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AUTOGENOUS TOOTH TRANSPLANTATION - REALITY OR NOT

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ABSTRACT:

Autotransplantation of tooth in children is the surgical movement of a tooth from one place in the mouth to another in the similar individual. Once thought to be tentative, Autotransplantation has achieved high success rates and is an outstanding option for tooth replacement in children. Although the indications for autotransplantation are narrow, careful patient assortment coupled with a suitable method can lead to exceptional esthetic and useful results. One benefit of this procedure is that placement of an implant-supported prosthesis or other form of prosthetic tooth replacement is not needed. A review of the recommended surgical technique as well as success rates is also discussed.

Key words: Autogenous tooth transplantation, Tooth loss,Autotransplantation

INTRODUCTION:

Dental auto-transplantation or autogenous transplantation is defined as the movement of one tooth from one position to another, within the same person.[1,2] This could involve the transfer of impacted, embedded, or erupted teeth into extraction sites or into surgically prepared sockets.[2] The procedure itself is not a new invention, and the earliest reports of tooth transplantation involve slaves in ancient Egypt who were forced to give their teeth to their pharaohs.[3,4] Eventually, allotransplantation,transplantation of a tooth from one individual to another, was abandoned because of histocompatibility and replaced with auto-transplantation.

Premature loss of the first molar tooth results in mesial movements of the posterior teeth, the resultant loss of space, and over eruption of opposing teeth and consequent changes in the occlusion which must be avoided. Fixed prosthesis and implants are not feasible in growing patients because they may impede the normal growth of facial bones, in particular, of the alveolar process. Transplantation of an immature third molar with incompletely formed roots could possibly serve as a suitable treatment option as it helps to maintain alveolar bone and enables endosseous implantation without requiring bone regeneration.[4] It has been reported that during growth, a successful transplant preserves the alveolar bone, diminishes the extent of resorption of newly formed alveolar bone and provides functional stimulation. [5,6]

Many factors have been implicated to affect the prognosis of an autologous implant. Transplantation of teeth with immature roots offers higher success rates. This is attributed to the unimpeded root development of the transplant as well as the growth of the adjacent alveolar bone .[7] Transplanted teeth with incomplete root formation have 96% rate of pulp healing when compared to 15% for teeth with complete root formation .[8]

Teeth with an apical diameter greater than one mm have a diminished risk of pulp necrosis because post operative revascularization is more likely .[9]

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. [7, 8] A transplanted

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third molar also aids in maintaining natural space, with none or minimal root resorption, [8] alveolar bone volume [9,10] and morphology of the alveolar ridge through necessary proprioceptive stimulation. [8,11] 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 age at which the first tooth appears differs very much from child to child. Very occasionally, children are born with one or more teeth These may need to be removed if they are very loose, as there is a risk that the child could swallow them, or have difficulties with breastfeeding [2]. Other children may not expand any teeth until they are more than a year old. Usually, however, the first tooth - which tends to be in the middle of the lower jaw - appears at around six months of age. The complete set of 20 primary teeth (baby teeth) is usually present by the age of two-and-a-half years. The first permanent teeth appear at around six years of age. These tend to be the incisors in the middle of the lower jaw and the first permanent molar teeth. The molars come up behind the primary teeth, they do not replace them.[2,6,7,10]

As there are a lot of reasons for autotransplanting teeth in children, tooth defeat as a result of dental caries is the most common sign, particularly when mandibular first molars are concerned. First molars erupt early and are often a lot restored. Autotransplantation in this situation involves the removal of a third molar which may then be transferred to the site of an unrestorable first molar. Extra circumstances in which transplantation can be careful include tooth agenesis (particularly of premolars and lateral incisors), shocking tooth loss, atopic outbreak of canines, root resorption, large endodontic lesions, cervical root fractures, localized juvenile periodontitis as well as other pathologies. Successful transplantation depends on specific requirements of the patient, the donor tooth, and the recipient site.[12,13]

