

## Wire-Composite Splint for Reimplant Procedure of First Permanent Incisors

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### Abstract

Reimplant procedure is a treatment of choice to avulsed or exarticulation or total luxation of teeth from their socket. Splint is a part of reimplant that is important in stabilized and immobilized tooth for the time needed to ensure the healing of periodontal membrane. This clinical report describes a simplified wire-composite splinting procedure of avulsed upper anterior teeth due to fall 10 days ago of 10 years old, boy. He visited to Pediatric Dentistry clinic, Faculty of Dentistry Universitas Indonesia accompanied by his mother without any pain and also no dilaceration around his face. Intra oral examination shows sockets region 11 and 21 filled of blood clot, and teeth 13, 12, 22, 23 in good position and immobile. Treatment planned is reimplant of teeth 11 and 21, and splinting by ligature wire-composite from 13 to 23. Procedures treatment of avulsed teeth are endodontic extra oral, reimplant, and wire-composite splint using SS wire 0.18 inch and self-adhesive composite resin. Periodically control post-reimplant and the wire-composite splint are once a week on the first month, then on the third and sixth month. The wire-composite splint removed at the sixth check-up or 4 month post-reimplant due to fixation of 11 and 21 was completed.

The ligature wire bonded with resin-based composite works well for splinting avulsed teeth, in a boy aged 10 years old, due to avulsed teeth 10 days prior the trauma.

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### Introduction

Avulsion in dentistry is teeth out of its socket due to traumatic injury and involve damage to gingiva, periodontal ligament and pulp tissue.<sup>1-3</sup> Traumatic injury of the anterior permanent teeth are common during childhood as a result of falls, exercise or accident.<sup>4</sup> Reimplantation is the treatment of choice for anterior avulsed permanent teeth, especially in the adolescent as well as children and should be done immediately after the injury. If not possible, the tooth should be stored in an adequate storage medium.<sup>1,4</sup> Reimplantation procedure followed by splinting to stabilize and immobilize, protect teeth from traumatic stress, helping mastication, oral hygiene and increased patient comfort in the period of healing.<sup>5-7</sup> Type of splint

can be flexible, semi-rigid or rigid, can be designed by using ligature of Stainless Steel wire and resin-based composite. Avulsed tooth should use semi-rigid splint which can deliver physiological pressures.<sup>5</sup>

### Literature Review

Avulsion or exarticulation is a state that the teeth apart from its alveolar socket because of a traumatic injury.<sup>2,11-14</sup> Clinically, it showed empty teeth socket as well as gingival bleeding, and radiographic interpretation present empty socket with/or without related alveolar bone fracture.<sup>14</sup>

Percentage avulsion cases occurrence estimated at 0.5% and 16% of all traumatic injuries in the permanent dentition.<sup>11,15</sup> Avulsion most often occurs in children aged 7-9 years, when the alveolar bone sufficiently flexible to provide minimal retention of the pressure extrusive and frequently in the central incisor teeth.<sup>11,15</sup>

Reimplantation is one of management option for young permanent anterior avulsed

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teeth. If the young anterior permanent tooth loss, it can lead to cessation of the alveolar bone formation, the alveolar bone on the alveolar ridge becomes narrow and difficult to be restored in the future using either a bridge or implant restoration.<sup>2,3,14</sup> The best time to do reimplant is immediately the tooth avulsed. It is associated with a good prognosis because the chances of healing pulp tissue and periodontium ligament.<sup>2,3,15,16</sup> If reimplant could not be performed immediately, the teeth are stored in a medium that has an osmolality and pH in order to maintain the vitality of membrane periodontium and avoid drying of teeth.<sup>3,16-18</sup> Some of the storage media are Hank's Balance Salt solution (HBSS), a solution of a modified Eagle, Via Span, Euro-Collins, Emergency Medical Tooth Saver, saline, powdered milk or pasteurized milk, cow's milk, saliva, or chicken eggs.<sup>2,12,14,17-19</sup> If the avulsed tooth have an extra-oral dry time of more than 60 minutes, it was preferably soaked in an acid solution for 5 minutes to remove the remaining periodontium ligament and then the teeth soaked in stannous fluoride 2% for 5 minutes or the root can be coated with endogain.<sup>2,16,19,20</sup> The teeth resistance to resorption due to expected to have slightly vitality of the of periodontal cells.<sup>1,2,4,16,19</sup> Endodontic treatment can be done extra oral for not longer than 60 minutes, to discard of necrotic pulp tissue, cleaned and obturated.<sup>1,3,4,19,21</sup> The endodontic procedures should be stay with the trias endodontic rules and ensure the root canal free of bacteria.<sup>19</sup>

