

CASE REPORT

Severely altered post-traumatic internal morphology of upper incisors associated with biologic width violation – the combined conservative approach

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Abstract

This is the report of a case of four upper incisors with multiple internal/external resorptions after a falling accident in the childhood and subsequent violation of the biologic width by incorrect individual coronal restorations. Endodontic orthograde retreatment was performed and mineral trioxide aggregate (MTA) was placed as apical plug and to repair the large internal resorption. In order to re-establish the biologic width, a controlled surgical crown-lengthening procedure was performed. The expression of matrix metalloproteinase (MMP)-9 in the gingival tissue was used as a biomarker for the presence of inflammation in the hypertrophied gingiva. The one-year control revealed the cessation of the resorptive activities and the stability of the periodontium. The choice for a conservative combined treatment was essential in maintaining the affected teeth in an esthetically challenging area.

Keywords: tooth luxation, root resorptions, root canal therapies, crown lengthening, immunohistochemistry, violated biologic width.

Introduction

Internal and external root resorptions of various extents of permanent teeth following dental trauma, occurred especially during childhood, are commonly reported in the literature. Luxation injuries, which are the most common [1, 2] result in damage of the attachment apparatus or in the affection of the apical neurovascular supply of the pulp [3].

As sequelae of attachment damage, surface resorptions [4] or replacement resorptions [5] were described. As consequences of pulpal necrosis caused by damaging the neurovascular supply, apical periodontitis with apical root resorption [3] or peri-radicular periodontitis with root resorption [6, 7] can occur.

Internal root resorption is rare in permanent teeth [3, 7] and are often misdiagnosed as external resorptions. They are characterized by a radiolucency confined to the root and therefore the original outline of the root canal is distorted [3], but they do not involve the bone [3]. On the other hand, external root resorption is always accompanied by resorption of the bone [3]. Although internal resorptions may have multiple causes, it has been reported that trauma may be recognized as an initiating factor [8].

Sometimes, falling trauma of incisors teeth in young adults result in fractures which necessitate extensive prosthetic restoration. They may interfere with the biologic width; its violation frequently leads to persistent inflammation of marginal soft tissues, deteriorating the long-term prognosis of the affected teeth.

Matrix metalloproteinase (MMP)-9 or gelatinase B is an endopeptidase with different active forms, weighting 82–130 kD. The activity of MMP-9 is related to inflammation and the involvement of MMP-9 in periodontal disease was already shown [9, 10].

This case report illustrates an unusual and clinically relevant late post-traumatic situation – the management of multiple internal and external resorptions in all four maxillary incisors, treated by a combined endodontic-periodontal approach, aimed to arrest the resorptive processes and to correct the prosthodontic violation of the biologic width. The expression of MMP-9 in the gingival tissue was used as a biomarker for the presence of inflammation in the hypertrophied gingiva.

Patient, Methods and Results

A 21-year-old female patient attended the Department

of Periodontology of the “Victor Babeș” University of Medicine and Pharmacy, Timișoara, Romania complaining about anesthetic gingival growth with persistent inflammation, spontaneous and provoked bleeding of the gingiva of the upper incisors, despite regular and reinforced personal hygiene.

The personal history revealed a trauma (falling accident) at the age of eleven, which resulted in a deep subgingival horizontal fracture of 11 and the subluxation of 12, 21 and 22. At that time, 11 underwent immediate endodontic treatment followed by post-and-core restoration, while the luxation of the other teeth was reduced and they were adhesively splinted. Reportedly, within a couple of months, all teeth, except the already treated 11, became initially hypersensitive, then tender to percussion. At the first sharp-pain episode, all untreated incisors were checked for vitality, the pulpal necrosis of 12, 21 and 22 was declared, and they underwent endodontic treatment. Two years after, an apical lesion at 22 underwent apical surgery. As the crowns of all incisors suffered color modifications following the endodontic treatments and considering also the anesthetic enamel cracks, all incisors were provided with individual ceramic crowns.

