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Treatment of complex dentoalveolar injury – avulsion and loss of periodontal tissue: a case report

CASE REPORT

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Dental avulsion is a complex injury which affects multiple tissue compartments including dental pulp, gingival soft tissue, periodontal ligament, alveolar bone and cementum, which all suffer from damage. This damage includes disruption of the gingival epithelium, severance of the periodontal ligament and the dental pulp neurovasculature and injury to the cementum and alveolar bone. Similarly, the pattern of healing for a replanted tooth is a complex process that rests on the healing potential of the cellular compartments (1).

Avulsion injuries usually occur close to the home or school (2). Falls and collisions have been reported as the essential causes of dentoalveolar injury worldwide (3). Large incisal overjet and inadequate lip coverage are known as important biological predisposing risk factors to dentoalveolar injury (4, 5).

The American Association of Endodontics published therapeutic protocols to standardize the concept and treatment of dental trauma cases. Recently, the International Association of Dental Trauma published new recommendations for avulsed teeth (6, 7). The guidelines are generally similar in content. The therapeutic protocol emphasizes preconditioning the root as a prior stage to the replantation of the tooth. Treatment of teeth that have completed root development is different from those which have an immature root. It is very important to take into consideration how long and under which conditions the tooth was kept out of the mouth (1, 5-13). Avulsed teeth should be immediately replanted for best results within 5 min (13). In case the tooth cannot be replanted at the place of the accident, it should be stored in special storage media to maintain periodontal tissue in as good a state as possible until the patient receives appropriate treatment at a dental office (1, 5, 6, 8). The mature permanent teeth with extraoral dry time of 1 h or less, or teeth stored in a biological medium should be treated carefully to avoid further damage to the root surface and remaining periodontal ligament tissues. In cases of teeth with open apex, it is recommended to soak the tooth in doxycycline for 5 min before replantation. It was found that pulp revascularization was importantly enhanced (5, 7, 8, 14–17). In the open apex tooth, essential aim is to promote revascularization of pulp, on this occasion avoiding pulpal infection has a paramount importance.

Traumatic losses in periodontal tissue are treated with various mucogingival methods. Laterally sliding flap (LSF) procedure has been used for many years since it was first introduced by Grupe and Warren in 1956. LSF is a pedicle soft tissue graft procedure used in the treatment of recession defects that have adequate donor tissue laterally and vestibular depth. (18–20).

In investigations on the dental trauma, treatment has usually dealt with tooth, not the surrounding tissues. Therefore, there has been no study about complex cases involving both avulsion and severe periodontal tissue loss in the literature as in our case.

This report presents a successful replantation and repair following loss of gingival tissue in a patient with complex dentoalveolar injury.

Case report

A 9-year-old female patient was referred urgently to Gülhane Military Academy, Department of Periodontology 45 min after falling prostrate in a play park. The



Fig. 1. Clinical appearance from buccal view just before the replantation and the laterally flap procedure.

extraoral examination revealed the swelling of the upper lip. In the intraoral evaluation, it was revealed that two maxillary central incisors were avulsed. Each tooth lost its vestibular alveolar socket wall. In addition, the gingival soft tissue loss of 26 mm diameter at half circle shape has occurred between the central incisors (Fig. 1). Neither damage was seen in other teeth. Two avulsed central incisors were carried by the patient in a plastic cup partially filled with cool light (low-fat) milk. On arrival in the Department of Periodontology, the extraalveolar period was 45 min. Both the avulsed teeth were observed to have immature root. Treatment guidelines for avulsed permanent teeth with open apex were carried out for the both teeth. The root surfaces and apical foramens were cleaned by a stream saline. The teeth were placed in doxycycline (1 mg per 20 ml saline) for 5 min. The coagulum from the sockets was removed by a stream saline. Each tooth was replanted by slight digital pressure. Loss of gingival soft tissue was primary repaired by bilateral laterally sliding flap procedure. With a 15 blade, we made a vertical incision from the gingival margin to outline a flap adjacent to the recipient site and slide the flap laterally onto the avulsed root and alveolar bone. Owing to thin thickness of the donor site, we used full-thickness flap. This procedure was made as double side.

The teeth were splinted with orthodontic wire, which is supported by composite material for 6 weeks. Doxycycline two times per day for 7 days and a chlorhexidine mouthrinse (0.1%) twice a day for 2 weeks were administered. Soft diet for 8 weeks was suggested. Instructions were given to patient to perform good oral hygiene and not to bite at all with the injured area. Anti-tetanus serum was given prophylactically. Clinically, the central incisors seemed to have healed with no detectable complications and on removal of the splint at 6 weeks, the central incisors showed surprising stability. They responded positively to sensitivity test made with CO2 ice after 2,5 months post-operatively. When CO2 ice was applied to the cervical portion of the avulsed teeth, it responded positively beginning from 3 s. We also applied CO2 ice to the neighbouring teeth which responded positively at a similar time to avulsed teeth. Clinical and radiographic examination will be continued. There was no gingival recession on the donor sites during the following period.

Discussion

An improved understanding of the inflammatory process has led to a more conservative approach in managing dental trauma.