Splinting is one of the important things in the treatment of avulsed teeth.<sup>22</sup> According to the American Association of Endodontic, dental splint is a rigid or flexible tool or material used to support, protect, or immobilize tooth after reimplantation, fracture or exposed certain endodontic surgical procedures.<sup>20</sup> The aim is to stabilize and immobilize the teeth for the time needed to ensure there are no additional injury and to protect the attachment apparatus to assist periodontal fibers to regenerate.<sup>10,20,21</sup> The terms dental splint, are as followed<sup>1</sup> it can be created quickly outside the laboratory using conventional dental materials, easy to use, and inexpensive;<sup>2</sup> it easily removed without damaging the hard tissue of teeth, gingival tissues or increase the risk of caries;<sup>3</sup> it does not cause trauma to the teeth or surrounding tissue;<sup>4</sup> it does not interfere with occlusion, aesthetics, dental hygiene or

orthodontic treatment;<sup>5</sup> the precise position followed reimplantation should issue a minimum pressure between the root surface and the alveolar bone to help reorient functional periodontal membrane fibers.<sup>6,9,15,18-20</sup>

Rigidity splint should be adjusted to the type of trauma.<sup>7</sup> Flexible splint allows the distribution of pressure functional, so they are indicated for treating injuries to the periodontal ligament, such as dislocation injury and root fracture horizontal infra-alveolar.<sup>7,16,22</sup> There are several types of splints in trauma cases. Cap Splint (Figure 1) or Erich's Arch Bar (Figure 2), used several decades ago, when the rigid splint on the tooth luxation considered necessary.



Figure 1. Cap Splint.



Figure 2. Erich's Arch Bar<sup>8</sup>

Suture splint is the simplest type of splint, by placing sutures passed through the incisal edge of the tooth gingival palatal or lingual to the buccal gingival. The indications for this splint is to prevent extrusion of teeth that have been repositioned. This splint is effective for short periods of time and can be used after the procedure autotransplantasi (Figure 3).<sup>8</sup>

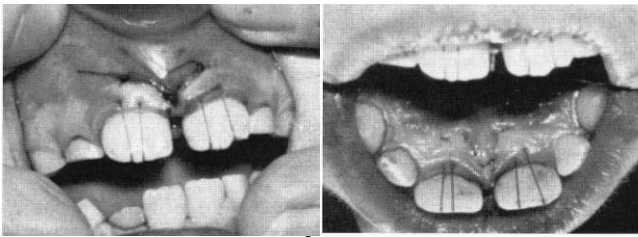


Figure 3. Suture splint.<sup>9</sup>

Composite Resin Splint, the advantages of using resin splint is that it is aesthetically pleasing, easily created and used as a functional splint (Figure 4).