On intra-oral examination, single metallo-ceramic crowns were found on the upper incisors. The gingiva adjacent to the ceramic crowns presented moderate inflammation both on the buccal and on the palatal aspects, with visible modifications of color, volume, texture and contour, in sharp contrast with the adjacent gingiva (Figure 1a). Moderate gingival pockets of cca 4 mm and bleeding on probing (Figure 1b), but no loss of attachment were found on all aspects of the involved teeth, while bleeding on probing of the gingiva of adjacent teeth was absent. All other teeth showed no signs of periodontal disease. A maxillary frenum with low insertion was also found. The patient demonstrated excellent oral hygiene status with Plaque Index 0.2 Silness and Loe (1964) [11], excellent oral hygiene measures knowledge and motivation.

Radiographic examination revealed: tooth 12 – mid-root resorption with total replacement of the apical third by trabecular bone, with osseous entrapment of the gutta-percha point; tooth 11 – a thin bone-entrapped gutta-percha point, a voluminous post-and-core restoration; tooth 21 – circular resorption of the middle third of the root, reaching the periodontal space on the distal aspect of the root, with no interruption of the lamina; intact appearance of the apical third (Figure 2a); tooth 22 – absence of the apical third with sharp resective line and complete corticalization over the resected area, incomplete canal treatment, absence of the retrograde filling (Figure 2b). The reduced distance between the margins of the crowns and the alveolar crest in the upper frontal region, with no loss of the periodontal supporting bone was also noted.

Based on the clinical and radiographic findings, the periodontal diagnosis of violation of the biologic width of the upper frontal region was established.

Endodontic procedures

The old ceramic crowns were removed and orthograde endodontic retreatment was initiated. Under the dental

operating microscope (OPMI PICO, Carl Zeiss AG, Oberkochen, Germany) the old filling of 12 was removed up to the resorption and a large part of the entrapped gutta-percha point was removed without damaging the replacement bony tissue.

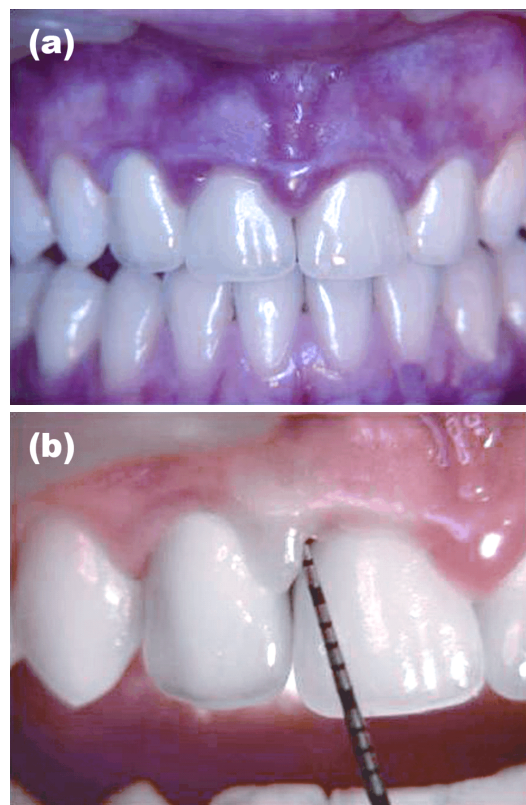


Figure 1 – Initial clinical situation. Note the peculiar aspect of the gingival inflammation, characteristic to the violation of the biologic width (a) and the gingival pockets (b).

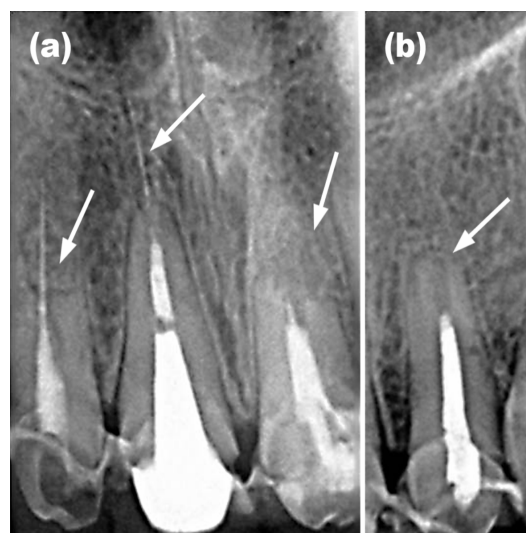


Figure 2 – Initial radiographs of the incisors. Internal resorption on 21, replacement resorption with entrapped gutta-percha point on 12 (a), absence of the apical third with sharp resective line and complete bone corticalization over the resected area on 22 (b).

