and could affect *i*) the appearance of teeth, *ii*) interfere with teething, and *iii*) contribute to the development of caries, periodontal diseases and orthodontic abnormalities [1-3]. "Double Tooth" (DT) is an anomaly which can be divided into two categories: fusion and gemination. Tooth fusion (synodontia, false gemination) is the union of two or more separately developing tooth buds at the dentinal level, yielding a single large tooth during odontogenesis, when the crown is not yet mineralized. Gemination (dentes geminati, twinned teeth) is a similar dental anomaly that is presented as 2 crowns and/or 1 large partially separated crown, usually sharing a single root or root canal. Gemination may involve the entire length of the tooth or the roots only, in which cementum and dentin are shared. Root canals may also be separated, shared (which may lead to a reduced number of teeth) or may occur between a normal and supernumerary tooth [4-6]. Gemination results in a mirror image of the coronal halves, while fusion may occur at an angle, resulting in a crooked appearance. Geminated teeth tend to have an undivided pulp, while fused teeth are subjected to have a double pulp space [7]. In some cases, it is difficult to differentiate

Figure 1. *A*) Pre-operative clinical photograph showing the double tooth #22-#22bis; *B*) Clinical photograph showing the right maxillary incisors

between fusion and gemination, and there are still no flawless criteria to discriminate between them. It has been proposed to use one term "Double Tooth" for both anomalies [8-10].

The causes of fusion and gemination have not been definitely established. Fusion may be a result of trauma and crowding of tooth buds. Physical forces, pressure, or trauma may lead to the necrosis of basement membrane and, consequently, to the fusion of teeth. Other researchers have also added environmental factors such as thalidomide embryopathy, alcohol consumption during pregnancy, avitaminosis, vitamin A hypervitaminosis, endocrine disorders, achondroplasia, and Gorlin-Goltz syndrome. Moreover, some authors have not excluded the possibility of autosomal dominant inheritance [5, 7].

Double teeth are more frequently found (0.5%-2.5%) in primary teeth, however, they tend to occur among secondary teeth, usually in the incisor region. Nevertheless, a few cases of DT involving molar and premolar teeth have been reported [10-12]. The treatment of DT is complex and multidisciplinary and involves endodontic, orthodontic, surgical and prosthetic procedures.

The following report describes the treatment of fused teeth in a 9-year-old girl, concerning the left permanent maxillary lateral incisor and a supernumerary tooth.

Case Report

A 9-year-old girl with an abnormally large left permanent maxillary lateral incisor was referred to the Paediatric Outpatient Clinic at Pomeranian Medical University, Szczecin, Poland. The treatment plan proposed by the referring orthodontist included *a*) the extraction of fused teeth and *b*) subsequent orthodontic/prosthetic treatments.

The patient was generally healthy, with no significant medical/family history of dental anomalies.

The remaining maxillary and mandibular permanent teeth were of normal size and shape. The corresponding tooth on the opposite side appeared normal clinically and radiographically. The number of teeth was not reduced.

Intra-oral clinical investigation showed macrodontia in the region of tooth #22 due to the fusion of the left permanent maxillary lateral incisor and a supernumerary tooth (Figure 1). In addition, a groove could be observed between the crowns of the teeth. Pulp sensibility tests showed a normal response to cold and electric tests. Cone-beam computed tomography (CBCT) revealed that the fused tooth had two separate roots and two root canals, with communication between the pulp systems of the two teeth (Figure 2). The point of communication (2mm^2) was located in the area of the tooth cervix. The development of the roots of the fused teeth was not complete.

After consultation with the referring orthodontist and the patient's parents, and explaining other treatment options (extraction of fused teeth and prosthetic treatment), the final treatment plan involved separation of the fused teeth along the line of communication, and extraction of the supernumerary tooth. The treatment plan was explained to the patient and her family and the informed consent was obtained.