Figure 4. Composite Resin Splint.<sup>6,8</sup>

The disadvantage is susceptible to fracture in the inter dental, easily dislodged, rigid, and difficult to remove without damaging the tooth structure underneath.<sup>8,10</sup> Orthodontic Bracket and Wire Splint usually used for splinting displacement and avulsed teeth. The advantage are the reduction more accurate under light pressure.<sup>10</sup>

However, the accurate wire bending is required to ensure that the splint is a tool that is passive, especially when using a wire rectangular.<sup>8,9</sup> To prevent, it is recommended to use orthodontic wire bending.<sup>8</sup> The other disadvantage is a splint may cause irritation of oral mucosa, complicates the oral hygiene and cause discomfort during the initial setup splint (Figure 5).<sup>8</sup>



Figure 5. Orthodontic Bracket-Wire Splint.<sup>21</sup>

Wire-composite Splint (Figure 6), was introduced in 1987 and since then it has been reviewed and tested in vitro and in vivo.<sup>15</sup> Wire-

composite splint reinforcing material bonded using the technique of etching acid the requirements for a modern splint in dental trauma.<sup>6,9,20</sup>

The advantage of using a splint wire-composite are easy to clean and well tolerated by patients, provided in place practical and easy to make, flexible that distribute occlusal forces similar with normal teeth, but did not give a lot of mobility in the teeth.<sup>1,6,19,20</sup> Since the occlusal forces were given nearly identical to normal teeth, the length of the installation splint is not too influential and installation of a splint can be extended as long as it is required for the healing of soft tissue and bone supporting.<sup>20</sup> One of the disadvantages of using a splint which is bonded using adhesive is a risk of damage to the enamel during the disposal of the splint.<sup>5</sup> Splint type is contraindicated in teeth using crowns artificially or have restorations are great because they can not be etched.<sup>20</sup> The risk of developing gingivitis exist and generally are reversible and disappear after the splint is removed.<sup>20</sup> Wire-composite splint preferably made of rectangular wire size 0:16 x 0:22 inches or out of round wire measuring 0:18 inches.<sup>19,20</sup> Make a small loop at both ends of the wire when using round wire to prevent lateral movement of the wire (Figure 6A).<sup>9,10,21</sup>

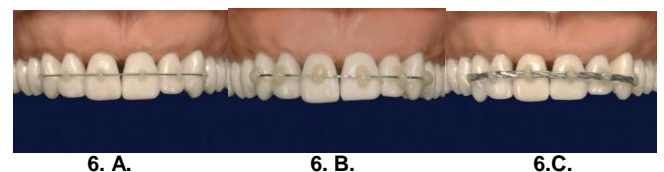


Figure 6. Wire-Composite Splint: 6. A. Round wire, 6. B. Rectangular wire, and 6. C. Coaxial wire 3x1.<sup>6</sup>

Enamel on the labial surface (the middle third of the crown) were etched for 30 seconds using phosphoric acid 37%, rinsed and filled with resins and composites, both polymerized separately using ultraviolet light.<sup>9,10,20,21</sup> Polymerization of composites in the central part of the crown begins on abutment tooth and ended with tooth avulsion, which can be maintained in position using a digital pressure this time.<sup>9,10,20,21</sup> After surface polymerization of composite resin, the rough wire-composite splint should be polished.<sup>9,10,20,21</sup> Do not have to stick to the wire tightly to enamel because composites will fill the gap between the teeth and the wire.<sup>20</sup>

Wire-Composite Splint should elongated two or three teeth laterally from the avulsed teeth.<sup>20,21</sup> Once the splint is in place, radiographs should be taken to ensure the avulsed teeth position is correct and as a reference pre-operative treatment for further control.<sup>19</sup> Surface if etched enamel will experience remineralization within 24 to 72 hours.<sup>19</sup> Rigidity splint can be improved by increasing the thickness of the wire or fill in the labial interdental teeth with composite.<sup>7,15,22</sup> The recommendation of duration splinting in avulsed teeth is not more than 7-10 days to prevent ankylosis. Splint is causing quite a lot of damage to dental injuries and the risk of bacterial invasion into the wound periodontal splint and wires due to proximity to the edge of the gingiva.<sup>8</sup>

