

**Tooth Auto Transplantation: A Review**

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**Abstract**

Auto transplantation is the repositioning of an autogenously erupted, partially erupted, or unerupted tooth from one site to another in the same individual. Successful auto transplantation can offer many advantages in a growing patient, including a normally functioning periodontium, proprioception and preservation of alveolar bone volume. In the event that the auto transplantation eventually fails, the bone and soft tissue conditions would still be likely to be favorable for subsequent implant treatment. This review article will discuss the biological principles, indications, clinical criteria, and clinical considerations for auto transplantation.

**Keywords:** Auto-transplantation, Periodontal ligament, growth, teeth.

**Introduction**

The primary objective of comprehensive dental treatment planning is conservation of tooth tissue. The absence of teeth, either congenital or due to caries or trauma, presents a challenge to the concept of conservative tissue

treatment. Orthodontic space closure and prosthetic replacement are two possible approaches to solving this problem, but these can result in compromises of esthetics, symmetry, occlusal function, or periodontal stability<sup>[1]</sup>. Allogenic transplants, from one individual to another within the same species, too often cause an immunologic reaction resulting in failure and are not considered to be realistic alternatives at present<sup>[1]</sup>.

**Advantages of autotransplantation in comparison to restorative implants<sup>[2]</sup>**

- 1) Suitable option for adolescent patients.
- 2) Normal proprioception and thermal feedback.
- 3) Can be moved orthodontically.
- 4) Preserves alveolar bone volume.

**Biologic principles**

Favorable periodontal ligament [PDL] healing is the critical factor for success whether teeth are mature or immature. Pulp regeneration can be expected in immature (developing) teeth but not in mature teeth. Similar healing patterns can be expected in auto transplantation of teeth.

In addition, bone induction is an interesting additional benefit of transplantation. Wound healing in auto transplantation of teeth is discussed below according to PDL healing, bone induction, pulp healing and root development, respectively.<sup>[3]</sup>

### **PDL healing**

PDL cells can be damaged mechanically during extraction or bio-chemically due to various extra-oral conditions. PDL cells are easily injured under stressful conditions such as variable pH, osmotic pressure, dehydration. An important factor to consider in regard to PDL healing is the repair of mechanically damaged root surface with new cementum and periodontal ligament. The type of healing of a damaged root surface when a tooth is replanted or transplanted is dependent on the surface area of damaged root to be repopulated. If the area is small, cells with the potential to form new cementum and PDL are most likely to cover the damaged root. This type of healing is termed surface resorption or cemental healing. However if a large area is to be healed, cells programmed to form bone will attach to some areas of the root. This type of healing is termed surface resorption or cemental healing<sup>[4,5,6]</sup>. A physiologic process of bone turnover takes place. The root is resorbed (like the adjacent bone) but in the apposition stage, bone (and not dentin) fills the (previously) resorbed area. In this way, the root is replaced by bone. This process has been termed ankylosis, replacement resorption or osseous replacement. Replacement resorption is irreversible and will progress until the tooth is lost. The speed of the root replacement depends on the age of the patient; the younger, the more rapid.

### **Bone healing**

Periodontal ligament of a transplanted tooth appears to be able to induce bone production. Bone induction is observed as rapid bone regeneration and the emergence of lamina dura around the transplant. When donor teeth are

placed into recipient site with poor spacing buccolingually, resulting in roots that protrude through a bone dehiscence, graft materials should be placed over the exposed root in order to create space for bone regeneration. Bone induction around a transplanted tooth is a significant advantage for this procedure compared to the use of implants.<sup>[7]</sup>

### **Pulp regeneration**

Pulp regeneration can be expected in replantation and transplantation of teeth with incomplete root formation. Such a pulp healing response can be expected when the diameter of the apical foramen is radiographically at least 1mm. In most cases, these cells will differentiate into the cells of a functioning pulp. The teeth will usually react positively to sensitivity tests in 6 months. Pulp-canal obliteration (hard tissue deposition inside of canals) is inevitable. Pulp healing should be anticipated even if a small Hertwig's epithelial sheath is visualized apically at surgery.

