ARTICLES SCIENTIFIQUES

Surgical extrusion for the reconstruction of a fractured central incisor: a case report

Extrusion chirurgicale pour la restoration d'une incisive centrale fracturée: un rapport de cas

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Abstract

The restoration of crown-root fractured teeth is a challenging procedure, especially in the esthetic area. It is crucial to ensure an adequate amount of sound tooth structure to establish a ferrule effect and recreate supracrestal tissue attachment, without compromising the esthetic appearance. Available treatment options include surgical crown lengthening and orthodontic or surgical extrusion. In this report we present the management of crown-root fractured maxillary central incisor through atraumatic surgical extrusion.

Key words

crown-root fracture, surgical extrusion, esthetics, supracrestal tissue attachment

Résumé

La restauration de fracture corono-radiculaire constitue un veritable challenge, particulièrement dans la region. Il est crucial de garantir une quantité adéquate de structure dentaire saine afin d'établir un effet de ferrule et de recréer l'attache tissulaire supracretale, sans compromettre le resultat esthétique. Les options thérapeutiques disponibles comprennent l'élongation coronaire et l'extrusion orthodontique ou chirurgicale. Dans ce rapport, nous présentons la gestion d'une fracture corono-radiculaire d'une incisive centrale maxillaire par une extrusion chirurgicale atraumatique.

Mots clés

fracture corono-radiculaire, extrusion chirurgicale, esthétiques, attache tissulaire supracrestale

INTRODUCTION

Significant tooth structure loss with a subgingival limit can be attributed to a variety of factors including, crown-root fracture, extensive carious lesion, cervical root resorption, and iatrogenic lesions. The restoration of these severely destructed teeth is challenging, and their overall prognosis remains uncertain (1). This challenge arises from two specific factors. The first factor is the preservation of the supracrestal tissue attachment, commonly referred to as the biological width (2). This biological width encompasses both the apico-coronal dimensions of the junctional epithelium (≃ 0.97 mm) and the supracrestal connective tissue (≃ 1.07 mm) (3). In fact, the infringement of restorative margins within the biological width is associated with inflammation and loss of periodontal supporting tissue (2). Moreover, in the same time as maintaining

the biological width, it is essential to ensure there is enough sound tooth structure available for crown preparation. In fact, at least 1.5 mm of ferrule is required to ensure the crown's retention and resistance to fracture (4). Although individual differences occur in the supracrestal tissue attachment dimension, a minimum of 4.5 mm of supracrestal sound tooth structure is considered optimal; 1.5 mm ferrule, 1 mm sulcus depth and 2 mm biologic width distance (4).

In the case of a severely damaged tooth without sufficient supra-alveolar structure to achieve an effective ferrule effect and to ensure the preservation of the supracrestal tissue attachment, mainly three treatment options have been described.

Crown lengthening procedure is the surgical removal of hard and soft periodontal tissue to gain supracrestal tooth structure (5). However, this invasive procedure is associated with unfavorable gingival architecture and poor esthetic results in the anterior region (6). Furthermore, this procedure increases the crown-root ratio, which, in turn, has a detrimental impact on the long-term survival of the abutment tooth (7).

Orthodontic extrusion, with or without fiberotomy, may be a suitable alternative for transposing the lesion to a more coronal position. Limitations of this method include longer treatment duration and higher costs. Due to coronal movement of the gingiva and the supporting bone, periodontal surgery is often required to restore optimal gingival contour (8).

In order to address the limitations of the aforementioned procedures, surgical extrusion has been suggested (9,10). This surgical approach, also referred to as intra- alveolar transplantation, involves the intentional repositioning of the remaining root portion within the socket to a more coronal position to obtain sufficient ferrule and restorability.

Therefore, the aim of this work is to provide a case report of the surgical extrusion of fractured maxillary central incisor.

CASE REPORT

A 15-year-old adolescent was referred to the department of Periodontology at the Clinic of the Faculty of Dental Medicine in Monastir, for crown lengthening of the tooth n°11 with trauma history to the maxillary anterior tooth region. The patient's dental, medical, and family history were non-contributory.

The extraoral examination did not yield relevant information.

The intraoral examination revealed an oblique fracture line extending from the mid-coronal region on the labial side with the involvement of pulp and subgingivally on the palatal surface of the maxillary right central incisor #11.