Periodically check-up recommendation performed once a week in first month post-reimplantation and splinting then in the 3<sup>rd</sup>, 6<sup>th</sup> and 12<sup>th</sup> month, and once a year for at least 5 years parallelly to level of healing.<sup>1,2,19</sup> Examination of the clinical and interpretation of radiographic done to provide information on the conditions on the tooth avulsion and periodontal membrane.<sup>1,19</sup> Although there is the risk of ankylosis, in pediatric patients and adolescents reimplant should still be done and considered as a temporary settlement.<sup>2</sup> Wire-composite splint give advantage to maintain the teeth post reimplantation and the vertical as well as horizontal dimensions of the alveolar bone until the stabilization and immobilization has been completed.<sup>1-3,17</sup>

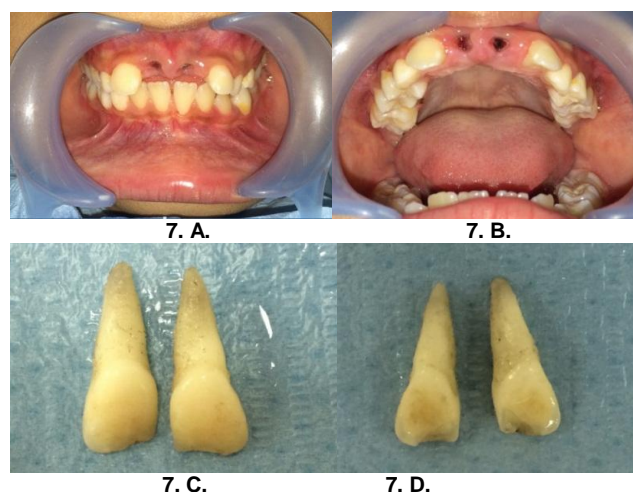
### Case Report

Patients boy, ages 10 years old, immediately post-trauma, his mother swept the bloody gums with warm water, and gently cleaned the dirty crown and root of avulsed teeth under the running water then wrapped by tissue paper. Then, they went to a dentist, and the dentist transferred avulsed teeth into a bottle and soaked in saline solution, and referred to pediatric dentist.

Ten days later, he and his mother visit to Clinic of Pediatric Dentistry Faculty of Dentistry Universitas Indonesia on 21 February 2014, his mother brought an avulsed teeth kept into saline solution and demand information about how to manage the missing two front teeth caused by falling while he is going to school. As the child come, the child is in good condition, no complaints of pain and fever.

Extra-oral examination, there are no wounds or lacerations due to fall, tender palpated lymph nodes submandible on the right and left. Intra oral shows avulsion of teeth # 11 and 21, socket filled blood-clot with a diameter less than 1 cm, no redness, the teeth #13,12,22,23 in position and immobile. There is a reddish yellow traumatic ulcers on the labial mucosa of the lower jaw, in diameter of 3 mm, moon shape, with uneven edges. No visible redness of the gingival margin in the region of 31, 32, 41, and 42. Molar relationship is Angle Class II. Radiographic interpretation, teeth #11 and 21 total avulsed, empty socket, no foreign objects inside the socket, no alveolar bone fracture, alveolar bone edge is good, and the alveolar bone height of up to 1/3 of cervical root, complete formation of roots #12 and 22 and open apex of teeth #13 and 23, and there is no change of position.

The diagnosis is total avulsed teeth #11 and 21, and fracture Ellis class II and V, Malocclusion Angle Class II. Treatment planning is reimplant teeth #11 and 21, and long ligature Wire-Composite Splint from 13 to 23.



**Figure 7.** Intra oral features of patients: 7. A. and 7. B. Socket 11 and 21, 7. C.: labial 11 and 21; and 7. D.: lingual 11 and 21.

