Tooth Autotransplantation as a Treatment Option

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Introduction

Tooth autotransplantation refers to the extraction of a tooth from one location and its replantation in a different location in the same individual. The new location may be a fresh extraction socket after extraction of a non-restorable tooth, or an artificially drilled socket on an edentulous alveolar ridge. Its definition also encompasses the surgical repositioning of a tooth within the same socket. Cost effectiveness is the obvious advantage of this procedure which enables the utilisation of a tooth that is hitherto non-functional (usually third molar tooth) to be transferred to a functional position to replace a lost tooth in the same person. The main disadvantages are surgical involvements, technique sensitivity, relatively low versatility in their applications (e.g. tooth and space size discrepancy) and more importantly low predictability in results compared to conventional prosthetic (implants, bridge, dentures) restorations.

Over the years, the Oral & Maxillofacial Surgery & Dental Unit of the Princess Margaret Hospital has employed autotransplantation to manage patients' tooth loss as a cost-effective treatment modality in a variety of clinical scenarios. This article aims at sharing our clinical experience with our colleagues in this technique.

Biological Principles and their Clinical Applications

The understanding of the healing process of a transplanted tooth is imperative to its success. In other words, it minimises the incidence of root resorption and tooth ankylotic complications. The preservation of favourable periodontal ligament (PDL) on the donor tooth is the critical factor for success. Reattachment occurs in about 2 weeks after autotransplantation between the PDL connective tissues of the donor root surface and the wall of recipient socket. The type of healing of transplanted tooth is dependent on the surface area of the damaged root to be repopulated. When the damaged PDL surface is small, the healing can be achieved by cemental healing. However when the damaged PDL surface is large, some of the root surface will be resorbed followed by apposition of bone rather than dentine, thus root resorption will ensure. Genetically, PDL cells can differentiate into fibroblasts, cementoblasts and osteoblasts. In the ideal situation, one would hope PDL cells on the root surface to differentiate into cementoblasts and induce dentine formation, whereas PDL cells on the side of bony socket wall surface to differentiate into osteoblasts thus inducing bone formation. In addition, the contributions of the progenitors PDL cells on the recipient fresh extraction sockets should not be overlooked, that also accounts for the higher successful rate for freshly extracted recipient sockets compared to artificially drilled ones. It is important to minimise inflammation so that reattachment can progress to the healing stage with the proper differentiation of the PDL cells. Inflammation will be minimised when the transplanted tooth is sealed with tight suturing of the gingival cuff around the tooth to prevent ingress of infective agents. This can be achieved by trimming and suturing of the recipient site flap before the implantation of the donor tooth. When the follicle or even dentigerous cyst is present over the amelo-dentinal junction of the donor tooth, it is also useful to preserve the soft tissue lining around the tooth to facilitate suturing to the recipient gingival cuff. It is also important to minimise inflammatory pulpal response from the transplanted tooth. For fully developed donor teeth, root canal treatment should be initiated 2 weeks after transplantation. The interim period of 2 weeks is chosen to minimise trauma to the PDL in the initial reattachment healing phase, yet further delay will increase the chance of complication of inflammatory resorption secondary to pulpal infection. In the case of donor tooth with incomplete root formation, the preservation of the apical Hertwig's epithelial sheath is important to ensure pulpal regeneration and root maturation and eruption. Ideally, one would prefer the donor tooth to be at its maximum length but still has its potential for pulp regeneration with apex opening >1mm radiographically. This will ensure that a sufficiently long root can still be preserved even root development is curtailed prematurely after autotransplantation.

Case Reports

Case 1:
A 12-year boy was referred from School Dental Clinic for a massive calcified mass in left mandible. He gave a history of recurrent swelling & tenderness. There was no mental nerve parasthesia on presentation. Orthopantomogram (OPG) revealed a gigantic radiopaque mass extending from 36 to 38 molars region. The surface was convoluted and surrounded by a radiolucent rim distally. 36 was displaced to lower border and so was the inferior dental canal. The differential diagnosis made was complex composite odontoma

Surgical excision of the lesion and the displaced 36 was

done under general anaesthesia (GA). The inferior dental nerve was preserved with no sensory loss, nor had pathological fracture happened. New bone regenerated in the original defect left by the lesion. All lower left molars were missing and subsequent overeruption of upper molar 27 happened. At age 19, transplantation of right upper wisdom tooth 18 to left edentulous mandible was done under LA. Overerupted 27 was also extracted. On 5 year post-operative review at age 24, transplanted tooth 18 had further erupted with good bone support.

This case showed that transplanted tooth can be taken well in artificial cavity drilled in regenerated bone secondary to excision of pathological lesion.

