

Splinting of traumatized teeth with a new device: TTS (Titanium Trauma Splint)

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Abstract – Displacement injuries of permanent teeth are an increasing emergency in the dental office. Children and adolescents are particularly prone to dental trauma due to participation in risky activities. Repositioning or replantation with subsequent stabilization by a dental splint is the standard of care for most displaced or avulsed permanent teeth. Non-rigid fixation allowing physiologic tooth mobility has been shown to be desirable for periodontal healing. A flexible splint of short duration appears to reduce the risk of dentoalveolar ankylosis or external replacement resorption. Different splinting techniques are currently recommended for stabilization of repositioned or replanted teeth, including a wire-composite splint, an orthodontic bracket splint or a resin splint. Each splinting option has its specific advantages and shortcomings. This paper describes a new splinting technique which offers improved comfort and handling to the patient and dentist alike.

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Dental trauma has become a frequent emergency in children and adults alike. Andreasen & Andreasen (1) in 1990 wrote that tooth injuries will probably surpass dental caries and periodontal disease as the most significant threat to dental health in the foreseeable future. Indeed, it is estimated that today approximately half of all adolescents have sustained at least one episode of dental trauma before they reach school leaving age (2–4). A multitude of factors appear to contribute to the increasing number of tooth injuries, such as the popularity of accident-prone leisure activities like skate-boarding, roller-skating or snow-boarding, a general tendency of taking greater risks, and the unawareness of preventive measures.

There were an estimated 5.9 million episodes of care for orofacial trauma in the U.S. private practice sector in 1991 (5). More than 4 million (68%) were seen by general dental practitioners, the rest by specialists (5). However, dental trauma still represents one of the few situations where dentists are called upon to make unscheduled diagnostic and treatment decisions in an area that is outside their routine experience (6). Therefore, treatment guidelines and techniques should be simple and straightforward.

Traumatically displaced or avulsed permanent teeth routinely require a splint for stabilization following repositioning or replantation (7). The course of healing of the severed periodontal ligament will determine the treatment outcome of these injured teeth. There are many ways to stabilize traumatized teeth, for example fixation by means of orthodontic-wire splints, wire-composite splints, resin splints, porcelain veneers, miniplast or acrylic splints, etc. (8–13). Currently, non-rigid splinting of injured teeth to non-injured adjacent teeth is the standard of care. It has been shown that there is no benefit in extending the splint to more than one adjacent firm tooth (14). For most cases, a flexible splint of short duration, approximately 1 to 2 weeks, is thought to be in the best interest of the patient with respect to hygiene and esthetics. This type of splint also provides an ample stabilization period for PDL healing (7, 11). Experimental studies in non-human primates have demonstrated that rigid splinting, i.e. immobilization, or a prolonged splinting period may lead to extensive PDL healing complications, such as dentoalveolar ankylosis or external root resorption (replacement resorption) (15–20). Therefore, maintaining a certain degree of tooth mobility appears to be beneficial to

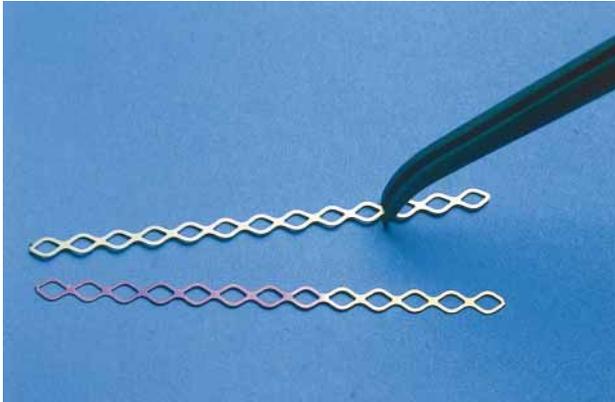


Fig. 1. TTS splints (52 mm in length) in different colors depending on the anodization process.

periodontal healing of traumatized teeth. Several studies have shown that physiologic tooth mobility is not or only minimally altered following the application of modern splinting techniques (21–25).