Patient selection is very significant for the achievement of autotransplantation. Child must be in good health, able to follow post-operative instructions, and available for follow-up visits. They should also demonstrate a satisfactory level of oral hygiene and be agreeable to regular dental care. Most importantly, the child must have a suitable receiver site and donor tooth. Patient collaboration and comprehension are extremely important to ensure predictable results. [2,5,7,14]Table.1

The most significant criteria for success connecting the recipient site are adequacy of bone support. There must be enough alveolar bone support in all dimensions with sufficient attached keratinized tissue to allow for stabilization of the transplanted tooth. In addition, the recipient site should be free from acute disease and chronic irritation.[13-15]

The donor tooth should be positioned such that extraction will be as a traumatic as possible. Irregular root morphology, which makes tooth removal very difficult and may involve tooth sectioning, is contraindicated for this surgery[13-15]. Teeth with also open or closed apices may be donors; however, the most unsurprising results are obtained with teeth having between one-half to two-thirds finished root development. Surgical treatment of teeth with less than one-half root formation may be too shocking and could compromise further root development, stunting maturation or changing morphology. When root development is better than two-thirds, the increased length may cause infringement on vital structures such as the maxillary sinus or the lesser alveolar nerve. Also, a tooth with total or near complete root configuration will usually require root canal therapy, while a tooth with an open apex will remain vital and should carry on root development after transplantation. In the latter case, successful transplantation without the need for further endodontic therapy is usually seen. [16 -20]

METHODS:

Indications for tooth transplantation are discussed in the following 3 case reports. All 3

children are presented to my private pediatric dental clinic.

Case 1

A 9-year-old child orthodontic patient was referred to the oral and maxillofacial surgery section for the assessment of an unerupted tooth 47. A panoramic radiograph exposed flat impacted teeth 47 and 48, total root configuration of tooth 47 and incomplete root formation of tooth 48. It was felt that orthodontic up righting of tooth 47 was not likely and that it would be difficult to bring tooth 48 into an ideal place using an orthodontic move toward. As tooth 48 established approximately two-thirds root formation, it was felt that transplantation of that tooth to position 47 could address this patient's problem, and the tooth was successfully transplanted.

Case 2

An 11-year-old child presented to the emergency hospital bad tempered of pain associated with tooth 47. A periapical radiograph showed wide obliteration of the crown of this tooth as a result of dental caries. Test led to a diagnosis of pulpal necrosis with periapical extension. Following discussion with the endodontic and prosthodontic departments, it was felt that the extent of the caries would make restoration of the tooth very difficult, if not impossible. Since the radiograph showed that tooth 38 had two-thirds root development, the decision was made to transplant tooth 38 to the space left following the extraction of tooth 37.

Case 3

In 2009, a 10-year-old female presented complaining of mobility linked with tooth 46. The patient was lost to follow-up until January 2010, at which time she was referred to the graduate periodontal clinic for a total examination. The patient was diagnosed with limited to a small area juvenile periodontitis, and removal of tooth 46 was advised due to a poor prognosis. Otherwise, the in general forecast was fair; all the other teeth could be retained and maintained for a prolonged period of time. Tooth transplantation was recommended to manage this patient's difficulty. Periapical radiographs of teeth 38 and 48 were taken. As the root development of tooth 48 appeared greater than two-thirds, tooth 38 was chosen as the donor tooth.

While no lasting follow-up is obtainable for these cases, the six-month post-operative radiograph for case 3 shows good bone fill at the receiver site, sustained development of the roots of the transplanted tooth, and development of the periodontal ligament space, which is characteristic of an appropriately healing autotransplant.