The clinical procedures were performed under local anaesthesia (Dentocaine 100, Inibsa Dental SLU, Barce-lona, Spain) using an operating microscope (4× magnification; OPMI Pico; Carl Zeiss, Jena, Germany). The clinical crowns of both teeth were polished with a rubber cup and polishing paste. Following rubber dam application, the field was disinfected with 2% NaOCl. The double tooth was sectioned with a sterile diamond bur in a high-speed handpiece with copious water irrigation and cooling (Figure 3A). Bleeding was controlled by irrigation with saline solution (0.9% NaCl) and using sterile cotton pellets. Direct pulp capping with Biodentine™ (Septodont, Saint-Maur-des-Fosses, France), as the dressing, material was chosen. When the bleeding stopped, Biodentine™ was applied on the exposed pulp. After 15 min, when the Biodentine™ was dense, glass-ionomer cement (Riva self-cure; SDI, Victoria, Australia) was applied as a temporary restoration (Figure 3B and C).

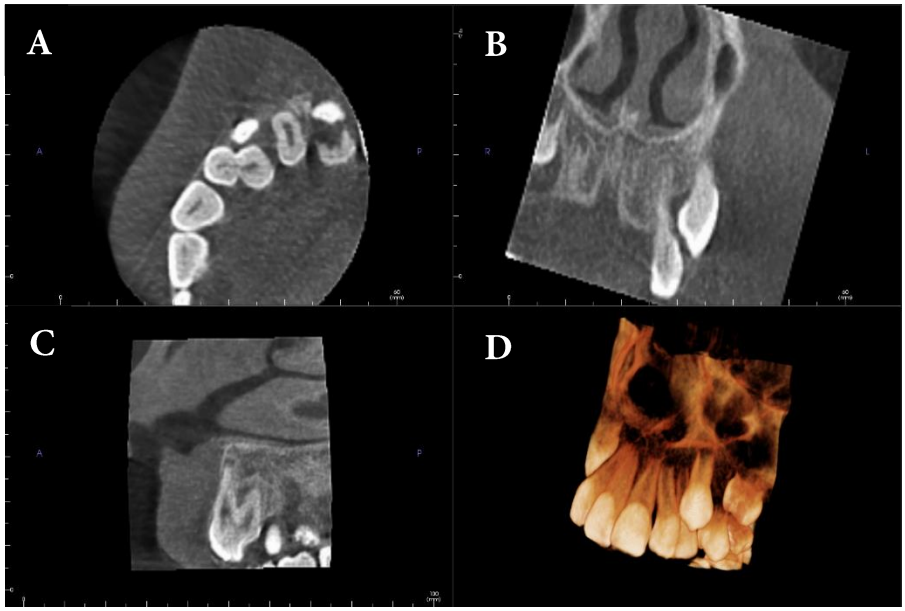

Figure 2. A preoperative cone-beam computed tomographic images showing the double tooth #22-#22bis: *A*) An axial section of the fused teeth, showing the point of communication between the pulp systems; *B*) Coronal section of the teeth; *C*) Sagittal section of the teeth; *D*) 3-D hard tissue reconstruction

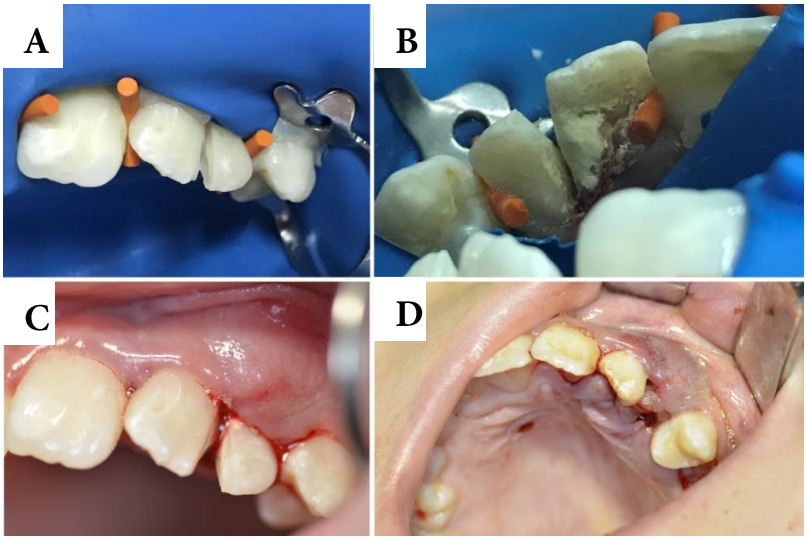

Figure3. Intra-operative clinical photographs: *A*) Fused teeth separated; *B*) Direct pulp capping with the use of the calcium silicate-based cement (Biodentine™) and glass-ionomer cement as a temporary restoration; *C*) Before the extraction of the supernumerary tooth; *D*) Clinical view of the alveolus after the application of platelet-rich fibrin

