

*Review Article*

## Autotransplantation- A Literature Review

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### ABSTRACT

A significant number of dental patients have premature loss of their first and second molars because of severe caries, periodontal disease, endodontic failure or trauma. In children and adolescents, bridgework and implants are not feasible for replacement of these edentulous areas as they may impede the normal growth of facial bones, in particular, of the alveolar process, and are hence contraindicated. Transplantation of a tooth of the same individual with incomplete root formation may be a viable alternative solution in such cases as both alveolar growth and root development shall be unimpeded. Successful tooth autotransplantation offers enhanced esthetics, arch form integrity, mastication, speech and dentofacial development.

Autotransplantation generally has not been a common procedure in clinical dental practice, but since few years it is being considered as a reasonable alternative to conventional prosthetic and implant rehabilitation from both economic and therapeutic standpoints.

Appropriate criteria for optimal case selection are discussed. Several advantages with some possible iatrogenic damages and side-effects are also described. Critical factors that may influence the outcome of the transplant have also been proposed. Literature based recommendations are made.

**Keywords:** Autotransplantation, tooth transplant, transplantation, autologous transplantation

### INTRODUCTION

Autotransplantation involves the transfer of embedded, impacted or erupted tooth from its alveolus into extraction sites or surgically prepared sockets when a suitable donor tooth is available in the same individual<sup>[1, 2]</sup> The foremost documented case reports of autogenous molar transplants appeared in the literature in the 1950s.<sup>[1-3]</sup> Several authors have demonstrated success rates varying from 85% to 96%.<sup>[4-6]</sup>

According to the dental literature, teeth usually chosen for transplantation are impacted maxillary canines, which play a vital role in dentofacial esthetics. A developing mandibular wisdom tooth can be transplanted to the socket of a first mandibular molar.<sup>[7,8]</sup> A transplanted third molar also aids in maintaining natural space, with none or minimal root resorption,<sup>[8]</sup> alveolar bone volume<sup>[9,10]</sup> and morphology of the alveolar ridge through necessary proprioceptive stimulation.<sup>[8,11]</sup> The clinical

outcome depends upon careful case selection and adequate understanding of the biological principles. [10] Generally, bridgework and osseointegrated implants are contraindicated for young patients with developing alveolar bone as infraocclusion is usually the outcome when the implant fails to form alveolar bone. Transplantation plays a key role in the replacement of adolescent patients' missing teeth. [9]

The great advantage over orthodontic traction is increased freedom of tooth movement, which is especially beneficial in hard-to-treat cases. [12] Moreover, it requires only a single surgical procedure, which is relatively easy when applied to a developing tooth germ. [12,13]

Autotransplantation is generally indicated for transplantation of impacted teeth to their normal position, replant failure, severe root fractures, agenesis of teeth and those cases of avulsion where the prognosis for successful reimplantation is poor. [14]

It is also indicated for rehabilitation or reconstruction for cleft palate patients whenever the same teeth are congenitally missing or possess an abnormal shape or route of eruption. [9]

Other indications for transplantation include developmental anomalies of the teeth and related syndromes, such as regional odontodysplasia, tooth aplasia, cleidocranial dysplasia [9,11] and tooth agenesis. [8] Even patients who have undergone chemotherapy and irradiation have had successful transplantation, despite doubts regarding the revascularization of the pulp of an autotransplanted tooth in irradiated bone. [15]

The few apparent disadvantages with autogenous transplantation are the limited supply of available donor teeth, attachment loss and root resorption, and its success rate is lower than that for implants. [16]

The dentin-pulp complex is primordial in relation to success or failure of

the grafts. Thus, the performance of the tooth transplant must necessarily be oriented by the caring for biological structures, since their follow-up will enhance the ability to pulpal and periodontal healing. [5]

The prognosis for an autologous tooth transplant is generally good as there is greater probability of total integration in the alveolus due to the lack of any histocompatibility problem. Some of the factors that may influence the outcome [9,17] are proper case selection, atraumatic surgical technique of extraction of the transplanted tooth that preserves the root structure; adequate immobilization of the transplanted tooth, preservation of periodontium and root development that allows re-establishment of both innervation and vascularity to the pulp and the need of endodontic treatment.