Calcium hydroxide was used as an interim dressing for one week. In the second appointment, the interim dressing was removed, 5.25% sodium hypochlorite irrigation and 17% solution of EDTA were used. The

canal was dried and an apical plug of gray MTA (ProRoot MTA, Dentsply Maillefer, Ballaigues, Switzerland) of 5 mm was placed in tight contact with the periapical tissue and adapted to the canal walls, to seal the apical exit of the root canal, by using Dovgan carriers (Vista Dental, Racine, WI, USA) and pluggers (Obtura S-Kondensors No. 80, Obtura Spartan, Earth City, MO, USA). A cotton pellet moisturized with distilled water was placed and the tooth was temporary sealed. After 24 hours, the MTA plug was checked for setting and the tooth was adhesively restored with a glass fiber post No. 2 (EasyPost, Dentsply Maillefer) luted into the root canal with self-adhesive cement (RelyX Unicem, 3M ESPE, Seefeld, Germany) (Figure 3a).

Because of the major risk of fracture and considering the lack of chronic lesions and resorptive activities at the apex, the cast metallic post on 11 was left in place.

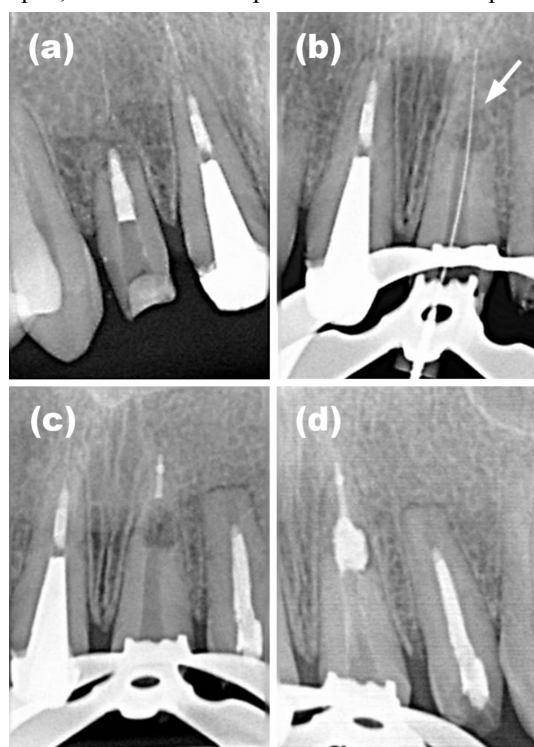


Figure 3 – Radiograph of 12 after endodontic orthograde retreatment (a), and of 21 after removal of the old filling (b). Note the large internal resorption separating the coronal third from the apical third and the retrieval and scouting of the apical canal up to the WL with an ISO instrument; 21 – control radiograph of the gutta-percha filled apical third (c); MTA placed as repair and filling material in the internal resorption (d).

Tooth 21 underwent orthograde retreatment, because of the major internal resorption. Special care was taken into removing gutta-percha from the coronal part of the canal with Gates–Glidden drills and hand K-files, respecting the thin canal walls in the middle part. Serial radiographs were the only mean to confirm the working length (Figure 3b); the chemo-mechanical preparation was performed with ISO K-files (Dentsply Maillefer) in step-back technique, under copious irrigation with 5.25% sodium hypochlorite, followed by 17% EDTA. One week of interim dressing of calcium hydroxide followed. In the second appointment, the apical third of

tooth 21 was obturated with a gutta-percha master point compacted with a System B plugger (Figure 3c). In the same session, tooth 22 was retreated using the same technique (Figure 4a). Special care was taken in debriding the apical part of the canal using MicroDebridors (Dentsply Maillefer).