Another prerequisite for periodontal healing is that the splint should not impinge on the marginal tissues thus preventing additional periodontal damage. Be-

Table 1. Requirements of modern splints for stabilization of traumatized teeth

<ul style="list-style-type: none"> - intraoral application - simple procedure (placement and removal) - adequate fixation for whole stabilization period - no additional trauma to splinted teeth - allowing physiologic tooth mobility - no interference with occlusion - be easy to keep clean - no damage to gingival tissues - esthetically acceptable - endodontic treatment and sensibility testing should be possible
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sides, mechanical tooth cleaning should not be impaired by the splint thus reducing the impact of plaque accumulation with respect to soft tissue and periodontal healing (Table 1).

TTS

The TTS (Titanium Trauma Splint, patent pending) has been developed by the authors in close collaboration with Medartis AG, Basel, Switzerland. The main objective of developing a new device was to optimize current splinting techniques.

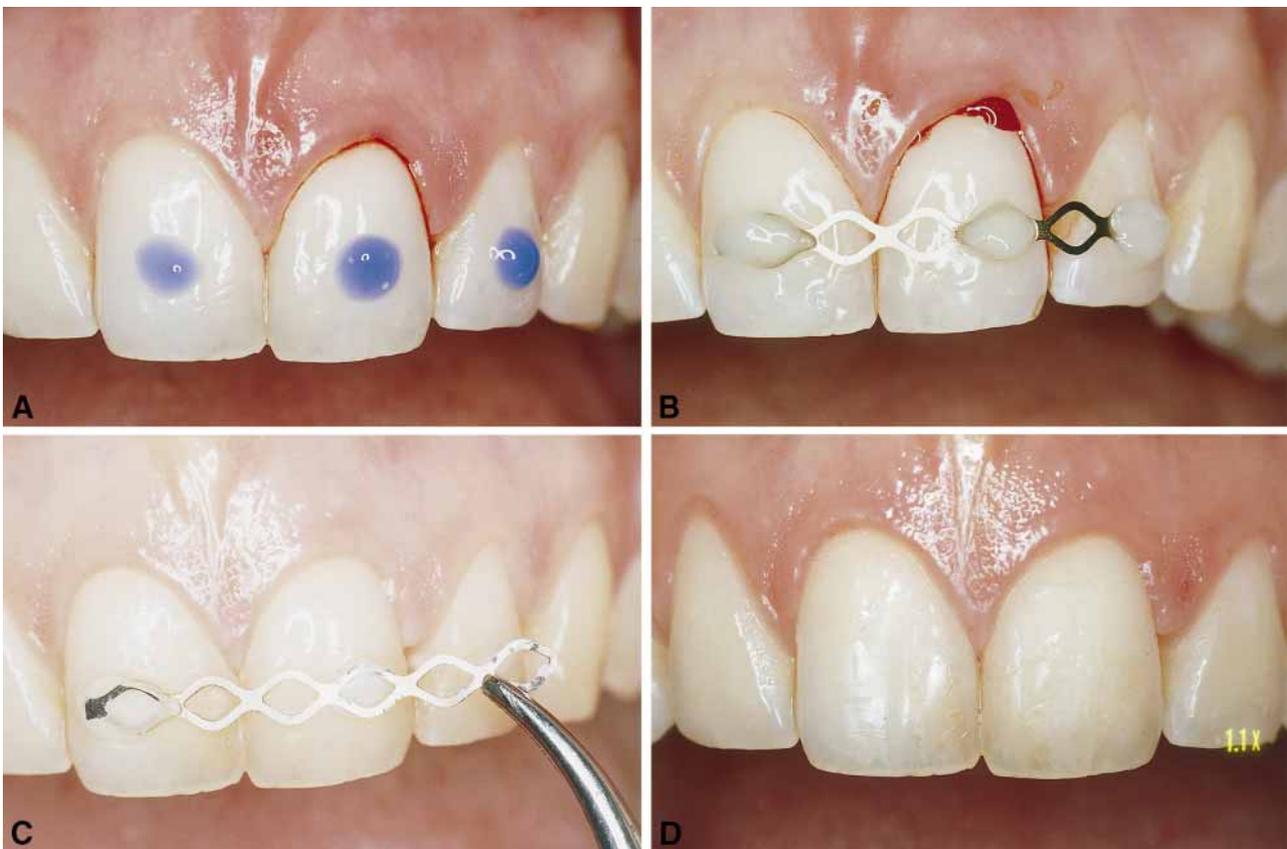


Fig. 2. A) After repositioning the traumatized maxillary left central incisor, minimal etching gel is applied according to the small openings of the TTS. B) Using bonding agent and light curing composite resin, the TTS has been fixed to stabilize the injured tooth. C) At the time of splint removal, the TTS can just be “peeled” off from the tooth surface. D) Final view after splint removal.