### **Root development**

Continued root development after transplantation can also be expected if a donor tooth is immature and Hertwig's epithelial sheath is preserved around the apices. Ideally, we would want to transplant a tooth that is at its maximal length but still has the potential for pulp regeneration (apex opening >1mm radiographically). Transplantation of a fully formed root negates the potential for pulp regeneration but adequate endodontic therapy of the pulp space will still ensure success.

### **Indications**

Most common indication is teeth to be extracted due to advanced caries destruction. In adolescents, the first permanent molars erupt early and are often heavily restored. When dental implants are placed in adolescent patients, they do not erupt along with adjacent teeth and result in infraocclusion with functional and esthetic

problems. Most frequently, a wisdom tooth is transferred to the site of a hopeless molar because of its late development compared to the other teeth.

The key to auto-transplantation in a growing patient is the absence of ankylosis. Therefore this feature can serve as the primary measure of success in a growing patient and every effort should be made to preserve the periodontal ligament.

Another indication is maxillary incisors that are most frequently involved in trauma. In such case, avulsed tooth brought to dental office in a proper condition (during first 24 hours after trauma, in a suitable solution) could be replanted and splinted for a healing period. Even partially damaged tooth (cracked, chipped, or broken crown) could be saved applying endodontic and restorative treatment. Therefore, considering the stage of root development and the size of the crown of a donor tooth is chosen<sup>[4]</sup>.

One more indication for tooth auto-transplantation is congenital tooth absence. Tooth agenesis is mostly of unknown etiology.

Atypical tooth eruption can also be an indication for auto-transplantation. Therefore, auto-transplantation of canine into a more natural orientation could provide a simplified and faster treatment option.

### Clinical considerations

**Source of transplants:** Any tooth within the patient's dentition might be a candidate for transplantation. Third molars have been most frequently used, for a number of reasons. These teeth, which otherwise are often extracted, have served well as replacements for cariously destroyed first molars. Moreover, their root development which continues into the late teens and twenties makes these teeth suitable for use into adulthood. Premolars have also been readily available as transplants. Furthermore, their anatomy is frequently better suited for more mesial replacement<sup>[8]</sup>.

**Size of transplant:** consideration should be given to the size of the recipient area- whether the transplant exceeds in any dimension the space available in the recipient region. Mesio-distal assessments are easily performed, but it is often difficult to determine the labio-lingual width of a donor root base and whether it can be made to fit well within the alveolar walls. Occlusal radiographs are recommended for such assessments. Depending upon the space available, the more limited size of the premolar may make this tooth a more favorable candidate than a third molar. The last tooth in the arch may offer better access for removal, and it is essential that the root not be damaged in any way during its relocation.

**Timing of transplant:** Since a primary objective is to obtain maximum root length of the transplant, timing becomes critical for a number of reasons. Slagsvold and Bjercke<sup>[9]</sup> have shown that transplantation performed near the time of completion of crown formation can adversely affect enamel calcification. On the other hand, the prognosis for successful transplantation is diminished as the root apex nears closure. It should be borne in mind that revascularization must take place. For the tooth in the bud stage of development, surgical manipulation is a traumatic episode and further development from that point forward may not be normal. Encroachment upon the maxillary sinus or the mandibular canal must be a consideration. Proper alveolar architecture is essential for housing the transplant.

**Recipient site:** Our primary concern in selection of a recipient site is one of periodontal integrity. In this regard, a suitable site must have sufficient alveolar support in all dimensions; it should be covered with adequate attached, keratinized tissue to allow proper coverage or approximation to the transplant, and it should be free of chronic inflammation.

**The surgical technique:** Strong emphasis should be placed on certain basic philosophic concepts: proper selection and preparation of patients, gentle handling of soft-tissue structures, and minimal handling of the transplant. Great care should be taken not to denude or even touch, where possible, any of the root sheath or exposed pulpal tissue. If fundamental surgical principles are followed, a well-planned transplant should have an excellent prognosis.