Treatment procedure as follows:

First visit, February 21, 2014, communication, information and education to patient and his mother the advantages of reimplantation teeth considering the growth, function and esthetics. His mother refused reimplanted but she choose to wear the denture. Emergency examination shows, extra oral: no

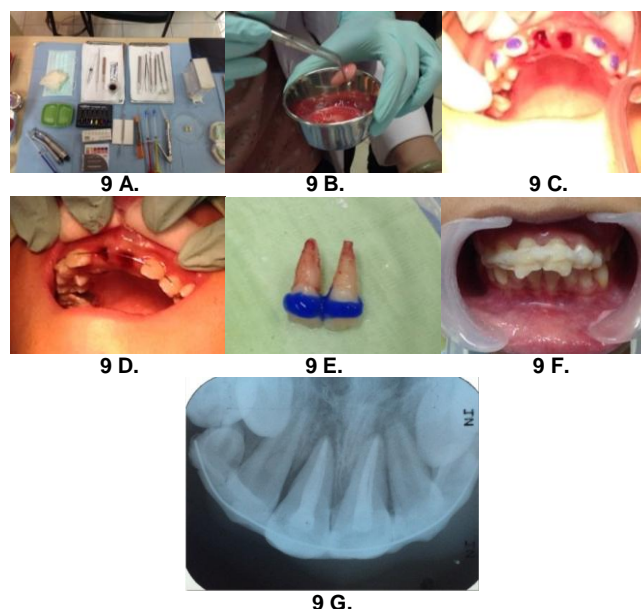
dilaceration or wound around his face, and intra oral: there were socket of teeth # 11 and 21, filled with blood cloth in diameter less than 1 cm, and avulsed teeth soaked in saline solution in the bottle. (Figure 7 A,B,C,D). And radiograph interpretation shows empty socket teeth #11 and 21. (Figure 8)



**Figure 8.** Overview panoramic and periapical radiographic.

Second visit, Februari 28, 2014, his mother approved teeth reimplantation. Preparation of tools and materials for reimplant and splint. The procedure are<sup>1</sup> preparing the avulsed teeth by extra oral endodontic treatment, rounding the apex then soaked in solution fluoride 1.23% for 20 minutes,<sup>2</sup> preparing the socket, swept desinfectant solutions such as chlorhexidin solution 0,2% around working areas, infiltration anesthesia lidocaine 1:100.000 in mucobuccal fold of region 11 and 21, as much as 1.5 ml, and 0.5 ml in palatal block anesthesia. Curettages the socket carefully to clear blood cloths and necrotic tissue. Irrigated by sterile distilled water, repeated of curettages to obtain fresh blood and repeat the irrigation by clorhexidin 0.1%.<sup>3</sup> Preparing the abutment teeth #13,12, 22, and 23. Etching procedure with phosphoric acid 37% for 30 second, at middle third of crown on labial, washed and dried. Applied bonding agent, polymerized, positioning the round stainless steel wire 0.18 inch, at middle third of crown on labial of teeth #13,12,22 and 23, then covered by flowable resin composite on labial surface include of interdental. Gently, taken out the avulsed teeth from storage of fluoride solution, washing, drying, and etching with phosphoric acid 37% at the middle third of labial surface crown then give the adhesive material and polymerized. Afterwards, the avulsed teeth carefully inserted one by one into the socket, and lightly pressured with the finger. Check occlusion clinically, and bending the wire using flowable composite resin. Repeat checked the

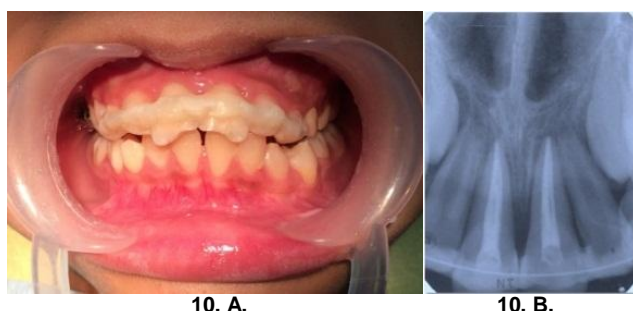
occlusion and polished the rough composite. Periapical radiograph taken to reference the next control (Figures 9).



