



Autotransplantation of teeth

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Introduction

The earliest tooth transplantations involved slaves in ancient Egypt who were forced to give up their teeth to the pharaohs. Allotransplantation, where a tooth is taken from one individual to another of the same species, has many problems associated with it, including transplant rejection and transmission of infectious diseases. Autotransplantation involves transfer of teeth from one site to another within the same individual. The purpose of this Clinical Update is to summarize the biologic principles required for autotransplantation of teeth.

Indications

Autotransplantation is indicated when a tooth has a hopeless prognosis and an appropriate donor tooth can be utilized without negative effects from its loss. Often the indication is the transplantation of third molars to the extraction site of unrestorable molars, however, transplantation is possible to the premolar or anterior areas. Premolars and canines can also serve as donor teeth. Donor teeth must be nonfunctional with the ideal shape being a smooth, conical single root. Teeth with large, widely spread or curved roots have a tendency toward mechanical trauma to the periodontal ligament (PDL) during extraction or transplantation. Teeth with short root trunks tend to develop periodontal pockets at the furcation area after transplantation. Multi-rooted teeth with enamel projections or with more than one third root attachment loss are contraindicated. The ideal recipient site should have enough width and height to receive the donor tooth, but if needed the socket can be surgically enlarged. In the case of maxillary sockets, sinus lifts may be required.

Wound healing

Once a tooth is extracted PDL healing can occur via reattachment or new attachment. The size of PDL deficit on the donor root and the socket wall distance to the root affect the likelihood of new attachment repair. The greater the distance between the bone and root, the more time required for the bone to reach the root. Transplantation success depends mainly on vitality of PDL attached to the donor tooth, since it contains cells that help prevent root resorption. PDL healing is expected when a donor is immediately placed into a freshly extracted recipient socket. However, PDL healing in a newly formed socket would need more time and the prognosis is poorer. An explanation for this finding could be the increased handling of the graft during the several attempts at adapting the tooth to the socket, with each attempt representing a risk of bacterial contamination and PDL damage. The PDL is also susceptible to changes in pH and osmotic pressure. Under dry conditions, most of the PDL is vital after 18 minutes, but after 30 minutes more than half is nonvital, and after 120 minutes most of it has become necrotic (1). If extraoral time is anticipated, the tooth should be stored in Hank's balanced salt solution (HBSS) to preserve vital PDL (2). The enamel matrix derivative EMDOGAIN® (Biora, Inc.) has promoted regeneration of periodontal tissues of transplanted teeth and healing and prevention of root resorption (3). Root resorption occurs when a donor tooth

with partial or total lack of vital PDL is transplanted and is categorized in three groups: surface, replacement/ankylosis, and inflammatory. The extent of missing PDL and existence of pulpal infection determine which type of resorption occurs (4). Unlike replacement resorption, inflammatory resorption can be arrested in its early stage with endodontic treatment.

Healing of the gingival tissue is enhanced by placing the donor tooth such that a 1 mm band of PDL is above the crest of the bone, thus allowing proper biologic width. Pulp regeneration can be expected in transplantation of teeth with incomplete root formation. The pulp space of these teeth often obliterates but until symptoms or radiographic signs of pathology are present, no treatment is indicated. Root growth is dependent upon the activity of Hertwig's epithelial root sheath (HERS) and pulpal/PDL cells. HERS shows three responses to injury: total arrest of root formation, partial arrest where a decreased root is formed, and unimpeded root formation. In a study of premolar transplantations, root development occurred to completion in 21% of cases, no development in 14%, and partial development in 65% of cases. The results indicate that a main factor in determining the final root length is the stage or length of root formation at time of transplantation. Considering both healing of the pulp and root development, the ideal timing of transplantation of developing teeth is when the donor roots are 3/4 to 4/5 completed. This will ensure that a sufficiently long root is preserved, even if no root development occurs. When the pulp of developing teeth does not heal, root canal therapy, which may include apexification or apexogenesis, is necessary. Root canal therapy should be initiated in the fully developed donor tooth before or within two weeks after transplantation to prevent inflammatory resorption, because healing of the pulp cannot be expected after apical closure (5). Extraoral root canal treatment is not recommended since it enhances PDL damage and root resorption.

Procedure

Antibiotics are taken prior to the procedure since short-term administration (7 days) of tetracycline could help ensure success of the procedure (6).

If recipient site extraction is performed the day of transplantation, it should be done prior to donor tooth removal. The PDL of the socket must not be removed, but any endodontic lesion should be lightly curetted. If tooth extraction at the recipient site has been performed previously, a full-thickness flap is made to expose the bone and transplantation should be performed 2-6 weeks after the extraction because extensive bone resorption will occur after 6 weeks.

Before preparing the recipient socket, the donor tooth should be extracted atraumatically and examined while handling it by the crown to minimize PDL damage. The donor tooth should be placed back in its original socket or in a storage medium like HBSS. The distance between adjacent teeth must be compared to the mesiodistal width of the donor tooth. When making adjustments, no more than two millimeters of enamel is removed.

When the extraction socket doesn't exist and the recipient site must be surgically prepared, reference cuts are made in the bone corresponding to the size of the donor tooth. Direction and depth are transferred using an implant or trephine bur.

The match between the recipient site and the donor is periodically checked while using light pressure. Changing the direction of the donor tooth by rotating it may help find a better fit.

The success of transplantation depends on primary closure of the gingiva around the donor tooth. Modification of the flap for coronal repositioning may be necessary.

If required for stabilization, a short-term (1 week), physiologic splint is recommended. The occlusion is checked so that no occlusal interferences are present. Radiographs are taken pre-operatively and after splinting to evaluate tooth position.

The transplanted tooth is protected with surgical dressing for 2 to 3 days. The patient should be on a soft diet, with gentle tooth brushing for two weeks, and a 0.12% chlorhexidine mouthrinse for one week.

Transplanted teeth should be monitored at 1, 2, 3, 6, 12 months, and then yearly. Evidence of pulpal healing in developing teeth is continuous root formation and pulp space obliteration. Lack of pulpal healing is manifested as periradicular lesions and resorption. The final restoration should place the tooth back into function.

Comparison of Autotransplantation and Dental Implants

Implants are indicated for a majority patients while transplants are limited to those with appropriate donor teeth. If implants are placed in patients before pubertal growth, they do not erupt along with adjacent teeth and result in infraocclusion with functional and esthetic problems. Transplanted teeth may erupt in harmony with adjacent teeth, readjust to occlusal demands and have a bone inducing capacity. For superior esthetic results, transplants have a natural emergence profile and gingival contour. Immediate transplantation can also provide significant time and cost savings.

Prognosis

It is not easy to determine the success rate of autotransplantation by a review of the literature because there is no common criteria. Vital PDL attached to the transplanted tooth is an essential condition for success. In a report of 220 transplantations with an average follow-up period of six years, the survival rate in extraction sites with existing PDL was 100% and the success rate was 95%. Due to faster PDL healing, survival and success rates of immature teeth seem higher than mature teeth. Overall, it appears that survival rates vary from 70-100% and success rates from 50-97%. This variation may be explained by the multiple factors that influence post-operative prognosis which include donor tooth, recipient site, patient characteristics, and clinical factors (7, 8). It should be expected that these results will continue to improve when more

advanced techniques, such as the use of HBSS and enamel matrix proteins become more widespread.

Conclusions

If a case presents the proper clinical indications and biological principles are followed, the dentition can be preserved using a natural tooth rather than a mechanical prosthesis. Autotransplantation offers the patient and dentist another viable treatment option when a single tooth is not restorable and requires extraction.

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