

# GUIDED BLOCK TOOTH AUTOTRANSPLANTATION in surgically created socket after TDI and inadequate hard and soft tissue in the esthetic zone on 12 y.o boy-case report.

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## Abstract

*Permanent tooth loss in the esthetic zone at a young age leads to inadequate quantity and quality of hard and soft tissue later on. This case report aims to demonstrate how to plan and manage central incisor loss after trauma, and TDI consequences related to hard and soft tissue deficiency using lower first premolar (stage 3 Cvek) in fully guided block autotransplantation with the vestibular bone into surgically created socket. Space insufficiency was corrected by orthodontics prior autotransplantation and continued after TAT to correct the overjet and mid-line deviation. Donor developmental stage and future active eruption was considered and planned on "Blue Sky Bio LL " and "Meshmixer". A Stereolithographic tooth replica was printed (Formlabs 3B+). "One Guide Osstem" drill sequence was used to create the surgical socket. Finally, the form was copied initially from the original tooth "11" and a printed model was used to guide the direct composite modeling.*

*Treatment outcome: At 10 months PA and CBCT follow-up further root development was observed on the transplanted tooth with ongoing pulp canal obliteration without any signs of inflammatory or replacement resorption. Vertical bone height and lamina dura were regenerated, while horizontal bone was significantly improved, with adequate quality and quantity of soft tissue. Guided restoration matched the original tooth shape and color. Self-appearance was improved.*

*Conclusion: Guided block tooth autotransplantation in surgically created socket after trauma complications resulted in significant improvement of hard and soft tissue quantity and quality on 12 y.o. patient.*

**Keywords:** avulsion, dental trauma, replacement resorption, inflammatory root resorption, tooth autotransplantation, autotransplantation in surgically created socket, guided block autotransplantation.

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## Introduction

Avulsion of permanent teeth is seen in 0.5%-16% of all TDI (1). Dental avulsion is well known for its unpredictable long-term outcome, as it affects both the pulp and the periodontal ligament. External inflammatory and replacement resorption are unfavorable avulsion outcomes, unlike the favorable functional healing and surface resorption (2). Another avulsion complication is dentoalveolar ankylosis. While in adults it is not a consideration, if diagnosed too late in growing patients may lead to interrupted alveolar process growth. Few treatment options are available when dealing with dentoalveolar ankylosis in growing individuals: composite build up, prosthetic reconstruction, decoronation, autotransplantation, extraction and orthodontics or implant (3). Autotransplantation of teeth is a technique that can replace a missing tooth by creating a surgical socket, or utilize a freshly extracted one by repositioning an autogenous erupted or unerupted tooth (4). Tooth autotransplantation and orthodontic space closure are the most biologic treatment options when dealing with anterior tooth loss in growing individuals. It is considered that tooth autotransplantation has more advantages compared to the other treatment modalities as there is no need to remove intact enamel, it supports vertical alveolar growth and autologous transplant can be orthodontically moved. It is advantageous compared to prosthodontics in terms of periodontal health and esthetics in the short and long term. The major advantage of

autotransplantation, however, is the bone inductive potential of the periodontal ligament.

Although many authors report a high success and survival rate of over 90% for autotransplantation, only a few papers have evaluated survival and success of autotransplantation to surgically created sockets (5). Yu et al. 2017 demonstrated a similar healing rate between immediate autotransplantation to freshly extracted sockets (control) and delayed autotransplantation (experimental) with horizontal alveolar bone loss, or partial loss of the buccal bone wall at the recipient site. Although not statistically significant, he reported a higher success and survival rate when guided bone regeneration was used in narrow ridge cases and a lack of bone (6). Among many prognostic factors evaluated (7, 10), Ayoma et al. 2012 stated that inadequate buccolingual width and lack of buccal coverage by bone on the donor tooth was associated with more failures (8). It is assumed that autotransplantation to a freshly extracted socket of a hopeless tooth can benefit by the additional blood supply of the existing recipient periodontal ligament. Contrary, autotransplantation to surgically created socket may result in slower healing rate due to poor nutrition and trauma to the recipient bone by space preparation. Another possible explanation could be trauma on the donor PDL by testing the new position and extended extraoral dry time of the donor tooth.

This case report aims to demonstrate how to manage TDI consequences related to hard and soft



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tissue deficiency, using fully guided block autotransplantation with the vestibular bone into a surgically created socket.

## Materials and Methods

A 9-year-old boy was presented at author's office with right central incisor avulsion. The incident happened after a fall during a hockey match and, according to his companions, it took them approximately 60 minutes to find the tooth and visit the author's office. The avulsed tooth was kept in water after it was found until the visit.

The patient did not confirm nausea, vomiting or any type of headache. There was no other history of trauma, or previously performed treatment on that particular tooth. Extraorally there was a slight laceration on the skin above the upper lip (Fig. 1). No signs of a broken alveolar ridge was confirmed. The neighboring teeth were intact with a slight mobility. An informed consent form was given to his parents, describing the possible complications of late replantation. After providing local anesthesia using 4% articaine with 1:100 000 epinephrine, the socket was rinsed with NaCl 0.9%. Gently, without pressure, the avulsed tooth was repositioned to its original position and flexible stabilization was performed for 2 weeks. A standardized cone technique periapical x-ray with a film-holder for centrals and intraoral sensor (ProSensor size 2 Planmeca Finland) was taken to confirm the position, and also the tooth eruption stage. A stage 3 according to Cvek with a wide divergent apical opening and a root length estimated to 2/3rds of the final root length was confirmed (Fig. 2B). A possible pulp revascularization was aimed (IADT 2020 guidelines), so no endodontic treatment was