**Figure 9.** Reimplant and Wire-Composite procedures: 9 A. Tools and material endodontic, reimplant and splinting, 9 B. Avulsed teeth, 9 C. Socket 11 and 21, 9 D. Cemented wire to abutment teeth, 9 E. Etching the avulsed teeth, 9 F. Reimplant and splinting 11 and 21, 9 G.. Periapical radiograph post-reimplant and fitted with a splint.

Patient instruction followed reimplant consumed soft-diet, take care of oral hygiene properly, and referred to ATS, prescription of antibiotic (Amoxan capsule 250 mg, 3x1 days), analgetic (Paracetamole 250 mg, 3x1 days) and antiseptic mouthwash (Chlorhexidine 0,2%, 2 times a day for 1 week).

The third visits (first control: 2 weeks post-reimplantation). March, 14, 2014. The patient feels pain only in the first days post reimplantation. The wire-composite splint in position, teeth #11 and 21 immobilize, percussion 11(-), percussion 21(+), palpation region 11, 21 (-), no redness and oedema around gingiva. Re-checked an occlusion and articulation using articulating paper, no found heavy occlusion pressure, grinding 1 mm of the incisal to decrease extrusion. Periapical radiograph interpretation shows no darkening of periodontal membrane. Patient instructions consumed soft-diet, and take care an oral hygiene properly. (Figures 10)



**Figure 10.** Clinical features (10 A) and periapical radiographic (10 B) 2 weeks post-reimplant and splinting.



**Figure 11.** Clinical features: **11.A.** months post reimplant and splint, **11.B.** Removed wire-composite splint, **11.C.** Teeth 11 and 21 post-restored.

The fourth visits (second control). March, 28th, 2014 (Figure 11). No complaint, the wire-composite splint in good condition, no immobilize of teeth # 11 and 21, percussion and palpation(-), no redness and oedema around. Periapical radiograph interpretation shows no darkening of periodontal membrane. Patient instructions is consumed regular diet, and take care an oral hygiene properly.

The fifth visit (third control). May 2, 2014. No complaint at all, wire-composite splint in position, teeth # 11 and 21 immobilize, percussion and palpation(-), no redness around the gingiva and fair oral hygiene. Periapical radiograph interpretation shows darkening of periodontal membrane. Patient instruction, should take care an oral hygiene properly and planned on the next control to remove the wire-composite splint.

Sixth visit (fourth control). Juni 6, 2014. No complaint at all, wire-composite splint in position, teeth # 11 and 21 immobilize, percussion and palpation(-), no redness around the gingiva, fair oral hygiene. Periapical radiograph interpretation shows no darkening of periodontal membrane. Removed wire-composite splint, restored and counted the incisal edge of 11 and 21, polish all of the teeth and check occlusion. Patient instruction, consumed regular diet, and take care an oral hygiene properly,

recheck-up on next six month or a year after reimplant. (Figure 11. B., 11. C)

## Discussion

Reported case of the avulsed teeth regarding reimplant and wire-composite splint of central incisor teeth after 10 days of avulsion. In accordance with the literature, avulsion of young permanent tooth often occurs in children when retention against retrusion pressure on alveolar bone is minimal and based on some research the frequent of avulsed central incisor teeth is often.<sup>11,14</sup>

Reimplant in this case become the treatment of choice in spite of 10 days of avulsion by considering the age and the stages of growth and development of the patient. Based on the literature, teeth implants are the treatment of choice for esthetic and mastication returns immediately.<sup>2,11</sup> Some previous studies have said that reimplant in pediatric and adolescents dentistry patients is temporary care, but reimplant can maintain vertical dimension of face and horizontal alveolar bone until bone growth is complete.<sup>1-3, 17</sup>