### ***Proper Case Selection***

There seems to be no effect of sex or age on the final outcome. [18] However, because immature teeth are generally covered by a thick follicle or periodontal ligament, which enables extraction of the tooth transplant with minimal force, [19] there are lesser chances of damaging the ligament during the surgical procedure. Patients aged 15 years to 19 years are more appropriate candidates for third molar transplants. [19]

Some of the contraindications include poor self-motivation, [20] poor oral hygiene, cardiac anomalies and width of the alveolar process. [8,19] Resorption of the alveolar ridge may occur if the recipient site has insufficient buccopalatal or buccolingual width to accommodate the donor tooth. If deferred, transplantation should be scheduled not later than 6-8 weeks, so that the resorption of bone that occurs in the intermediate period does not compromise the wound bed for the donor tooth. [10]

### ***Atraumatic Surgical Technique***

An atraumatic surgical technique preserves bone and periodontal support. [8,21-23] Minimal handling of the transplant is required to protect the Hertwig's root sheath and pulpal tissue; [1-3] otherwise root growth may be compromised [1] leading to ankylosis or root resorption and attachment loss. [10,14] The tooth to be transplanted should be out of its socket a minimal amount of time to avoid desiccation. [10,14]

The longer the tooth is left outside the socket, the poorer the prognosis. [18,21,22] Vriens and Freihofer [6] noted that despite damage to the follicle of the upper third molar during surgical transplantation, the clinical outcome is good, even at 5 years follow-up. According to Tsukiboshi, [3] the periodontal ligament on the root surface may be repaired by a new attachment mechanism. Its success depends on the space existing between the socket wall of the recipient site and the donor tooth.

### ***Stage of Root Formation***

Studies have shown that the prognosis of a transplanted tooth is considerably affected by the stage of root development. [24] It is usually advised to transplant when the donor tooth reaches a root length between  $1/2$  and  $3/4$  of its intended root length [4,5,25,26] as revascularization of the pulpal tissue is ensured through the open apex and there is less risk of injuring the surrounding tissues during the surgical procedure. [27,28]

Some authors suggest that the teeth with roots developed beyond their bifurcation are better candidates for successful transplantation. [9] Even the diameter of the apical foramen has been used to predict pulpal healing. Teeth with an apical diameter more than 1 mm have shown promising results [8,10,21,29] as postoperative revascularization is more likely. [8] In contrast, successful results have also been achieved by some clinicians after surgical

repositioning of an impacted incisor at its initial root-forming stage. [30-32] They reported that the early stage of root formation allowed not only easier mobilization of the developing tooth germ, but also less risk of injuring the developing root.

Intra et al [33] did a 10 year follow up study to see the correlation between the developmental stage of the tooth germ and root complementation in autotransplanted teeth and showed that there was a lower root growth for transplanted teeth, which corresponded to 06 and 07 Nolla's stages. The 08 Nolla's stage showed a higher relation in root growth, when compared to its counterparts. Need for endodontic treatment was found in cases of transplanted teeth at 10 Nolla's stage. It was concluded that in every developmental stage in which the autotransplantation were made, there was root growth. However the 08 and 09 Nolla's stages are the preferred ones for assuming the root complementation with minimal possible changes.

### ***Adequate Immobilization***

Kristerson and Andreasen reported that prolonged rigid fixation of autotransplanted immature third molars had a significant negative influence on final root length and root length increment, especially in transplants at earlier developmental stages. Possible explanation for this finding might be that rigid fixation exerts a negative influence on the revascularization process and ingrowth of new vessels is promoted by small movements of the transplant. [34,35]

Periodontal inflammation around the transplanted tooth can also occur as splints can compromise oral hygiene procedures too. [21] The splint should not force the tooth against the bony walls of the alveolus as it may damage the periodontium. [23] Most clinicians advise flexible splinting for 7 to 10 days, [8,21,23] with sutures placed through

the mucosa and over the occlusal surface of the crown [15] because this permits adequate functional movement of the transplant and stimulates periodontal ligament cellular activity and bone repair. [8,23]

To avoid dislocation or possible aspiration of the transplant, [36-38] it is advised to perform splinting that is firm enough to retain the tooth in the socket but flexible enough to permit periodontal stimulation during functioning, that is, a flexible wire-composite splint. [39]

### ***Preservation of Periodontium***

Periodontal healing of the transplanted tooth is a key to a successful clinical outcome. [18,22] When the periodontal fibres are damaged, the healing process is characterized by periodontal fibres that run parallel to the root surface. [18] Periodontal healing of the vital periodontal fibres is usually completed after 8 weeks and appears radiographically as a continuous space around the root [8,21,29] with minimal or no root resorption and presence of a lamina dura. [9,40] Conversely, replacement root resorption arises in teeth with cementum injury, suggesting the importance of cementum for the regeneration of the periodontal ligament. [29]

As transplantation of immature teeth implies surgical removal at a time of incomplete root formation, further root development of the graft after transplantation depends on the preserved vitality and sufficient activity of HERS. [41]

Postoperative growth of supragingival plaque and infection at the host site adversely influence the success of tooth transplantation. Inflammatory resorption occurs due to bacterial contamination of either the pulp tissue or the dentinal tubules. [23] Although some studies [7,8,21] show no relation between graft survival and administration of antimicrobials, many clinicians believe that

patients should routinely rinse with chlorhexidine gluconate (0.12% in aqueous solution) for one to two weeks preoperatively to reduce plaque and promote healing. [42]