In both 21 and 22, MTA was placed with carriers, ultrasonically vibrated and condensed in two or more application-vibration-compaction series, to fill the large resorptive defect in 21 (Figure 3d) and to ensure an apical plug of 5–5.5 mm in 22 (Figure 4b). After 24 hours, teeth were isolated again and backfilled using thermo-plastified gutta-percha and then adhesively restored (Figure 4c).

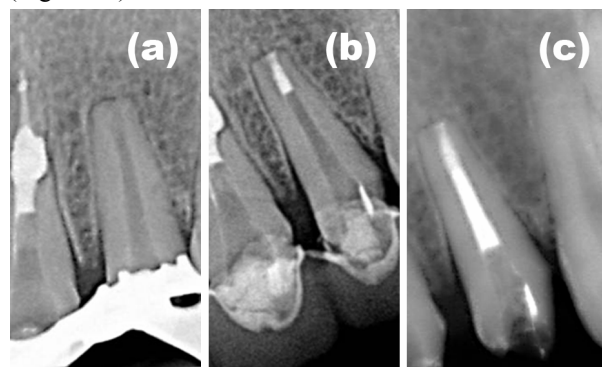


Figure 4 – Post gutta-percha removal (a), post-endodontic radiograph of 22 with MTA placed as apical plug (b) and the root canal backfilled with gutta-percha (c).

Periodontal procedures

In order to reestablish the biologic width, the orthodontic extrusion of the roots has been initially proposed. As the patient rejected this option, a controlled surgical crown-lengthening procedure was initiated. Briefly, after evaluation of the distance between the most apical part of the epithelial attachment and the bone crest by bone sounding with a periodontal probe (UNCPCP, Hu-Friedy, Chicago, IL, USA), a buccal split-full-split flap including vertical releasing incisions was created, including the four upper incisors. After the raising of the flap, the cervical shoulder preparation in close relationship with the crestal bone (less than 1 mm) became evident (Figure 5a). The flap was apically displaced and attached to the intact periosteum in the interdental papilla regions with positioning sutures. The crestal bone was removed and shaped using the Ochsenbein chisels up to a level which restored the biologic width of 3 mm. The scalloped contour of the crestal bone was also re-created and the cervical most apical contour of the central incisors was elevated to the level of the intercanine cervical line, to restore the esthetic appearance. Care was taken to create a crestal bone width aimed to ensure the soft tissue stability during the bone remodeling and healing. The flap was laterally sutured. On the palatal aspect, an excisional flap was created, which, after beveling of the old shoulder preparations, was sutured with continuous suture to the existing teeth. An immediate provisional bridge, to ensure esthetic appearance and masticatory function during the healing was manufactured, while keeping the margins of the provisional crowns supragingivally.

The healing occurred uneventful. The patient was kept under observation for the following four weeks through weekly visits, in which the food debris were gently ultrasonically removed and the maturation of the soft tissue was monitored. The sutures were removed at 14 days (Figure 5b), when the immediate provisionals were replaced with long-term acrylic provisionals, in order to guide the healing of the marginal gingiva and to re-create the papillas.

At six months after the surgery, the patient received the final metallo-ceramic crowns, designed to respect the surgically re-created biologic width. Recall appointments were scheduled every six months, to check the stability of the endodontic and periodontal relationships. At controls, the marginal gingiva appeared free of inflammation (Figure 6) and the Rx examination indicate the cessation of the resorptive activities and the stability of the periodontium.