The periodontal tissue showed no signs of inflammation, and the probing depths were within the healthy physiological limits (1-3 mm). No excessive mobility was recorded (Fig 1,2).

Figure 1 Initial intraoral buccal view

Figure 2 Initial intraoral occlusal view

The radiographic examination showed a sufficient endodontic treatment without peri-apical lesion (Fig 3). No root fracture was detected.

Figure 3 Radiographic examination

The diagnosis of complicated crown-root fracture was retained (11).
Multiple treatment options were proposed to the patient including, crown lengthening and orthodontic treatment, or surgical extrusion. After being informed of the risks and benefits of each of the available treatment options, the patient opted for surgical extrusion of the tooth n°11.

Surgical procedure

Under local anesthesia, an internally beveled para-marginal incision was realized in the palatal side of the toot n°11 to remove excessive marginal tissue (Fig 4). This incision was then extended with a fiberotomy performed on the buccal and proximal sides of the tooth using a 15c blade.

Figure 4 Palatal gingivectomy

A full thickness flap was gently elevated on the palatal side to in order to expose the crestal bone and visualize the fracture line, wich was slightly below the bone crest (Fig 5).

Figure 5 Palatal flap elevation: note the level of the fracture

Gentle luxation of the root was executed with a fine periotome to avoid fracture of the remaining root and to reduce damage to the surface cells of the root and the alveolar crest (Fig 6). The incisor was extruded along the longitudinal axis without removing it from the alveolar bone until the fracture line was positioned 4 mm above the bone crest (Fig 7).

Figure 6 Atraumatic luxation with periotome

Figure 7 Tooth extrusion

The palatal flap was sutured using two internal vertical mattress sutures in the interdental papillae. The tooth was immobilized by adhesive splinting to the adjacent teeth on the palatal side and additional interproximal composite resin fixation on the buccal side (Fig 8, 9).

Figure 8 Immediate buccal postoperative view

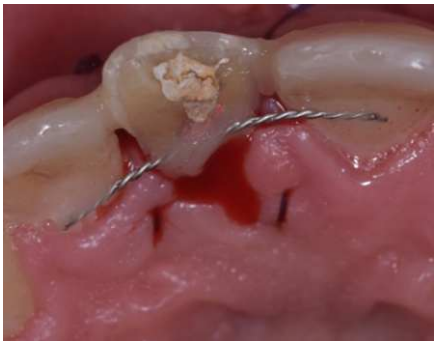

Figure 9 Immediate occlusal postoperative view

The patient was advised to avoid biting on the tooth and to rinse twice daily with chlorhexidine 2% until the next visit. Ha was prescribed analgesic during 5 days.
Immediate post-operative radiograph showed a wedge-shaped shadow around the apex (Fig 10).

Figure 10 Postoperative radiographic examination

The sutures and the composite resin fixation were removed after 2 weeks.
The adhesive splinting on the palatal side was removed two weeks later and the tooth exhibited mobility degree 2 (Fig 11, 12).

Figure 11 Healing at one month: buccal view

Figure 12 Healing at one month: occlusal view

A provisional restoration was prepared at two months of healing. At the three-month post-operative visit, the patient returned with the tooth displaying physiological mobility and a coronal migration of the gingival margin (Fig 13).

Figure 13 Healing at 3 months

An internally beveled gingivectomy was conducted to realign the gingival margin with the adjacent central incisor (Fig 14, 15).

Figure 14 Incision design

Figure 15 Gingivectomy

At 6 months post-operative, the final restoration was delivered and the radiographic examination showed the reorganization of the periodontal space and bone apposition in the periapical area. Periapical radiolucency was detected on the adjacent central incisor and endodontic treatment was scheduled (Fig 16, 17).

Figure 16 Healing at 6 months

Figure 17 Radiographic examination at 6 months

DISCUSSION

Surgical extrusion treatment outcome is considered successful when periodontal healing is present, without root resorption or ankyloses. A favourable outcome also includes the presence of a stable marginal bone level without significantly increased tooth mobility (12,13).

The biologic foundation for surgical extrusion has been demonstrated by Lindhe et al. (14-16) in animal studies. They showed that placing an intact root with a healthy cementum in the bone would lead to the formation of the periodontal ligament, whereas teeth that underwent root planning showed signs of resorption or ankylosis after 3 months. They concluded that to recreate a periodontal ligament, a healthy cementum is required. These studies suggest that a successful surgical extrusion technique requires an initial root with a healthy cementum and periodontium. Also implied are gentle surgical maneuvers to minimize wounds at the level of the root involved and of the alveolar bone (17). If the cementum is damaged, a dentin surface in direct contact with the bone may lead to resorption or ankyloses (10).