**Criteria for autotransplantation success<sup>[5]</sup>**

- 1) Medically healthy patient.
- 2) Donor tooth with normal morphology that matches the recipient site without complicating the occlusion
- 3) One-half to three-quarters root formation with underdeveloped root apex (over 1 mm wide open apex)
- 4) Atraumatic extraction technique preserving Hertwig's epithelial root sheath, periodontal ligament and the apical portion of the developing tooth bud.
- 5) Keeping extraoral time for the donor tooth to an absolute minimum (preferably less than one minute).
- 6) Transplanted tooth is placed into a fresh socket, rather than an artificially prepared socket.
- 7) Avoid trauma post-transplantation and maintain excellent oral hygiene.

**Successful healing factors associated with auto-transplantation of teeth<sup>[5]</sup>**

Categories	Influencing factors for prognosis
Patient-related factors	Better results in younger patients A patient free of major systemic and metabolic problems or specific habits (e.g., smoking) Good oral hygiene and a co-operative attitude
Donor tooth-related factors	Periodontal ligament (PDL) The presence of intact and vital PDL, attached to the root surface Preservation of vital PDL, when the tooth is outside the mouth using physiologic salt water or milk or preservation liquids and as short a surgery time as possible Enhanced healing of the gingival tissue by placing a 1 mm band of PDL fibers on the root above the crest of bone A major factor in the formation of alveolar bone A chance of inadequate PDL development as an effective attachment with an impacted tooth (non-functioning tooth) Healing of dental pulp The preservation of Hertwig's epithelial root sheath Healing of the dental pulp occurs until Moores tooth development stage 5 When the diameter of the apical foramina is 1 mm, there is more than an 87% chance the dental pulp will heal Continuation of root development Ideal timing of transplantation is when development of the donor tooth roots is 3/4 to 4/5 complete Gingival adaptation Tight flap adaptation prevents bacterial invasion into the recipient socket Root morphology
Recipient site-related factors	Teeth with a single, cone-shaped root without concavity around the cervical area are most favorable Bone width and height should be adequate to receive the donor tooth Better healing can be expected if the PDL tissue is still attached Transplantation should be performed on the day of transplantation or within 1 month after extraction
Clinical factors	Surgery should be performed by a clinician with experience in such areas as donor tooth extraction, preparation of the recipient site, and tissue management

**Discussion**

High success rates of autotransplantation have been reported over the past decade varying from 74% to 100%. The critical factor for success is favorable periodontal ligament healing, that depends on the number of viable cells preserved on the root surface.

The extraoral time should be from 3 to 16 min and during that time donor tooth should be kept moist. Hank's balanced salt solution and coconut water are the best storage media for such tooth. The survival ability of periodontal ligament is significantly reduced after 18 min as prolonged extra oral time increases the possibility of inflammatory root resorption.

Reattachment between the connective tissues of the root surface and the recipient socket walls occurs within 2 weeks. Complete healing occurs within 8 weeks that appears radiographically as a continuous space around the root and presence of lamina dura. Healing of the root surface of the tooth to be re-implanted depends on the surface area of damaged root to be repopulated. If the area is small, cells with the potential to form new cementum are most likely to cover the damaged root resulting in surface resorption or cemental healing.<sup>[6]</sup>

Fong stated that maxillary transplants should not be done because of the extreme variation in the size and shape of the maxillary third molars and because of the proximity of the maxillary antrum to the molar sockets. The most important factor in bone formation is the cervical approximation of the transplanted tooth and bone in the recipient area. If the cervical approximation is good, because the bone tissue below the cervical portion is a closed wound and there is a lower chance of infection, there is a tendency to heal well with out problems. Tsukiboshi et al reported that the tooth should be fixed for between 2 weeks and 2 months depending on whether the mobility is reduced<sup>[7]</sup>.