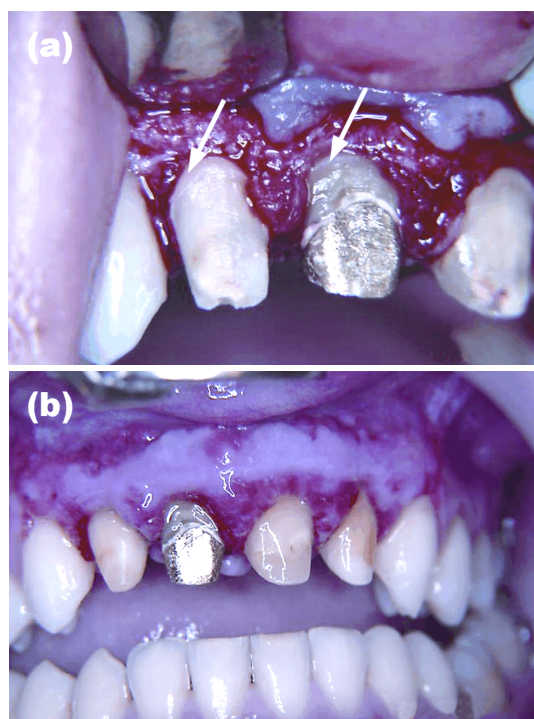


Figure 5 – Aspect during the crown-lengthening procedure. The close proximity of the shoulder preparation to the alveolar margin is visible (a). At 14 days after surgery, the early maturation of the soft tissue can be observed (b).



Figure 6 – Control clinical situation. Note the lack of inflammation and the improved esthetic aspect.

Immunohistochemical assay

The tissue samples obtained during periodontal procedure were fixed in 10% neutral formalin solution for 48 hours and then included in paraffin. The histological examination was performed using classic Hematoxylin–Eosin technique. For the immunohistochemical examination, the recovery was achieved by boiling for 11 minutes in the microwave oven in buffered citrate solution with pH 6. Immunomarking for MMP-9 was achieved using LSAB technique, with primary antibody rabbit anti-human MMP-9 (Abcam) in 1:200 dilutions. For detection, the Dako EnVision™ System, with 3,3'-diaminobenzidine (DAB) as chromogen was used. The sections were imaged with an Eclipse 90i microscope (Nikon, Apidrag, Bucharest, Romania).

The images showed the gingival hypertrophy with subepithelial inflammatory infiltrate and positive immunostaining for MMP-9 disposed under the basal epithelial layer and perivascular (Figure 7).

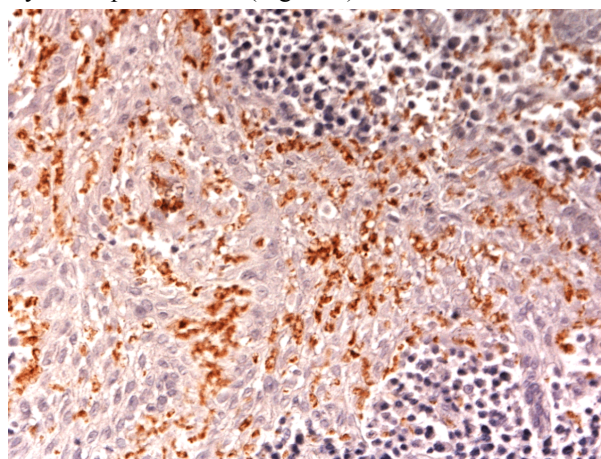


Figure 7 – Intense positive immunomarking for MMP-9, $\times 100$.

Discussion

This case report illustrates an unusual post-traumatic situation of multiple internal/external root resorptions associated with the violation of the biologic width of upper incisors. Multiple traumatic injuries of the frontal arch may lead to different patterns of lesions: crown fractures, luxations, pulpal necrosis, followed by internal and external resorptions. Difficulties were encountered in differentiating the type of resorption. Neither the case history nor the radiological diagnosis suggested a certain origin of the resorptions. The actual type was rather suggested by the radiological final appearance of the filled lesions, which pointed to a confinement by the internal lamina dura.

When multiple teeth are involved in traumatic injuries, different type of lesions can appear and progress with different rates and consequences [12]. The treatment and the prognosis depend on the stage of the defect, on the location and size of the lesion and on the post-traumatic delay of measures [12, 13]. In fact, large resorptions may reduce the tooth resistance to shear forces, resulting in fractures [14].