The surgical procedure began after the material was completely fixed. Before extraction, venous blood was collected in two sterile 10 mL tubes (Vacuette; Greiner Bio-One, Frickenhausen, Germany) and then centrifuged (EBA-200; Hettich, Tuttlingen, Germany) for 12 min at 2700 rpm (20º C). A mucosal-periosteal envelope flap was created in the region of tooth #21 to tooth #23. Using a luxator, the supernumerary tooth #22 was removed following the separation of teeth and afterwards, the post-extraction tooth socket was filled with platelet-rich fibrin (PRF) (Figure 3D). The post-operative wound was stitched with 4-0 silk threads (Sofsilk, Covidien, Poland). Immediately after the surgery the patient reported no symptoms post-operatively. Post-operative home instructions were provided, and the patient was scheduled for a second appointment 10 days later. The girl was told to brush her teeth carefully several times a day with a soft toothbrush and use dental floss. It was recommended that the patient should rinse her mouth twice a day with 0.1% chlorhexidine solution for seven days.

After 10 days, the patient returned, was asymptomatic and expressed no pain. To evaluate the pulp vitality/sensitivity of tooth #22, laser Doppler flowmetry (LDF) (moorVMS-LDF; Moor Instruments Ltd, Devon, UK) and cold/electrical pulp tests were performed, respectively. The value achieved with the laser Doppler flowmeter was 21.3 ± 8.3, which was similar to that of the contralateral incisor (30.9±11.5). Furthermore, the responses of the tooth to all pulp sensitivity tests were positive. Next, the sutures were removed. Healing continued without complications.

The distal surface of the tooth was restored with composite resin 2 weeks later. The restorative procedure was performed in a way that the shape of the tooth was consistent with the typical maxillary lateral incisor anatomy. The tooth was etched with 35% phosphoric acid (Ultra Etch; Ultradent, South Jordan, UT, USA) for 20 sec, followed by washing with spray (air/water) and drying with air. Then, a self-etching one-step bonding system (G-Bond; GC Corporation, Tokyo, Japan) was applied and light-cured for 20 sec. The tooth was restored with a microhybrid composite resin (Gradia Direct, GC Corporation, Tokyo, Japan). All layers were cured for 40 sec. The restored tooth was polished using diamond stones and a composite polishing kit (Shofu Co, Kyoto, Japan).

Follow-up appointments after 3, 6, 12 and 18 months included a standard clinical examination, vitality/sensitivity tests, and showed a fully functional healthy tooth. The tooth showed a normal response to pulp sensitivity tests in each control examination. The patient did not report any ailment, and no clinical or radiographic evidence of pathological resorption or apical periodontitis. Radiological assessment after 12 and 18 months revealed evidence of apical maturation. The composite restoration was intact with no clinical or radiographic signs of secondary caries. The patient remains under the supervision of an orthodontist (Figure 4).

Discussion

Double tooth, a dental anomaly caused by abnormal odontogenesis, may lead to aesthetic, medical and psychological problems [8]. In this study, we described the case of a 9-year-old girl with the fusion of the left permanent maxillary lateral incisor (#22) with a supernumerary tooth (#22-bis). Despite the orthodontist's initial plan to extract the fused teeth, it was possible to save the vital and fully functional tooth #22 by direct pulp capping using Biodentine™.