In these cases do pre-treatment before reimplantation with tooth avulsion more than 10 days is by immersing into a solution of fluoride of 1.23% for 20 minutes. In accordance with literature, with extra-oral dental cleaning time over 60 minutes to be at risk of high resorption, therefore soaking in fluoride for 5 minutes before reimplantation needs to be done to make the teeth more resistant to resorption.<sup>1,2,4,16,19,20</sup> Also the endodontic extra oral should be done before reimplant procedures. Based on the literature, if extra-oral dry time of more than 60 minutes, endodontic treatment can be carried out outside the mouth for removal of necrotic pulp tissue. Necrotic pulp tissue can increase the risk of resorption. Endodontic treatment carried out outside the mouth should be done carefully.<sup>1-4,21</sup> Reimplantation procedure in patient were preparation of teeth avulsed, the socket, and applied wire-composite splint. Systemic medication were give such as antibiotics, analgesics and an antiseptic mouthwash and a referral to Anti-Tetanus Serum Vaccin post-reimplantation. This administration in accordance with the literature that says that tetracycline, or penicillin V can be used as systemic antibiotics, chlorhexidine mouthwash as

an antiseptic and analgesic given in accordance with the needs of patients as well as the anti-tetanus vaccination.<sup>9,17-19,21</sup>

The periodic control planning once a weeks in the first month, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> post-reimplant. Each control performed extra-oral, intra oral, and periapical radiographs. This is consistent with literature indicating that each visit of clinical and radiographic control examinations conducted to provide information about changes to the avulsed tooth and the surrounding tissue.<sup>1,19</sup> Patient came 2 weeks post-reimplantasi procedures or 1 weeklate. This is not in accordance with the literature which suggest that the control performed every week in a month post-reimplant.<sup>1,2,19</sup> In this case the wire-composite splint is used for 4 months after the occurrence of avulsed. The reason using Wire-composite splint in this case due to the fabric splint easily available, inexpensive and does not require laboratory manufacturing process. Splint is also not damaging the hard tissue of teeth and gingiva, is easily removed, do not interfere with occlusion and esthetics, and not to complicate the cleaning of teeth.<sup>6,9,15,18-20</sup> The type of wire-composite splint is semi-rigid splint so occlusal forces could distribute almost similar to a normal pressure but do not generate a lot of mobility of the teeth.<sup>1,2,6,15,20</sup> Based on the study, as a splint of this channeling occlusal forces similar to normal teeth, period of usage splint does not unduly influence and installation of a splint can be extended for length of time needed for clinical healing of soft tissue and support networks.<sup>20</sup> Wire used in this case is stainless steel round wire sized 0,18. In this case not be made small loops at both ends. In accordance with the literature of the wire used to make the splint should wire round sized 0,18 or wire rectangular size 0,16 x 0,22 and small loops created to help fixing splint on the teeth.<sup>9,10,20,21</sup> In this case the rigidity of the wire was improved by adding composites in the area on the labial interdental tooth.<sup>1,15,22</sup> Teeth that are involved in the installation of dental splint is 13, 12, 11, 21, 22, 23. Splint installed starting from tooth abutment 13, 12and then proceed to the teeth reimplant and go through to teeth abutment 22, 23. In accordance with the literature indicating that the splint should have two or three teeth extending laterally and installation of dental abutment splint starts at first.<sup>20,21</sup> Once the splint is attached, radiographic examination should be done. This is

supported by the literature stating that radiographic examination is useful to ensure the position of the teeth and serves as a reference for the pre-operative treatment more control.<sup>19</sup>

## Conclusions

Splinting serves for stabilization and immobilization until the healing of periodontal membrane of the avulsed teeth. Expected to reimplant teeth avulsed such as capable embedded in alveolar bone and physiological functioning. Splint type for reimplant teeth should be flexible so that it can distribute occlusal forces such as the occlusal pressure normal. Wire-composite splint meet almost all the requirements of making splints, such as ease of manufacture, splint materials are relatively inexpensive and available in place of practice, and does not interfere with oral hygiene. This splint rigidity can be changed through the wire size and a composite filling in tooth interdental areas.

## Declaration of Interest

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