The process for tooth transplantation in children is typically no more traumatic for the child than the removal of impacted third molars. Depending on patient preference, local anesthesia alone or in combination with some form of sedation is enough for the surgical procedure. Once sufficient anesthesia is obtained, the tooth at the recipient site is extracted and the recipient socket prepared. Occlusal and periapical radiographs of the donor tooth should be used to determine its labiolingual and mesiodistal dimensions. Many practitioners use this information to make an acrylic replica of the tooth to be transplanted. This replica allows them to get ready the receiver site using a guide with dimensions similar to those required for the donor tooth. Next, the donor tooth is carefully removed to ensure minimal trauma to the periodontal ligament. When the donor tooth is unerupted, extraction involves flap elevation, bone removal, and gentle taking away of the follicle from around the crown. Traumatic injury to the root surface of the donor tooth will damage the success of the transplant due to insufficient periodontal ligament regeneration. This is important for integration at the recipient site. Once removed, the donor tooth should be handled as little as possible and the practitioner should be cautious to stroke only the crown. The tooth is then placed in the recipient socket. Minimal delay between extraction and transplantation is important to ensure preservation of periodontal membrane vitality. If further adjustment of the recipient socket is required, the donor tooth can be easily stored in its original socket.

Once the transplanted tooth is in its final place, occlusion is checked and, if wanted, adjusted using a high-speed finishing bur. The tooth should be in slight infraocclusion to allow it to

erupt into proper occlusion over the next few months. When proper positioning is obtained, the tooth can be stabilized with a suture secure for one to 2 weeks. On the other hand, adhesive resin, light polymerizing resin, or a temporary bridge of auto polymerizing resin and wire secure can be used.

Post-operative orders and sequelae are alike to those following the removal of an impacted tooth. A soft diet should be followed for a couple of days after surgery and the patient should be instructed to avoid mastication on the transplant. Patients should be instructed to maintain best oral hygiene. Some investigators sense that the child should rinse with chlorhexidine gluconate mouth rinse0,2% as an adjunct to oral hygiene. Child may also be given per operative and post-operative antibiotics.

A lot of clinician's advice that patients be seen the day after surgery to make sure the transplant has retained its new place, the splint is steady, and that swelling, edema, and hematoma formation are within normal limits. The child should then be seen at weekly intervals for one month if there are no complications. After one month, the patient should be seen every 6 months for 2 years. During this period the tooth should be evaluated for the onset of pulpal breakdown seen as intrapulpal calcification, periapical radiolucency, or root resorption. For vital transplants of developing teeth with open apices, endodontic treatment of the transplant is not necessary as these teeth can be revascularized and reinnervated. However, endodontic treatment is always required for transplants of mature teeth with complete root formation. Endodontic therapy begins approximately one month post-operatively with instrumenting of the canals and filling with calcium hydroxide. Gutta percha filling is completed 3 to 6 months post-transplantation.

RESULTS:

The literature reports outstanding success rates following tooth transplantation when the appropriate protocol is followed. We found 95% and 98% long-term survival rates for incomplete and complete root formation of 370 transplanted premolars observed over 13 years. Lundberg and Isaksson had success in 94% and 84% of case for open and closed apices respectively in 278 autotransplanted teeth over 5 years[6]. Kugelberg achieved success rates of 96% and 82% for 45 immature and mature teeth transplanted into the upper incisor region over 4 years[12]. Cohen showed success in the ranges of 98-99% over 5 years and 80-87% over 10 years with transplanted forward teeth with closed apices.[1] Nethander found 5-year success rates of over 90% for 68 mature teeth transplanted with a 2-stage technique[4]. Josefsson found 4-year success rates of 92% and 82% in that order for premolars with unfinished and complete root configuration.[11] These consistently far above the ground achievement rates are a contrast to the variable results reported in many older studies[22-28]. Schwartz and others yielded achievement rates of only 76.2% at 5 years and 59.6% at 10 years[16]. Also, Pogrel set up that his success rate for 416 autotransplanted teeth was 72%[29]. However, other investigators of that period had more positive results. Kristerson, for example, obtained a success rate of 93% when 100 autotransplanted premolars were observed for a mean of 6.3 years.[14]