To plan an appropriate treatment strategy, it was necessary to perform clinical examination and additional tests, particularly radiological tests. Similar to many other research, CBCT was used [13-16]; where the range of the tested area, depending on the indication, can be precisely selected. Literature describes several methods of treating fused or geminated teeth. When a double tooth has two completely separate roots, it is recommended to perform surgical separation, extract the supernumerary tooth, and use orthodontics to close the gap resulted from the extraction. Hemisection is most frequently followed by restoration of the crown with composite resin material followed by orthodontic treatment [1, 3, 5, 11, 17, 18], the procedure which was applied in the described case. In a study by Tuna *et al.* [5], post-operative control examinations were made after 3, 6, and 12 months from the surgery and showed no evidence of pulpal necrosis. On the contrary, there were positive reports indicating pulp vitality at 24 [17] and 52 months [11] after the surgery.

In the treatment of double tooth performed by Tuna *et al.* [5], Ozden *et al.* [17] , Tsujino and Shintani [11], and Cetinbas *et al.* [3], there was no need for endodontic treatment, as the pulp chambers were not connected. However, in some cases presented in literature, complete root canal treatment had to be conducted when the pulp systems of the fused teeth were connected. To prevent subsequent exposure of the root canals and tissue necrosis, intentional extirpation of the pulp in both roots must be performed before hemisection [1, 2, 4]. In another case, gemination from a fusion of a mandibular second molar with a paramolar in an adult patient required complex endodontic treatment, but it was not necessary to section the double tooth nor to extract any of its parts, as was presented by Salem Milani [12].

Endodontic treatment is recommended for the treatment of double teeth only after separation of the fused teeth and removal of the supernumerary tooth [9, 10]. In a case presented by Steinbock *et al.* [6], similar to our study, direct pulp capping was performed owing to pulp exposure during the separation of the connected teeth. It was shown that direct pulp capping with suitable materials, in our case Biodentine™, ensured the preservation of vital/functional pulp, and helped avoid the complicated root canal procedures. Direct pulp capping is the best choice, because it allows continuation of normal root growth. This was important in our case, because the treated tooth had an immature root and the applied method enabled its further development. The radicular pulp in immature permanent teeth has extensive capacity to remain sound and continue its physiological functions. In a case presented by Steinbock *et al.* [6], following separation of the fused teeth and extraction of the mesial part, a 4-mm-wide oval opening at the mid-third of the root was observed through which the dental pulp could be seen and then, direct pulp capping using MTA was performed. In our study, the point of communication was located in the area of the tooth cervix, and the pulp was exposed in a smaller size (2 mm^2).

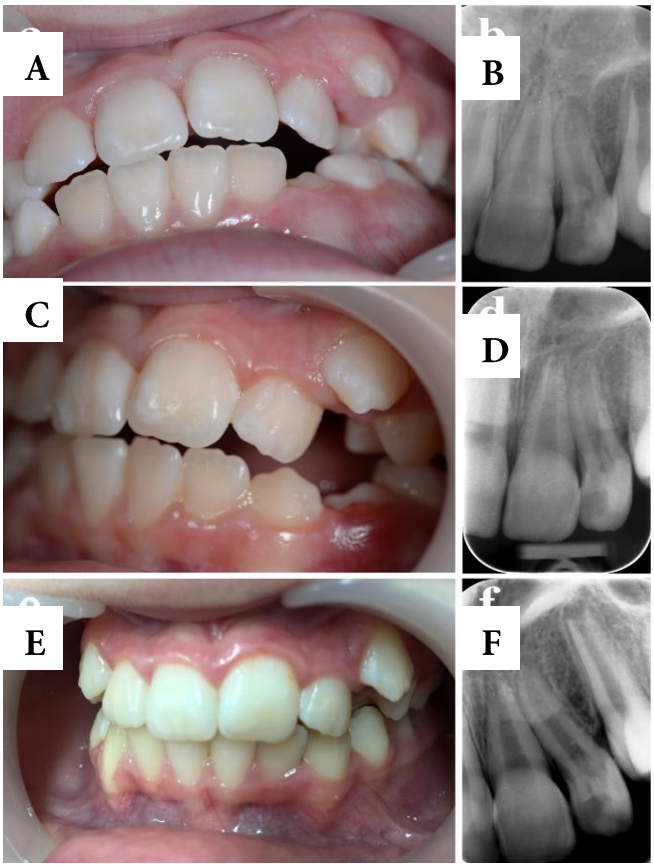

Figure 4. *A, B)* Clinical photographs and radiographs taken six months after surgery showing absence of clinical or radiographic evidence of pathological responses or apical periodontitis of tooth #22; *C, D)* Follow-up clinical and radiographic pictures of restored tooth #22 taken 12 months after surgery showing clinical normal view and continuing normal root growth; *E, F)* Clinical photographs and radiographs taken 18 months after surgery showing a correct clinical picture of tooth #22, continued root maturation of tooth #22