A systematic review focusing on the adverse events of surgical extrusion based on 11 case reports and 8 case series involving 226 patients with 243 teeth revealed that non progressive root resorption was the most common finding, with an event rate of 30%, followed by tooth loss (5%), slight mobility (4.6%), marginal bone loss (3.7%), and progressive root resorption (3.3%) (18).

In a clinical study conducted by Krug et al. (6), the success rate and the occurrence of biological and technical complications following tooth extrusion with the atraumatic extraction system (Benex system) were examined. According to the study, the authors found that 92.2% (47 out of 51) of the extruded teeth were deemed successful. The complications observed included transient resorption in 9.8% of cases and marginal bone loss in 19.6% of cases. A more recent clinical study conducted by Graf et al. (19) examined the effectiveness of this approach and the associated complications. The authors reported 100% success rate for the definitive restoration, with no recorded biological complications during a follow-up period of 36.5 months.

Hence, it is advisable to employ a minimally invasive tooth extraction technique to prevent damage to the cementoblast layer on the root surface and to minimize the risk of biological complications.

Even though surgical extrusion with the Benex extraction system seems to fully prevent progressive root resorption and ankylosis, removal of sound hard tissues during preparation of the screw hole and a risk of perforation that cannot be completely ruled out may be regarded as possible drawbacks (6). Further, insertion of the screw may induce dentinal cracks, thus potentially limiting the long-term prognosis of the tooth (12).

In this case report, a fine periotome was employed gently to luxate the tooth without the need for reducing tooth structure, offering a potential alternative to these systems.

Physiological splinting, rigid splinting and non-splinting are applicable for the extruded tooth (13). A flexible splint allowing physiologic tooth mobility promotes periodontal healing and reduces the risk of ankyloses (11). Due to mismatch between the socket and the extruded root the splinting period may be longer than that after replantation of avulsed teeth and can be extended up to 6 weeks, particularly in cases of high mobility of the extruded root (6). The recommended splinting time varies among studies from 2 to 6 weeks according to the stability of the tooth (12). Recent studies have demonstrated that periodontal healing is probably unaffected by splinting time (20). In this case a rigid splint was applied during the initial two weeks, followed by the use of a flexible splint for an additional two weeks.

A consensus regarding the amount of time required for healing after the surgical extrusion procedure is currently lacking. Periodontal indices recorded before the surgery and 1 month after surgical extrusion have been reported to show no significant differences; their values decreased from 1 to 3

months after surgery (21). A significant reduction in the mobility of the tooth has been reported after 45 days. Bone apposition in the periapical area was observed 2 months after surgical extrusion. While some authors have recommended restoration 2 months after the procedure (22), others have recommended a waiting period of 3 (23), 6 (21), or 9 months (24). In this case, the tooth was restored provisionally at 2 months, and the permanent crown was delivered at 6 months.

In the everyday clinical routine, a cost- and time-efficient treatment concept is usually preferred. Compared to the orthodontic procedures, the overall treatment time is shorter in surgical extrusion. The orthodontic extrusion time is described with an average of four to six weeks and a retention period is recommended for four weeks up to six months (25). One literature review stated that orthodontic extrusion is indicated in cases which request a highly predictable treatment, when an orthodontic device is already present, or tooth vitality should be preserved (8).

Nowadays, with the increased promotion of dental implants, crown-root fractured teeth are likely to be extracted, even if less invasive options are feasible. In fact, dental implants are not devoid of intraoperative and postoperative complications. The occurrence of perimucositis and peri-implantitis around implants is not uncommon, and effectively managing these issues presents a significant challenge (26). No less, extraction is an irreversible action that should be considered as the last resort. In this particular case, the option of a dental implant was not considered due to the patient's young age.

CONCLUSION

Surgical extrusion is an effective procedure to provide sufficient sound tooth structure, allowing a physiologic restoration of severely destructed teeth in the anterior region. This relatively predictable and feasible procedure has hardly any disadvantages for patients, and in case of failure, an implant or fixed partial denture are still an option.

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