The factors that guide to success have been at length investigated. The most important determinant for survival of the transplant is the sustained vitality of the periodontal membrane[20-28]. In cases where the periodontal tendon is traumatized during transplantation, external root resorption and ankylosis is often noted. Schwartz tried to link the loss of the graft to exact predictive factors and found that success rates are highest when giver teeth are premolars, have one-half to two-thirds root development, and experience minimal trauma and limited extraoral time during surgery. The experience of the surgeon also affects the success because this process is technique-sensitive. [16] Table.2

Although preservation of the tooth and restoration of the edentulous space is the desired result for patients, more exact parameters have been used to measure the health of the surviving transplant. These parameters include marginal periodontal attachment, mobility, pain, root resorption, root development, sensitivity to percussion, gingival pocket depth, presence of gingivitis, and presence of fistulae. However, these

studies are difficult to contrast because each used dissimilar measures to determine success.

The most general cause of breakdown of the autotransplant is chronic root resorption. More specifically, the causes of tooth loss following transplantation from most common to least common are provocative resorption, substitute resorption (ankylosis), marginal periodontitis, apical periodontitis, caries, and shock. Inflammatory resorption may become obvious after 3 or 4 weeks, while replacement resorption may not become evident until 3 or 4 months after transplantation. The incidence of both types of resorption can be decreased with atraumatic extraction of the donor tooth and instant transfer to the recipient site to minimize the risk of wound to the periodontal ligament. [17-20]

After approval by the St Jude Children's Research Hospital Institutional Review Board, the medical records and panoramic radiographs of all children who underwent tooth transplantation at St Jude between 2006 and 2008 and who had panoramic radiographs obtained before transplantation were reviewed. All radiographs were evaluated by a pediatric dental resident (MV) with supervision of a practicing dentist (CR). All radiographically apparent microdontia, hypodontia, taurodontia, root stunting, enamel pearls, caries, dental restorations/extractions, and pulpal calcifications were recorded. transplantation of the third molar were excluded because of the high rate of third-molar hypodontia and microdontia in otherwise healthy populations. transplantation of children were made by the sinor doctors.[30]

Results were statistically analyzed according to the type of teeth examined: primary teeth, permanent teeth, and mixed teeth. If patients had multiple dental examinations before transplantation of tooth, the information from the most recent examination was used. Fisher's exact test was used to compare the proportion of patients who had dental autotransplantation. For patients who had mixed dentition at the time of dental examination, information was recorded only for transplantation teeth and not for the total number of primary teeth and adult teeth examined. Therefore, the results of analysis are exploratory and should be interpreted with caution. [30,31]

Intra et al 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.[32]

Tsukiboshi [33] 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 sur-gery or initiated 2 weeks after surgery.

Huang et al 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.[34]

Studies by Skoglund, Tronstad and Skoglund indicate that the original pulp of autotransplanted immature and mature apicoectomized teeth becomes necrotic after transplantation. [35,36] 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. [35,36] Table.3

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. [1] It is not advisable to carry out endodontic treatment or apicoectomy during the surgical procedure as it increases the risk of root resorption. [8, 21,37]

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.[38]

Zachrisson et al recommend restoration of autotransplanted premolars with porcelain laminate veneers (PLV) over composite build-ups for better esthetics. Incoming light on the tooth is not blocked by a bonded PLV, resulting in no darkening of the gingival margin even upon root exposure.2

This minimum tooth reduction technique can, therefore, permit earlier placement of a permanent restoration.[39]

The study with the higher success rate (98%) was the one by Kahnberg et al. [12]. The study sample comprised 45 male and female patients of different age groups. Recipient sites also varied. A direct surgical approach with a basic socket preparation where required was used. A variety of fixation splint types was used depending on each case and fixation was accordingly maintained for 3-5 weeks. Endodontic treatment was performed for all teeth with fully developed roots 3-4 weeks postoperatively and coincidentally in 3 teeth with open apices. The transplants were followed up for a period from 6 months up to 10 years