started initially. On the 4<sup>th</sup> week, follow-up pulp sensibility testing was negative, no clinical symptoms and normal sound on percussion tested. However, on the periapical x-ray there were clear signs of inflammatory root resorption. Immediate endodontic treatment was recommended (Fig. 2B). No instrumentation was performed and infection was controlled with irrigation. The first irrigant used was NaOCL 2% with side vented 30 G needle, heated and activated using ultrasonic activator (Endo1 Woodpecker). Three cycles of 20 seconds activation with 1 ml of fresh irrigant between the cycle was performed with a total time of 15 minutes. During the irrigation negative apical pressure was utilized by high speed aspiration using 20 G inside the canal. The sodium hypochlorite was rinsed with 3 ml of NaCl 0.9 followed by 17% EDTA. Two cycles of EDTA activation were used with 1 ml refreshing EDTA between the cycles. Total time of EDTA was 2 minutes, followed by 5 ml of NaCl 0.9%. The canal was filled up until the bleeding tissue with NeoMTA plus (Avalon Biomed) (Fig. 2C). The pathognomonic radiolucency associated with inflammatory root resorption was not present at the 6<sup>th</sup> month follow up, on the periapical x-ray and replacement resorption obviously having taken place (Fig. 2D). Ankylosis was confirmed by the slight infraocclusion intraorally on tooth 11 and the dull metallic sound on percussion. The parents were informed about the possible consequences of dento-alveolar ankylosis, so decoronation was chosen and performed until a premolar was available for autotransplantation. Upper second left premolar was chosen by the orthodontist according mid-line deviation. Meanwhile, the clinical crown of 11 was used as a space maintainer and bonded to tooth 21.



Fig. 1



Fig. 2. Replantation of avulsed central right incisor after 60> minutes extraorally. A. Day 0, just after replantation and splinting. B. External inflammatory resorption. C. Replacement resorption. D. Replacement resorption and ankylosis.

Two and a half years after the trauma a big bony defect was evident on the CBCT (Fig, 4). The space between 21 and 12 was not properly

maintained due to regular debonding of the fragment. Surprisingly, after digital segmentation on "Blue Sky Bio LL", the upper second left

premolar turned out to have an enormous clinical crown and divergent roots, therefore it was impossible to fit the space. On the other hand, the lower right first premolar was in the 3<sup>rd</sup> stage while the left premolar was in stage 6. Having that situation, the most suitable option was the lower right first premolar (stage 3 Cvek) to be taken in block with the overlying vestibular bone (Fig. 3). Patient is Angle Class 1, hyperdivergent pattern. Braces were bonded in

order to increase the space for tooth 11. Further orthodontic treatment will be provided, because the space for tooth 13 is not enough. In the lower jaw, where tooth 44 was planned for autotransplantation, space will be closed by mesial movement of 45 and 46, so that lower midline will not be affected (Fig. 17).