It was decided to perform the same type of treatment in the presented case, however, with the use of Biodentine™. This biomaterial is capable of inducing the healing process in the exposed pulp tissue; including re-organization of the soft tissue and differentiation of odontoblast-like cells from subodontoblast cells [19, 20]. Biodentine™ is a bioactive, biocompatible material with good physico-chemical and biological properties. It enables proper healing and dentin bridge formation, and has a short setting time next to effective sealing capacity; allowing the bioactive cement to be used in stomatology in cases of vital pulp therapy. Biodentine™ has the smallest hard-tissue staining potential compared to other dentin substitutes, which makes the material more efficient in cases of aesthetic restoration [21-23]. In the current case, both the aesthetic factor and short fixation time were important in the selection of the material, however, the key factor was its properties. Maintaining the vitality of the tooth enabled apical maturation, which was later confirmed radiographically. Similarly, Smail-Faugeron *et al.* [14] presented a double tooth treatment using Biodentine™, but performed an intentional pulpotomy *before* separation of the fused teeth to prevent subsequent exposure of the vascular canals and tissue necrosis. Yet another method of treating double tooth based on auto-transplantation has been presented by Smail-Faugeron *et al.* [14] and Tuna *et al.* [5]. In the case reported by Tuna *et al.* [5], the left lateral incisor was fused to a supernumerary tooth. The fused tooth was extracted as a whole and then separated. The remaining distal portion of the tooth was immediately replanted. After 4 years, the tooth was still functional and placed in the proper occlusion.

In our case, extraction was performed using an atraumatic method. The additional application of PRF to the post-extraction socket had positive effects on healing. The platelet concentrate a) contained growth factors, b) stimulated collagen production, c) recruited other cells to the site of injury, d) produced anti-inflammatory agents, e) initiated vascular ingrowth, f) induced cell differentiation, and g) improved the wound healing potential in soft and hard tissues [24].

After extraction of the supernumerary tooth, the remaining part of the double tooth takes up less space than before separation, which may result in diastema, open contacts, and other orthodontic disorders. This condition requires orthodontic treatment, which was applied in the current and other cases [1, 2, 5, 6, 18]. Some authors recommend preparing the fused teeth to reduce the width of the crown. Others prefer extraction of the double tooth and subsequent orthodontic treatment [7, 8]. In a study conducted by Velasco *et al.* [4], it was claimed that fused tooth extraction and succeeding orthodontic treatment were less risky than hemisection and endodontic treatment.

In some cases, patients are treated by the extraction of entire double tooth, and subsequent long and complicated orthodontic, implantological and prosthetic treatments. This method was chosen by Pair [25], who reported the long-term treatment of a patient with a double tooth. He decided to remove the entire double tooth, and then pursue complicated orthodontic treatment. In the case described in our study, the orthodontist treating the patient had also considered the extraction of both fused teeth followed by orthodontic, implantological and prosthetic treatments as secondary course of action if the if the regenerative procedure did not work. However, that was not necessary considering the procedure followed. Bearing in mind that double tooth in the lateral sections are extremely rare.[12], this study can help clinicians in similar situations.

Conclusion

Literature reveals a wide array of strategies for the management of double teeth, but the morphology of the fused teeth can be so different that the chosen treatment must always be determined on an individual basis. Full functionality of the tooth and aesthetic considerations are most significant when choosing a therapy. The novelty of our case was the multidisciplinary treatment, using a minimally invasive method, and applying Biodentine™ as a bioactive cement; this accelerated the healing of the pulp, retention of tooth vitality and assisted in further root development as well as a favourable aesthetic result.

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Conflict of Interest: 'None declared'.

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