Classification and clinical indications , Auto-transplantation can be classified into three groups:

- (1) Conventional transplantation,
- (2) Intra alveolar transplantation
- (3) Intentional replantation

In comparison to the use of implants, bone induction around a transplanted tooth is a significant additional advantage. The differentiated osteoblasts may generate bone around the transplant that is observed as a rapid bone regeneration and appearance of lamina dura. Pulp healing response or pulp regeneration can be expected if transplantation of immature teeth is done under optimal conditions, and the diameter of the apical foramen is more than 1 mm radiographically. Through the wide apical foramen, blood capillaries can invade the pulp resulting in differentiation of invading replacement cells into a functional pulp. If a donor's tooth is immature and Hertwig's epithelial sheath is preserved around the apices, continued root development can also be expected. The root development of the donor's tooth should be from 1/3rd to 3/4th of its final documented length<sup>[10]</sup>.

### Conclusion

Therapeutic phases may be summarized as follows<sup>[16]</sup>:

- 1) pre-operative evaluation of compatibility between root anatomies;
- 2) Atraumatic extraction of the compromised tooth;
- 3) Atraumatic extraction of the donor tooth;
- 4) Osteoplastic, if necessary, of receiving site;
- 5) Donor tooth insertion in the new site and stabilization with sutures;
- 6) Sutures removal after 2 weeks;
- 7) Root canal treatment after 2 or 3 months.
- 8) Follow-ups.

### References

1. Northway WM, Konigsberg S. Autogenic tooth transplantation the "state of the art". American Journal

of Orthodontics and Dentofacial Orthopedics. 1980 Feb 1;77(2):146-62.

2. Ong D, Itskovich Y, Dance G. Autotransplantation: a viable treatment option for adolescent patients with significantly compromised teeth. Australian dental journal. 2016 Dec;61(4):396-407.
3. Tsukiboshi M. Autotransplantation of teeth: requirements for predictable success. Dental Traumatology. 2002 Aug;18(4):157-80.
4. AndreasenJO. Periodontal healing after replantation and autotransplantation of incisors in monkeys. IntJOral Surg 1981;10:54^61.
5. Andreasen JO. Relationship between cell damage in the periodontal ligament after replantation and subsequent development of root resorption. Acta Odontol Scand 1981;39:15^25.
6. AndreasenJO, Skougard MR. Reversibility of surgically induced dental ankylosis in rats. IntJOral Surg1972;1:98^102.
7. InoueT, ShimonoM, YamamuraT. Osteogenetic activity of periodontal ligament of rat incisor in vivo and invitro. JDent Res1988;67:401.
8. Nordenram, A., and Bergman, G.: Autotransplantation of teeth, Br. J. Oral Surg. 7: 188-195, 1969-70
9. Slagsvold, O., and Bjercke, B.: Indications for autotransplantation in cases of missing premolars. AM. J. ORTHOD. 74: 241-257, 1978.
10. Thomas S, Turner SR, Sandy JR. Autotransplantation of teeth: Is there a role? Br J Orthod 1998;25:275-82.
11. Park JH., Tai K, Hayashi D. Tooth autotransplantation as a treatment option: A review. J Clin Pediatr Dent 2010;35:129-35.
12. Gupta S, Goel M, Sachdeva G, Sharma B, Malhotra D. Autotransplantation. Journal of conservative dentistry: JCD. 2015 Nov;18(6):500.

13. Bae JH, Choi YH, Cho BH, Kim YK, Kim SG. Autotransplantation of teeth with complete root formation: a case series. *Journal of endodontics*. 2010 Aug 1;36(8):1422-6.
14. Hale, M. L.: Autogenous transplants, *Oral Surg*. 9: 76. 1956.
15. Nimčenko T, Omerca G, Varinauskas V, Bramanti E, Signorino F, Cicciù M. Tooth auto-transplantation as an alternative treatment option: A literature review. *Dental research journal*. 2013 Jan;10(1):1.
16. Milani S, Generali P. Tooth autotransplantation. What's the limit of our possibilities in conservative treatments?. *Giornale Italiano di Endodonzia*. 2018 Nov 1;32(2):86-91.