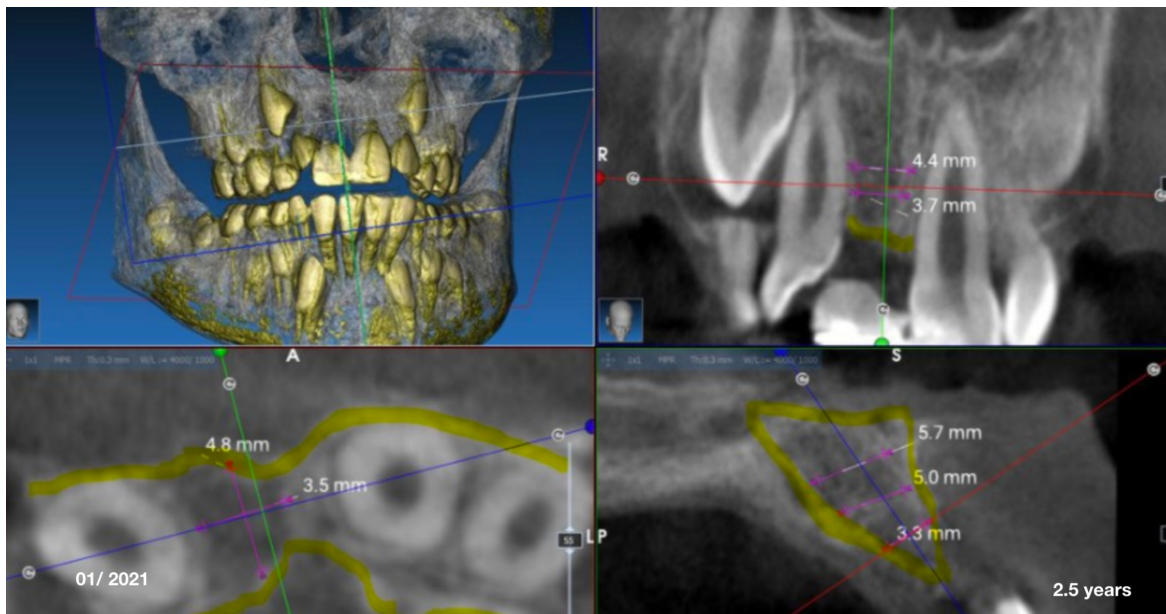


Fig. 3

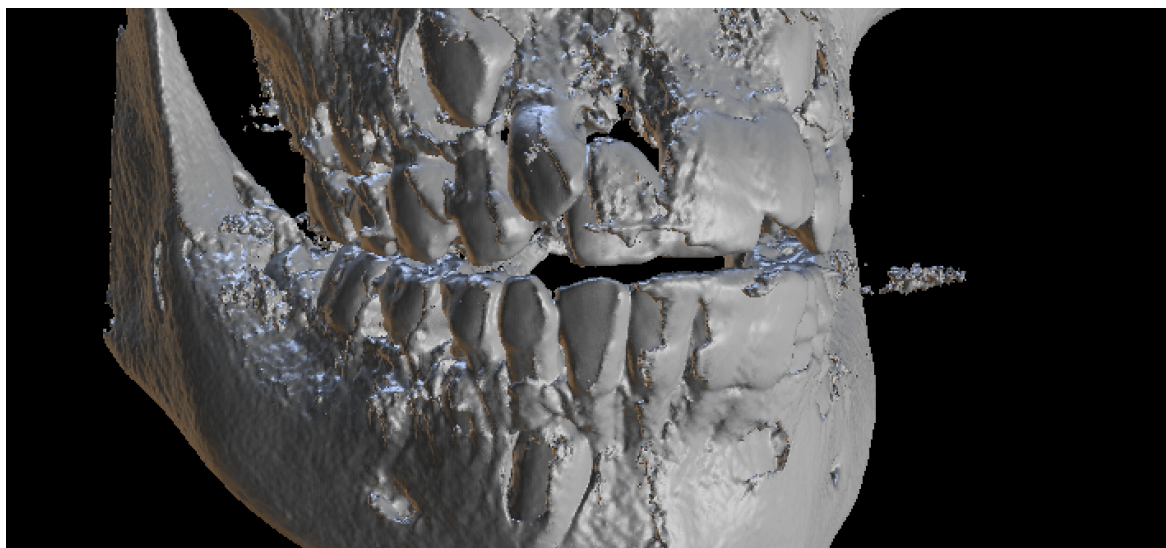


Fig. 4



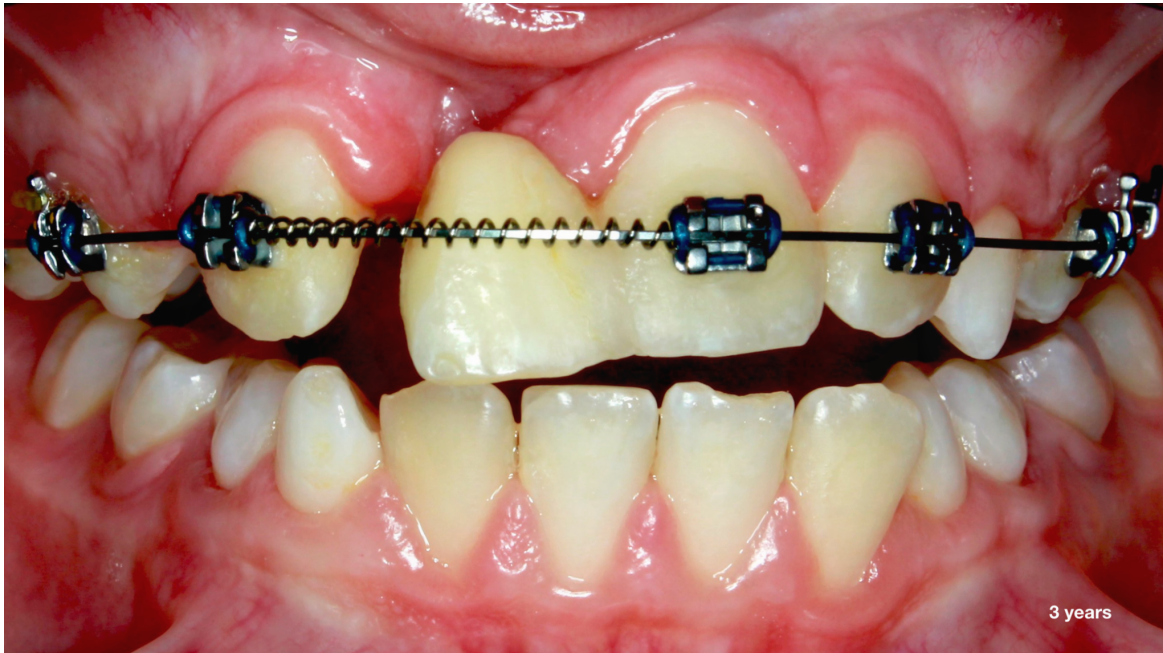


Fig. 5

Eight months after the orthodontics (Fig. 5), a new intraoral scan and another CBCT was taken (FOV 12x9, 90kv and voxel size of 0.070-Vatech Green X).

Using "BlueSky Bio LL" software, advanced segmentation was performed on the donor premolar and moved digitally into the position of the lost 11. Position was chosen on "x, y and z" planes (Fig. 6, 7). Eruption stage was compared to the contralateral lower first premolar and the possible eruption length calculated in order to avoid possible soft tissue correction. Due to lack of hard and soft tissue, donor position was planned out of the vestibular bone completely to avoid damaging the canal of n. Nasopalatinus (Fig. 7). Small manual modifications on donor

bed preparation were considered as well (Fig. 7 drawn in yellow). Tooth replica was exported from "Blue Sky Bio LL" and finished in "Meshmixer". The sleeveless surgical guide was planned using a 5.5x11.5 implant drill sequence by "Osstem One Guide" system. Both the replica and the surgical guide were printed by "Formlabs 3B+" using surgical guide resin on 50 micrometers and kept in 2% CHX, 30 minutes prior to surgery (Fig. 8).

On the day of the surgery, the parents were advised not to give food and drink 6 hours prior surgery, as conscious sedation was planned using "Dormicum, Ketoral and Atropine" according to the patient's weight and age.