Maintaining the viability of the periodontal ligament (PDL) that is attached to the avulsed tooth is critical. One of the most important factors determining the prognosis for the tooth is the length of extra-alveolar time. Ideally, the tooth should be replanted immediately (within 5 min) after the injury in an effort to preserve the viability of the PDL cells, and so to optimize healing and minimize root resorption (12, 13, 21). If immediate replantation is not possible, avulsed teeth should be stored in a physiologic storage medium such as milk, balanced salt solution, tissue culture media, physiologic saline until the tooth can be replanted (1, 22-27). Water is the least desirable storage medium because the hypotonic environment causes rapid cell lysis and increased inflammation on replantation (23). It has been shown that cool milk $(4^{\circ}C)$ is preferable to room temperature milk (23°C) to maintain periodontal cell viability (28). The best storage medium for avulsed teeth, hitherto, seems to be the tooth rescue kit Dentosafe (29, 30). Low-fat milk is an appropriate alternative to the optimal solution for storage of avulsed teeth (21). In view of this information, storage and carriage has been in optimal conditions in our case.

Hammarström et al. found that the administration of parenteral antibiotics prior to extraction and immediately following replantation resulted in less inflammatory root resorption in monkeys (31). Cvek et al. report that the occurrence of revascularization is highly dependent on the presence or absence of bacteria in the pulpal lumen. Their experimental study has demonstrated that topical treatment with doxycycline before replantation significantly increased the frequency of complete pulp revascularization, presumably due to a decrease in the number of micro-organisms that contaminated the root surface during the extra-alveolar period (5, 8, 14, 16, 17). Ritter et al. suggested that minocycline facilitates pulp revascularization in replanted immature teeth after replantation also (15).

There is consensus in the guidelines that the pulp should be removed within 7–14 days of replantation in mature permanent teeth (5–8). All guidelines recommend delaying the initiation of endodontic treatment in avulsed teeth which has immature apices with extraalveolar time of 2 h or less, because of the possible revascularization of the pulp. However, a recent clinical study found that the overall 'length of the pulp' at the time of replantation and the extraoral storage conditions were the most important predictors of pulp revascularization. Teeth with 'shorter' pulp length were more likely to become revascularized than teeth with longer pulp length. Overall, revascularization occurred in 34% (32/94) of teeth in which it was considered as a possible result (12). In another clinical study, only 18% (13/72) of teeth replanted with immature apices became revascularized (32). Apical development at the time of replantation was found to be significantly related to survival (33). Teeth with open apices had a relative risk of failure 4.2 times greater than incisors with closed apices. Andreasen and Borum suggested that incisors replanted with open apices had lower survival up to 10 years after replantation (9). If revascularization does not occur, the pulpal space will inevitably become infected. The combination of bacteria in the root canal and cemental damage on external surface of the root can result with an infection related root resorption that can be very serious and lead to the rapid loss of the tooth (34).

CO2 ice has been the most effective sensitivity test, particularly in teeth with immature apices (35). Sensitivity test used with CO2 ice may take up 76–90 days to respond positively (7, 36). In our case, positive response to sensitivity test carried out with CO2 ice in replanted teeth was obtained after 2.5 months. However, laser Doppler flowmeter is an earlier indicator (at 34 days post-trauma) of pulp revascularization (36).

As soon as the tooth is replanted, the need for immediate splinting has not been shown to favour either the pulp or periodontal ligament (10). However, due to patient considerations, immediate splinting will, in most instances, be indicated in order to avoid accidental displacement of the replanted tooth (11). Splinting provides stabilization for replanted teeth through the initial healing period and allows some movement (37, 38). The splinting period, usually 2–4 weeks (9), was extended to 6 weeks in order to wait for the attachment of connective tissue in this case because of missing bone tissue in vestibular socket walls of both central incisor.

Periodontal plastic surgery is defined as the surgical procedures performed to correct or eliminate anatomic, developmental or traumatic deformities of the gingiva or alveolar mucosa. LSF procedure is a periodontal plastic surgery technique which is usually performed, involving one or two teeth in order to cover denuded root surface (39). In this case, however, as wound site could not be closed primary due to loss of gingival tissue, we carried out LSF procedure involving two teeth each on either sides with the aim of protecting the bone tissue below and restoring lost soft tissue. In the selection of surgical treatment procedure, gingival tissue factors such as depth and width of missing in gingiva, availability of donor tissue, presence of muscle attachments and aesthetics was taken into consideration (18). In this case, because adequate amount of attached gingiva is present in donor area, LSF procedure has been preferred to free gingival graft which necessitates a second surgical procedure.

Replanted incisor teeth in our case have got asymptomatic normal mobility, eruption pattern, normal sound on percussion and still positive sensitivity test in 5 months after replantation (Fig. 2). These are satisfactory outcomes as suggested by The International Association of Dental Traumatology (7). Follow-up procedures which include clinical and radiographic examination will be continued in 6th month, 1st year and 5th year.



Fig. 2. Two avulsed central incisors in 5 months after replantation.

In childhood, teeth losses due to trauma are quite common. As in this case, there may be not only avulsion of teeth due to trauma, but also tissue damage involving gingival and surrounding tissues. In conclusion, it should be borne in mind that, in avulsion cases involving periodontal tissue damage as well, periodontal surgical approaches in addition to replantation procedure are important treatment options for preserving the tooth in its place.

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