In contrary, the lowest success rate (67%) was reported in the study of Elliasson et al. [40]. This study included 36 teeth (molars, premolars and canines) with completed root formation. A direct surgical technique was used comprising a simple socket preparation. Only rigid types of fixation were used (acrylic splint, orthodontic arch wire, surgical cement) for 1-10 weeks postoperatively. All transplants were endodontically treated before of within 12 weeks postoperatively and were followed up for a period of 12-121 months.[40]

The success of tooth transplantation relies on several factors (i.e., the initial stability, the extraoral time, the surgical procedure, as well as the handling and care of periodontal ligament [41]. Common complications of tooth transplantation are observed, such as root resorption and ankylosis [41]. Therefore, it has been suggested that root canal treatment should be performed in transplanted teeth with complete root formation to prevent root resorption [42] .

Different data have been published on the influence of splinting method and the period of fixation on the success of transplant. Following rigid or extended fixation, increased incidences of ankylosis and disturbances of pulp revascularization have been reported .[10] The splint should not force the tooth against the bony walls of the alveolus because it may damage the periodontium .[11] Most reports suggest flexible splinting. The splint used in this case permitted some functional movement of the transplant, thus would have helped in stimulating periodontal ligament cell activity and repair.

The absence of transplant mobility, pain, root resorption in addition to positive pulp vitality test and continued root formation one year post operatively were suggestive of favorable prognosis, although long term success rate needs to be evaluated.

CONCLUSION:

Although autotransplantation in children has not been established as a traditional means of replacing a missing tooth, the process warrants more reflection. New studies obviously show that autotransplantation of teeth in children is as successful as endosseous dental implant placement. Minimum acceptable success rates for endosseous titanium dental implants are 85% after 2 years and 80% after 5 years. For children, autotransplantation may also be considered as a provisional measure. The transplant can replace missing teeth to make sure preservation of bone until growth has ceased and then, if essential, the patient can become a candidate for implants. With suitable patient selection, and presence of a suitable donor tooth and recipient site,

autotransplantation should be considered as a viable option for treatment of an edentulous space.

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TABLES:

Factors in the choice of dental autotransplantation

a. Patient age
No patient age limit
However, patients older than 40 have a better successrate when implant treatment has been used

b. Function and esthetics
Has a normal PDL, serving as a shock absorber and aproprioceptor Can promote bone formation
Normal eruption is possible
In some cases, prosthetic treatment is not required
Adjustable position after surgery
Needs an ideal donor tooth

c. Orthodontic movement
Can be moved orthodontically

d. Gingiva
A normal gingival contour can be induced

e. Time and cost
Needs fixation stage
Less costly

f. Long-term results
Transplanted teeth have been observed for up to 40 years
and have similar healing rates

Table 1

Criteria for success in autotransplantation

Radiographic examination
- No evidence of progressive inflammatory root resorption
- Normal PDL space width around the transplanted tooth
- No disturbance in root development
- Lamina dura
- Healing of alveolar bone

Clinical examination
- Normal tooth mobility and normal tooth function
- Gingival healing and no indication of marginal attachment loss, inflammation
- Healing of dental pulp
- No patient discomfort
- Normal percussion sound

Histological examination
- The PDL fibers are aligned to perpendicular, not parallel, to the root and alveolar bone
- However, without extraction, it is impossible to evaluate clinical cases histologically

Table 2

Successful healing factors associated with autotransplantation of teeth

a.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 cooperative attitude.

b.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 (nonfunctioning tooth)

Healing of dental pulp
- The preservation of Hertwig's epithelial root sheath (HERS)
- Healing of the dental pulp occurs until Moorrees 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
- Teeth with a single, cone-shaped root without concavity around the cervical area are most favorable.

c. Recipient site related factors
- 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 the day of transplantation or within 1 month after extraction

d. Clinical factors
- Surgery should be performed by a clinician with experience in such areas as Surgery should be performed by a clinician with experience in such areas as donor tooth extraction, preparation of the recipient site, and tissue management

Table 3