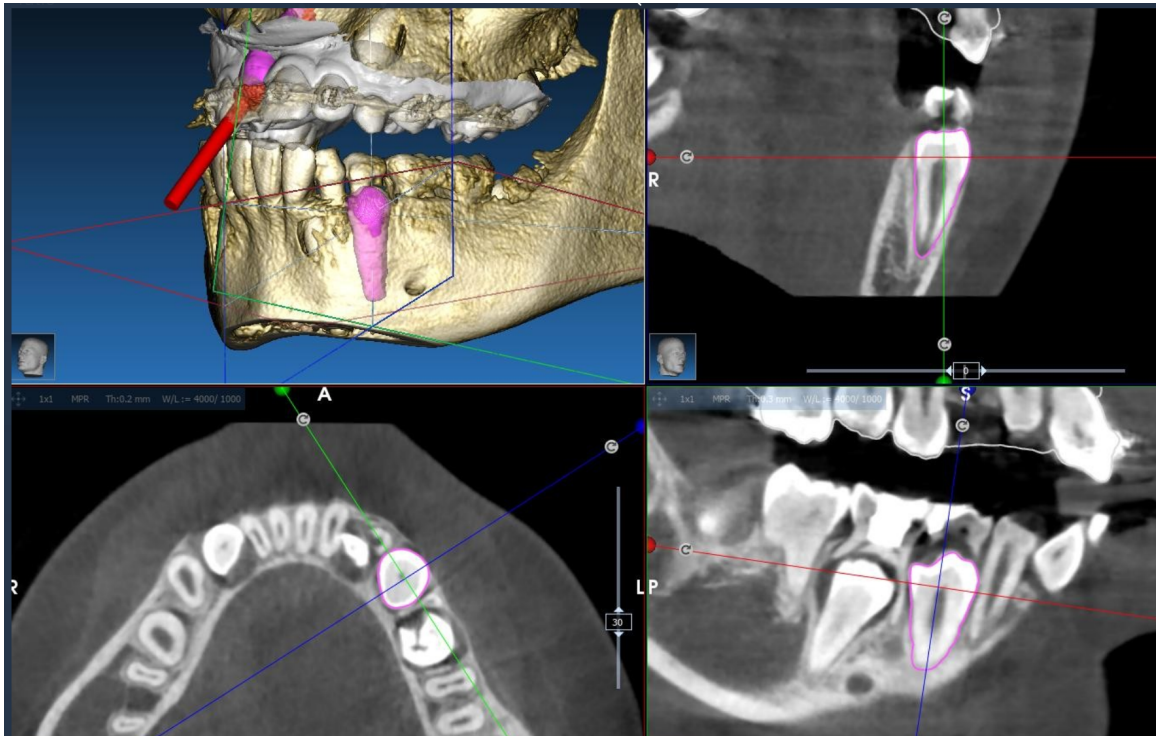


Fig. 6

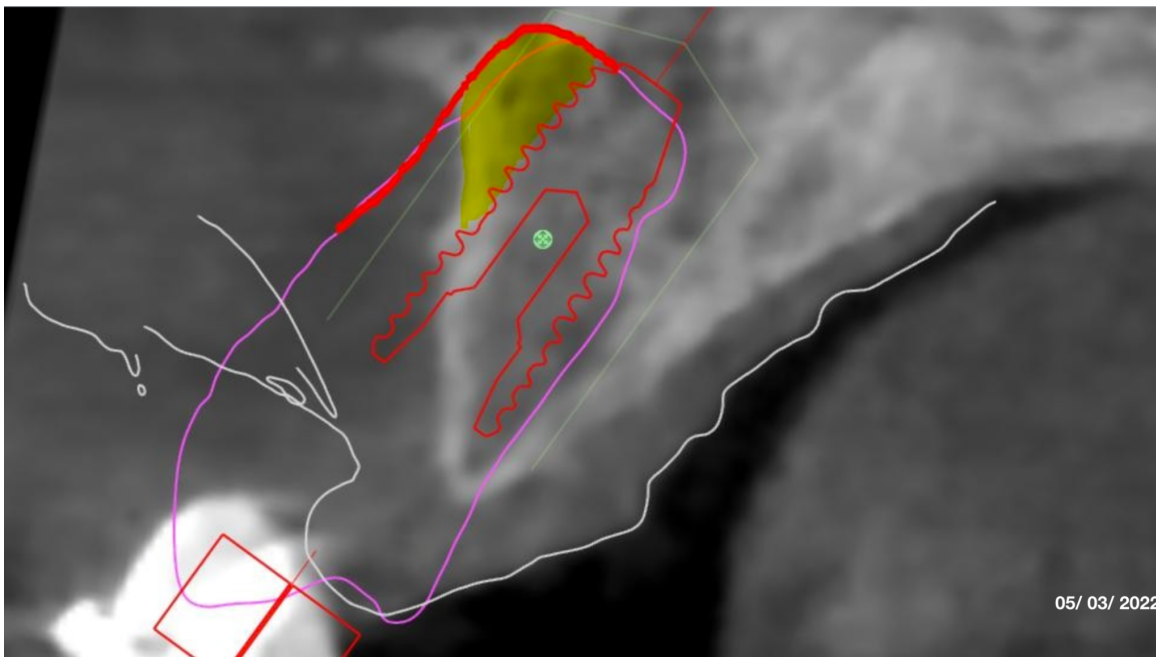


Fig. 7

After checking the surgical guide accuracy, a local infiltrative anesthesia was provided on the upper central incisors and also palatally to block

n. Nasopalatinus. Papilla based full thickness flap was elevated and drill sequence performed (Fig.9). After adjusting the printed replica in

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infraocclusion, an IAN block was provided on the right lower side and again full thickness flap was raised. Two vertical cuts along the roots were done by using a piezo surgery device (Surgic Smart Piezo Bone Surgery- Woodpecker) and "US3" tips. Extraction together with the vestibular cortical plate was performed in atraumatic manner and suturing using 4.0 black braided sutures with a needle C6 Reverse

Cutting 3/8" 19MM SMI (Fig. 10). Extraoral dry time was less than 10 seconds. Stabilization was initially performed by using sutures and semi-rigid stabilization for 2 weeks due to weak primary stability (Fig. 11). Interestingly, after removal of the stabilization wire, the orthodontic excessive-opening made by the brackets was corrected spontaneously in just two months( Fig. 13).