The ultimate position of the transplanted tooth within the recipient socket influences periodontal healing. The graft should be placed so that 1 to 2 mm of the width of the periodontal ligament remains above the crestal bone to achieve an ideal biologic width. [10] Otherwise, vertical bone resorption (too deep placement) or long connective tissue attachment (too shallow placement) can occur because of apical migration of epithelium. [10]

### ***The Dilemma over Necessity of Endodontics***

Endodontic treatment is usually indicated when planning autotransplantation for teeth with complete root development. [10,20,21] According to recent data; the success rate of transplantation of teeth with complete root formation is arguably higher. [29]

According to American Association of Endodontists, it is recommended that the pulp of teeth with closed apices be extirpated 1 to 2 weeks post transplantation; otherwise the necrotic pulp and subsequent infection may result in inflammatory resorption and diminish the survival rate of the autografts. [10,21] It is not advisable to carry out endodontic treatment or apicoectomy during the surgical procedure as it increases the risk of root resorption. [8,21]

Tsukiboshi [43] suggested that in teeth with immature roots, regular radiographic examination should be done to find inflammatory resorption and that apicoectomy must be initiated if any signs of pulpal infection were observed, whereas in fully developed donor teeth, endodontic treatment should be completed before surgery or initiated 2 weeks after surgery.

It has been shown that new tissue consisting of well organized and well vascularized connective tissue could grow into the transplanted teeth [44] and that sufficient vascular supply could secure the survival of pulp cells [45] by the 30th day after the autotransplantation of teeth. Until revascularization, the transplant is dependent on diffusion from the recipient site for nutrition. [46-49]

Studies by Skoglund, Tronstad and Skoglund indicate that the original pulp of autotransplanted immature and mature apicoectomized teeth becomes necrotic after transplantation. [50,51] Ingrowth of well-vascularized cell-rich connective tissue does the repair, but a reduction of cells and blood vessels occurs after a period of time. Finally, the new tissue resembling bone or cementum grows in most parts of the pulp cavity causing obliteration.

### ***Miscellaneous Factors***

Minimal extraoral time and wet storage in physiological solution have been found to be critical for pulp and PDL cell vitality. Irreversible cell damage has been reported if the tooth is stored dry for more than 30 minutes. [52] Several clinicians recommended an extraoral storage time of less than 15 minutes and storage in a sterile physiological saline solution. [53,54]

The graft must be placed at the same occlusal level as the donor site so that it develops a longer root than those placed in a superficial, more occlusal, position. [8] On the contrast, if the transplanted tooth has a mature root and is fully erupted, it should be placed slightly below the occlusal level to prevent postoperative trauma. [8] Patient should also be advised to eat a soft diet for initial few days after the transplant.

Tight closure of the gingival flap around the donor tooth is another vital step. Tsukiboshi [43] recommended that this procedure would secure the reattachment of

periodontal ligament and impede bacterial invasion into the blood clot between the donor tooth and the socket. Trauma of any sort should be avoided for the success of the transplant; otherwise it may become an extra cause of impaired healing. [18]

According to some authors, [20,21,55] transplanted teeth can be submitted to orthodontic treatment only 3 to 6 months after transplantation. Hamamoto and others, [40] believed that orthodontic treatment can be initiated just after regeneration of the periodontal space and further confirmation of the lamina dura on the radiographs, though it usually results in a slight increase in the frequency of surface and inflammatory root resorption.

Orthodontic extrusion and minor lateral movements of immature third molar transplants, as well as rotation of single-rooted immature third molars, represent no additional risk to graft survival. In contrast, rotation of multi-rooted transplants has been observed to initiate severance of the vascular and neural supply to the pulp later. [56]

Additional surgical procedures are recommended to obtain an adequate recipient site in patients with premolar aplasia or early molar loss with marked atrophy of the alveolar process, such as simultaneous transplantation of free bone autografts, [57-59] or split osteotomy of the alveolar process. [60-61]

Huang et al [62] recently studied the role of stem cells from the apical papilla (SCAP) as a possible source of odontoblasts for root dentin and concluded that the preservation of SCAP during the treatment of immature teeth is critical for subsequent root formation and maturation.

### **CONCLUSION**

Advantages like better alternative than fixed or removable prosthodontics, avoidance of adjacent teeth preparation and



comparative cost-effectiveness justify autotransplantation to a considerable extent.

Although surgical repositioning of tooth is associated with certain risk of complications, such as root resorption, pulpal necrosis and partial or complete arrest of root formation; ideal case selection and careful surgical procedures can minimize such adverse conditions and lead to desired outcomes.

Performance of the tooth transplant is said to be appreciable when a tooth has normal periapical healing with no detrimental root resorption, and progressive root development to maintain the function of the tooth.

With more and more clinicians sharing their experiences, autotransplantation thus is turning out to be a very reasonable and promising treatment alternative of permanent restoration without implants, orthodontic space closure or prosthetic replacement. Clinicians who treat growing adolescents should therefore, keep this option in their armamentarium during treatment planning and rigorously analyze various aspects in order to make the prognosis more reliable.

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