In view of the dentist

– ease the application and removal procedures of the splint.

In view of the patient

– raise comfort with respect to speech, nutrition and oral hygiene.

The TTS is made of pure titanium and is only 0.2 mm thick (Fig. 1). Therefore, it can be easily adapted to the contour of the dental arch. Pliers or bending instruments are not necessary, since the TTS can be bent with the fingers. The TTS is available in two lengths, 52 mm and 100 mm. The TTS can be cut to the desired length with any cutting instrument, or preferably with the specially designed scissor-instrument.

The unique design of the TTS with its rhomboid mesh structure makes it flexible in all dimensions, thus allowing physiologic tooth mobility without transferring orthodontic forces to the splinted teeth. On the other

hand, the material and dimensional characteristics of the splint (width 2.8 mm) still guarantees a certain mechanical stiffness to withstand shearing forces.

Another advantage of the TTS are the rhomboid openings of the splint which facilitate its fixation. The size of the rhomboid openings (1.8×2.8 mm) clearly defines only a small area of bonding, thereby reducing the amount of composite to be used. It is no longer necessary to shape a bulk of composite around the splint. On the contrary, a thin layer of a (fluid) composite can be simply applied to fill the rhomboid openings with subsequent light-curing.

Case report 1

A 26-year-old female patient was referred to our department after sustaining a tooth injury in a basketball game. The patient reported that her upper left incisor was displaced to the palate, and that she had