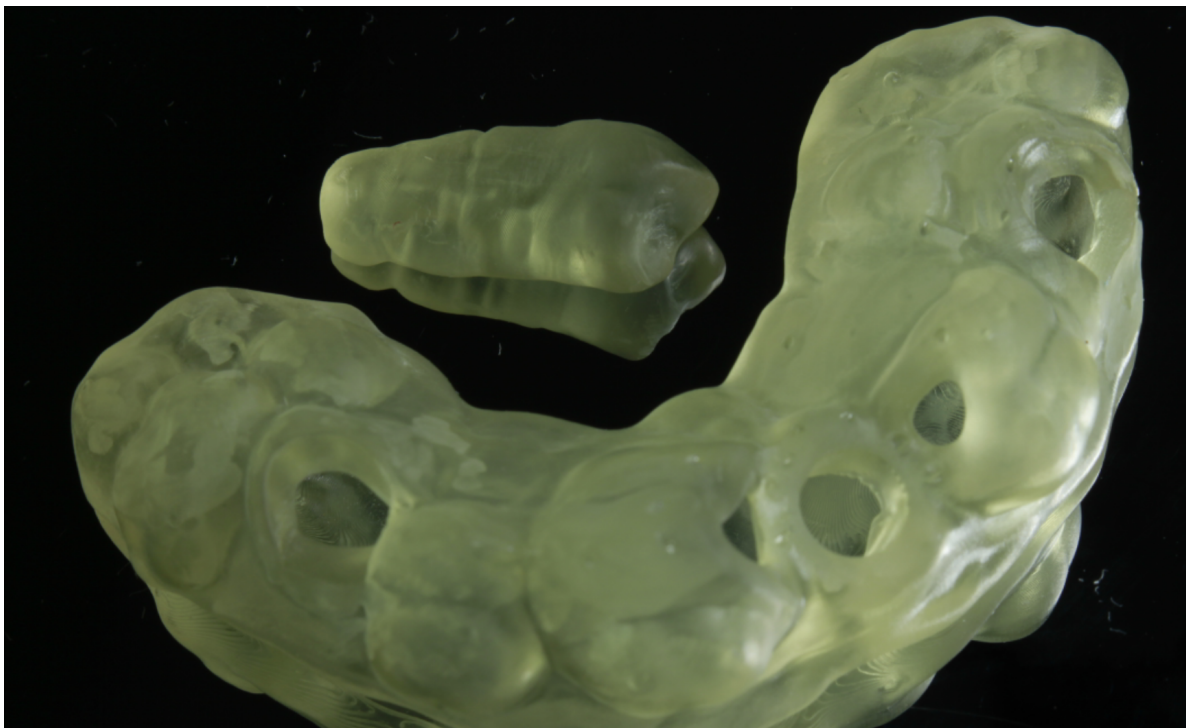
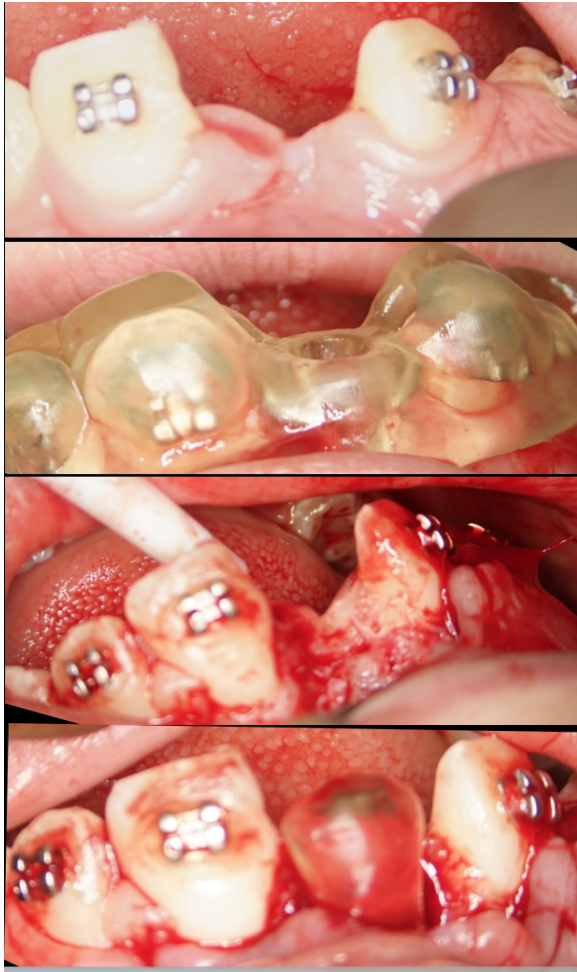