The current literature opinion is that ankylosis and osseous replacement that follows cannot be reversed

and can be considered a physiologic process since bone resorbs and reforms throughout life [15]. However, the follow-up of this case suggests at least a possible cessation of the bone replacement process, provided the appropriate treatment is performed.

The finding of a bone-entrapped gutta-percha point indicates the resuming of the resorption after the initial endodontic attempt at an early age. Therefore, the follow-up of a conservative approach in post-traumatic luxation injuries should extend up to the adult age [15].

As the final treatment option offered to patients with a sufficient amount of restant bone support is always a dental implant, the decision to extract the trauma-affected tooth must be carefully considered [16].

Emergency treatments of traumatic dental injuries in young adults do not always ensure a successful long-term prognosis, as the status of the injured area may change over the time. Therefore, both the endodontic and periodontal status of the involved teeth should be periodically re-evaluated, to avoid asymptomatic deteriorations. There is little evidence in the literature about long-term success of combined endo-perio approaches following late complications of traumatic injuries of frontal teeth [17–19].

Calcium hydroxide is recommended as interim dressing in resorptive processes of various origins to necrotize the resorptive tissue and to stop the bleeding [20], to alkalize the environment [21, 22] and to combat the acute stage of infection or immunodestruction [13], in order to arrest the process.

Irrigation with sodium hypochlorite is an important phase of endodontic treatment of teeth with internal resorptions [20] because of its tissue dissolving action, controlling the bleeding, while disinfecting and cleaning the area [20]. Thus, it helps to dry the root canal, in order to place the MTA plug at the desired level in a relatively dry environment. MTA creates a hard barrier that closes the root canal breaches and it is totally tolerable for the periodontal tissue. Moreover, it was shown in the literature that application of MTA in extensive dental destruction originating from internal/external resorptions may lead, paradoxically, to an increase in resistance [16, 23].

The case report also underlines the importance of the re-gaining of the biologic width when planning prosthetic restorations of teeth recovered after deep subgingival fractures. In the present case, the incorrect subgingival shoulder placement has been extended to all involved teeth, so the restorations have subsequently violated the biologic width, affecting the entire involved area. It has been theorized that infringement on the biologic width by the placement of a restoration within its zone may result in gingival inflammation [24], pocket formation, and alveolar bone loss [25]. These consequences were clinically evident in the present case, justifying the primary esthetic complaint of the patient, and were sustained by the presence of intense immunomarking for MMP9 in the gingival tissue harvested during the periodontal surgery. The involvement of MMP-9 in inflammatory events during plaque-induced periodontal disease has been already proven [26, 27] and the particular case of the gingival inflammation caused by

the prosthodontic violation of the biologic width seems to make no exception.

As the orthodontic extrusion was rejected by the patient, the classical remedy remained a surgical crown lengthening. This aimed to provide retention form to allow for proper tooth preparation, impression procedures, and placement of restorative margins [28] and to adjust gingival levels for esthetics [29, 30]. It is recommended that there should be at least 3 mm between the gingival margin and bone crest [31–34]. This allows for adequate biologic width when the restoration is placed 0.5 mm within the gingival sulcus [23, 34]. On the other hand, creating a distance of at least 3 mm from the alveolar crestal bone level to the future reconstruction margin leads to stable periodontal tissue levels, avoiding late post-surgical recessions, as well [35, 36].

In our case, the crown-lengthening surgery re-gained the lost biologic width. The surgical procedures were justified by the violation of the biologic width and by the esthetic appearance of the crowns.

Conclusions

This case report suggests that combined conservative endodontic-periodontal approach seems to have a stabilizing role in young adults' subjects to falling trauma, especially in esthetic-sensitive areas, affected by previously ill-managed measures and lack of appropriate follow-up. The combined treatment succeeds in restoring and maintaining the biologic width, arrests the resorptive processes and ultimately reverses the prognosis of natural teeth which otherwise would have been replaced by dental implants, by maintaining them functional and improving their esthetic.

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