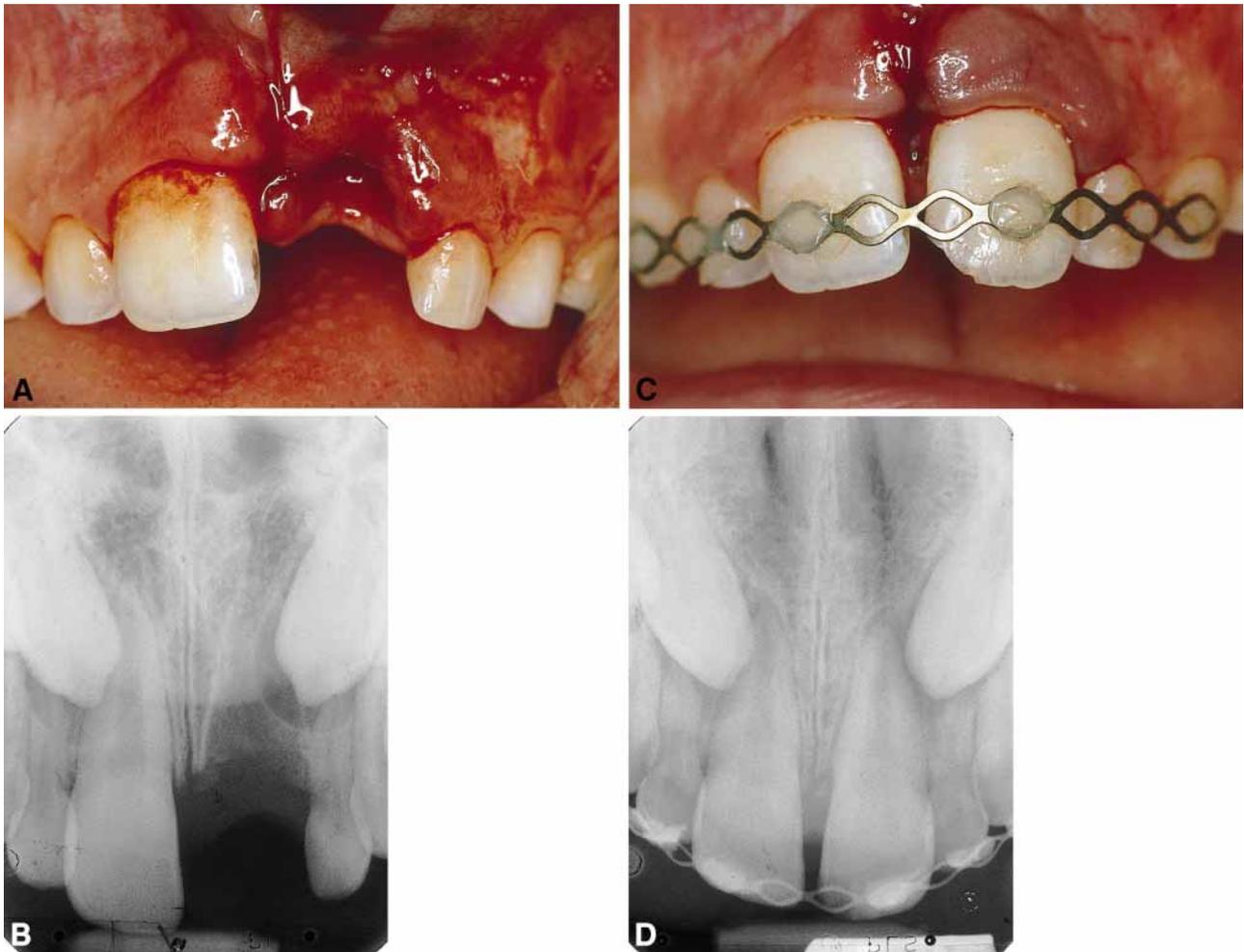


Fig. 3. A) Avulsion of the maxillary left central incisor in a 9-year old boy. B) The radiograph depicts the empty alveolar socket. C) Following tooth replantation, an extended TTS was placed for stabilization of the avulsed tooth. D) The radiograph shows the correct replantation of the maxillary left central incisor.

repositioned her mobile tooth immediately by pushing it forward with her tongue.

Intraoral examination revealed a slight axial displacement of the maxillary central left incisor by 1.5 mm. The tooth was mobile and tender to percussion. Sensibility testing with CO₂ was negative. The gingiva showed bleeding on both buccal and palatal aspects. None of the adjacent and opposing teeth showed signs or symptoms of trauma. A diagnosis of lateral (palatal) luxation was made for the maxillary central left incisor.

The injured tooth and one adjacent tooth on both sides were cleaned using a small gauze with saline with subsequent air-drying. Small areas of the buccal enamel corresponding to the openings of the TTS were etched employing 35% phosphoric acid gel for 30 seconds (Fig. 2A). After rinsing off the gel and drying the etched enamel surfaces, the splint was bonded first to the non-injured teeth. Finally, the traumatized tooth was repositioned and held in position by finger pressure. It was then bonded to the already fixed TTS (Fig. 2B).

The splint was left 10 days until the patient was scheduled for splint removal. The composite was ground down to the level of the TTS. Subsequently, the TTS could simply be "peeled" off from the tooth surfaces utilizing a hemostat (Fig. 2C). Any composite remnants were removed with a curet and the tooth surfaces were refined with polishing disks (Fig. 2D). Finally, fluoride-containing fluid was applied for remineralization of the etched enamel. Endodontic treatment continued uneventfully.

Case report 2

Following a car accident, a 9-year-old boy was referred for treatment of an avulsed permanent central maxillary incisor (Fig. 3A,B). The tooth was stored dry for 1 h prior to placing it into a physiologic storage medium (Dentosafe[®], Medice, Iserlohn, Germany). After careful clinical and radiographic inspection, the tooth was replanted and secured with a TTS splint (Fig. 3C,D). An antibiotic treatment was instituted for 1 week with 100 mg tetracycline given on the first day and 50 mg per day for the following days. Since the avulsed tooth was not ideally stored following trauma, and because root formation was complete, endodontic treatment was performed with a Ca(OH)₂ suspension 10 days after splinting, immediately prior to removal of the splint.

Discussion

These cases describe a new device for splinting repositioned or replanted teeth. The presented technique fulfills all requirements to splint injured teeth as listed in Table 1. Moreover, the application and removal of the

splint are further simplified by the unique design of the TTS. All patients so far treated with this new splint have unanimously reported that the TTS rarely impairs function and esthetics due to the small dimension of the splint. However, these subjective findings should be substantiated in a controlled clinical study. The authors also plan to analyze the benefits of the TTS in a multi-center study and in experimental studies.

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