Fig. 8

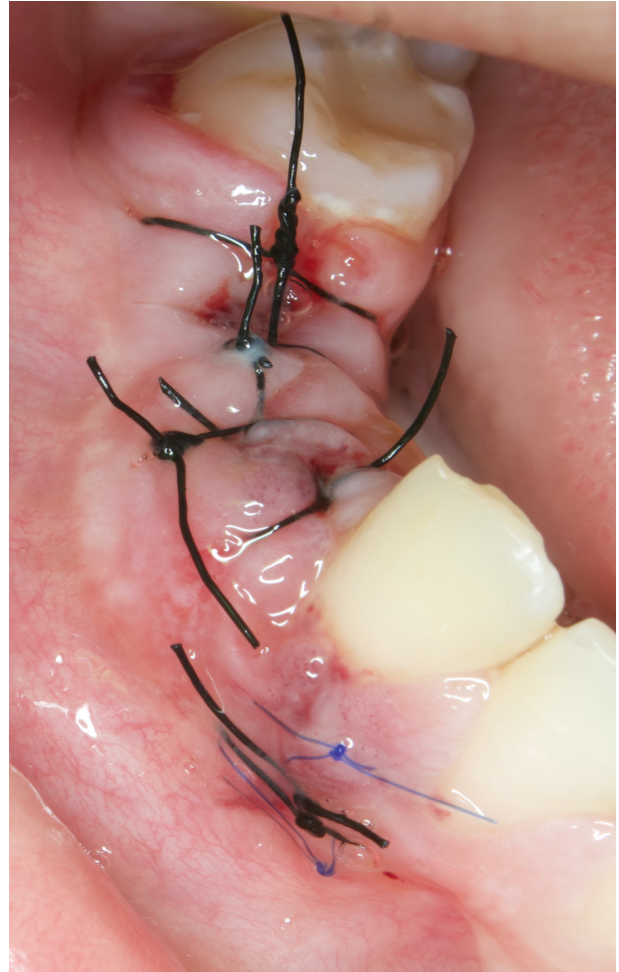
Six months later, or 8 months after the autotransplantation on the periapical x-ray, further root growth was evident and new bone formation was detected on a small field of view (4x4 FOV; 0.075 voxel size; 90kv- Green X Vatech) (Fig. 15, 16). A new intraoral scan (MEDIT I500) was taken and intact tooth 21 was mirrored into 11. The model was 3D printed and, following parental approval, a silicon index was taken. After the isolation, the silicon index position was confirmed. Disks were utilized to remove the excess outer surface of the enamel

followed by sandblasting with 35 micrometers particles through "Rondoflex" (KAVO). Direct composite modeling was performed using 4<sup>th</sup> generation bonding technique with adhesive only (Optibond FL Kerr) after etching with 37% orthophosphoric acid for 30 seconds. Nanohybrid "Brilliant Everglow" shades and stains were used (Coltene Whaledent) as a modeling composite (Fig. 14).

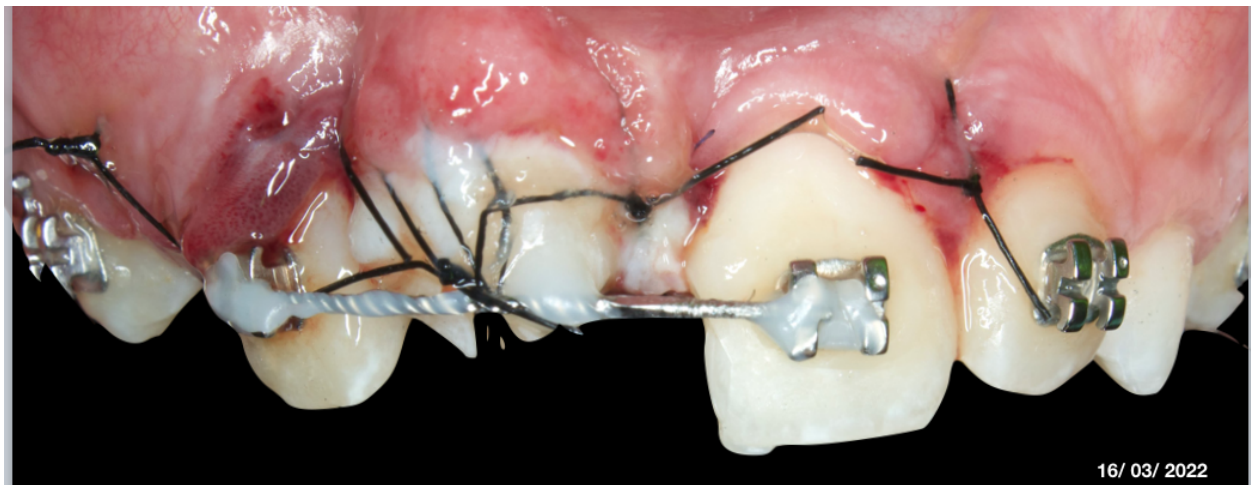




*Fig. 9. Recipient site- surgery day*



*Fig. 10. Donor site-surgery day*



*Fig. 11. Transplanted lower right premolar into position of upper right central incisor*



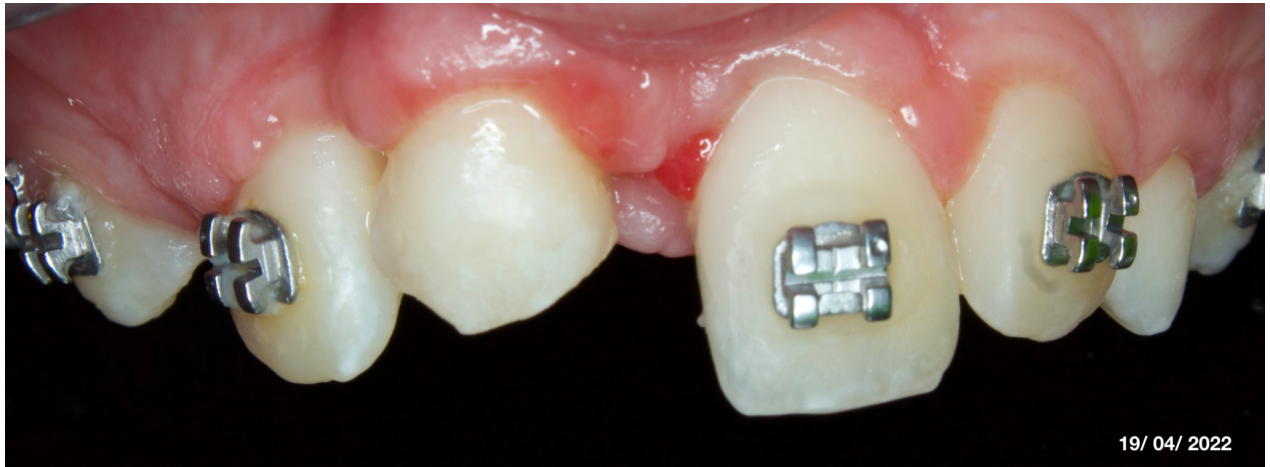


Fig. 12

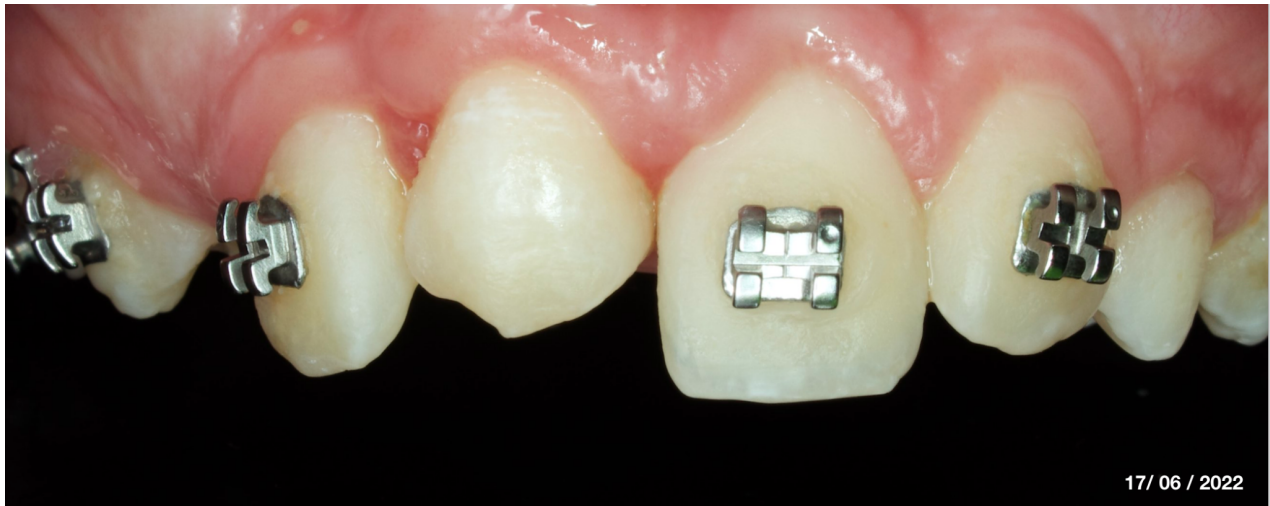


Fig. 13.



Fig. 14.

Fig. 12. Three weeks following autotransplantation. Fig. 13. Three months follow up. Fig. 14. 11 months follow up



*Fig. 15. Periapical follow up: A. Two weeks follow up. B. Three months follow up, root thickening has started. C. Apical closure is evident on the 11 months follow up.*



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Fig. 16. CBCT follow up axial view: A. Preoperative . B. Eleven months follow up.



*Fig. 17. Eleven months follow up on the recipient site after extracting tooth 44*



Fig. 18. Four years and a half after the avulsion trauma.



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## Discussion:

Central incisor loss in growing individuals can cause functional and esthetic problems, with the last directly related to emotional and social consequences for children and their families. The association between overjet and TDI was documented by Lewis in 1959, who found that fractures to anterior teeth were significantly more frequent among children with overjet larger than 3 mm. Early tooth loss in growing individuals is associated with hard and soft tissue defects in later stages such as bone dehiscence, bone fenestration, horizontal and vertical bone loss, inadequate quantity and quality of soft tissue. The long-term prognosis of avulsed teeth depends mainly on the extraoral dry time. External inflammatory and replacement resorption are the most serious complications after avulsion. For the external inflammatory resorption to occur, an infection within the root canal space plus mechanical damage to the cementum are needed. Some studies suggested performing endodontic treatment in immature avulsed teeth as a prophylaxis to external inflammatory resorption, only if there is additional crown fracture associated with the avulsion (9). Despite that, one could argue that root canal treatment should have been performed initially to prevent external root resorption, which could be logical, considering the extraoral time of the avulsed tooth. According to IADT guidelines of 2020, the risk of external inflammatory resorption and the benefit of pulp revascularization should be

carefully weighted. In this case the author decided to give the pulp a chance for a revascularization due to the fact that the apical papilla was bleeding on probing at the first emergency visit. Performing apexification in 3-rd stage Cvek is technically a sensitive procedure, while performing a root canal treatment outside the mouth does not support the "preserving PDL cells" philosophy. A revascularization could have also been an option after diagnosis of external inflammatory root resorption but then the question applies whether the remaining stem cells would have been capable of repairing, considering the death of SCAP and DPSC?

Once replacement resorption is evident, there is a high chance of dento-alveolar ankylosis. Decoronation can be performed until a donor tooth for an autotransplantation is available. Autotransplantation in early age after tooth loss seems to be the most suitable option in terms of providing further alveolar growth, function and esthetic to the young individual. Everybody agrees that preserving donor tooth "PDL" seems to be the key factor for success. Some researchers found that immature teeth have a better prognosis in autotransplantation as they could promote revascularization compared to mature teeth. Andreasen et al. found 95 % pulpal healing in immature teeth evaluated at first year with and 95 % tooth survival rate for immature teeth at 5 years (5).

Several case report studies have reported high-success rates for autotransplantation of mature teeth. Mature teeth can be either used

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as donors in immediate autotransplantation to freshly extracted sockets or in delayed autotransplantation to surgically created sockets in cases of congenitally missing or early lost teeth due to TDI. Yu et al. 2017 found no significant difference comparing delayed autotransplantation in surgically created sockets with autotransplantation to freshly extracted sockets (6). Few prognostic factors have been pointed out: extra-oral dry time of the donor, primary stability, the eruption state of the donor tooth, root length, recipient position, postoperative marginal bone loss, history of root canal treatment of donor tooth, multirrooted, maxillary tooth as a donor and time interval of tooth absence at the recipient site (2, 7, 8, 10). Importantly, Andreasen reported a significant relationship between repairing of vestibular bone and the presence of vital periodontal ligament (11).

## Conclusion

Guided block tooth autotransplantation in surgically created socket after trauma resulted in significant improvement of hard and soft tissue quantity and quality on 12 y.o patient. This treatment option reestablished function, improved the pink and white esthetics with a further root development. It did also improve the self appearance during the vulnerable age (Fig. 14, 15, 16, 18).

Hurzeler and Carlos in 1993 stated that tooth autotransplantation success depends on adequate recipient socket and described guided tissue regeneration in autotransplantation (12). Mejare et al. 2004 concluded that narrow recipient socket and lack of vestibular bone was the only significant predictor of transplant failure (13). Previous researchers found that having a printed donor tooth (3D replica) prior extraction could optimize the total time of the procedure and most importantly decrease the donor extra-oral time. Although the computer- assisted template-guided model was introduced in medicine in the 1980's, Lee et al. 2001 implemented it in dentistry (14). With digital planning and CBCT, autotransplantation in surgically created sockets is not a limitation anymore. If planned well the procedure could be performed fast and predictable.

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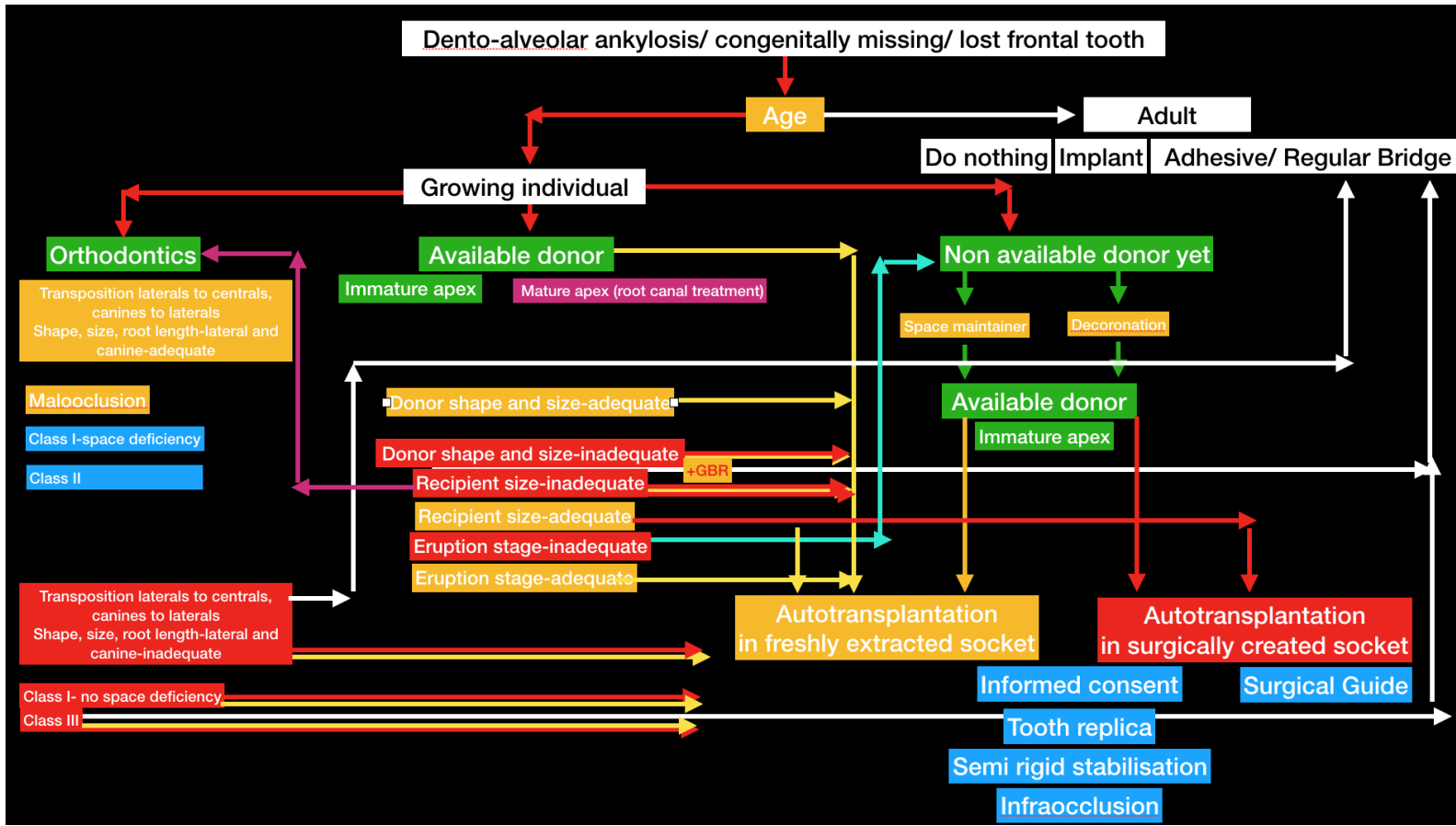


Fig. 18. Management of central incisor loss strategy