Case 2:
A 12-year old girl was referred from School Dental Clinic for odontomes and displaced lower right canine 43. OPG revealed a haphazard odontoma-like calcified mass in 43 region surrounded by radiolucent rim compatible to soft tissue sac. Canine 43 was displaced to lower border and towards midline, also surrounded by radiolucent rim attached at dentigerous relationship compatible to dentigerous cyst. Deciduous canine 83 was retained with short root and poor prognosis. Transplantation of displaced canine 43 to 83 socket after excision of 83 and odontoma via buccal window approach was carried out under GA. Overlying cystic lining of 43 was excised with soft tissue rim left attached to facilitate primary closure to the gingivae cuff. 43 was fixed with arch wire and composite splint for 2 weeks. At age 14 two years post-op, 43 had erupted into functional occlusion. Periapical X-ray confirmed healthy periodontal ligament space surrounded with lamina dura. Neither root resorption nor ankylosis was noted.

Case 3:
A 12 year-old boy was referred for unerupted upper right lateral incisor & canine 12 & 13. OPG revealed displaced dilacerated 12 labially, 13 eruption was impeded and impacting against central incisor 11. The dilacerated 12 was excised and 13 was disimpacted from 11 and transplanted into position of 12 (Intra-alveolar transplantation) under local anaesthesia. It was noted that there was deficiency in bone support in the mesial aspect of 13 left by the void of the follicle of 12. 13 was fixed with arch wire and composite splint for 3 weeks. Post-operatively, 13 continued to erupt and upright into functional occlusion. At age 15 and 3-year post-op, OPG & periapical radiographs confirmed deposition of new alveolar bone mesial to 13 next to the incisor, close up to the amelo-cemental junction. The apex of 13 also continued to grow (Apexification) and there was obliteration of the root canal and chamber, signs of positive regeneration and absence of pulpal infection. This case illustrated the osteo-inducing potential of the PDL cells of the transplanted tooth which is a major advantage over implants.

Discussion

Implant technology has taken great strides in recent years in terms of predictability in both success rate & aesthetic result. Comparison between autotransplantation & implantation as treatment options in replacing missing teeth seems inevitable. One major advantage of transplantation over implantation is its applicability in the management of patients before puberty growth has finished. Implants will not grow with the growing patients and result in infraocclusion. The beauty of transplanted teeth is that they are biological and able to erupt in harmony with adjacent teeth and growing jaws. The open apex of the transplanted tooth with intact Hertwig epithelial root sheath also allows healing and regeneration of the pulpal tissue and therefore saving subsequent root canal procedures. Another advantage of transplantation is the osteoinducing potential of the periodontal ligament (PDL) cells resulting in bone regeneration between gap of the walls of socket and the transplanted tooth. This is a welcome phenomenon we observed again and again clinically and confirmed with radiographs, especially in children & adolescents. Genetically the PDL cells can differentiate into fibroblasts, cementoblasts and osteoblasts thus explaining this osteoinducing phenomenon. It would be an interesting thought to utilise these valuable PDL cells to the advantage of our implant technique in future. One might harvest PDL cells from the root surface of extracted non-functional wisdom tooth and transfer them to the gap between implant and the drilled hole. Just in the case when transplanted teeth induce bone growth in drilled bone cavity, it would be interesting to observe if the free PDL cells will have similar adjunctive bone inducing effect on the wall of the drilled implant cavity bony surface. The mode & medium of transfer remain to be a subject of further research.

Conclusion

There is obvious limitation in terms of versatility in the application of transplantation verses implantation in replacing missing teeth. The availability of suitable size & morphology donor tooth being the major constraint. The success rate of implant is also higher than that of transplant. Reported survival rates of autotransplantation vary from 74-100%, artificially drilled recipient sockets tend to be at the lower end of the range of success rate. It is also more technique sensitive and less predictable in terms of success rate & aesthetic outcome. Admittedly our cases are more challenging than most reported autotransplantaion series in that the ablations of associated pathological lesions result in less than ideal recipient socket wall support. However our experience in autotransplantation demonstrates that it is a viable treatment alternative especially in growing adolescents even in cases after ablation of pathology. It provides a biological & economical treatment alternative for tooth replacement subsequent to surgery loss in the patient group typical of public service.

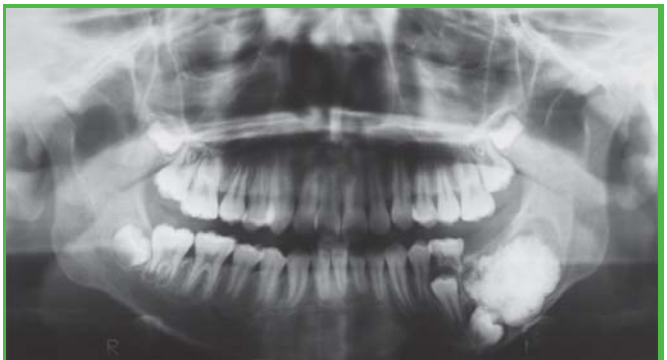


Figure 1a. Age 12. Gigantic complex composite odontoma of left mandible and displaced lower left first molar 36 prior to excision..

Figure 1b. Age 19. Good bone regeneration in left mandible but missing all molar teeth. Overerupted opposing upper molar tooth 27.

Figure 1c. Age 19. Transplantation of upper right wisdom tooth 18 to lower left mandible 36 molar region. Excision of opposing overerupted tooth 27.

Figure 1d. Age 24. Five years post-op. Transplanted tooth showed further eruption and firm with good bone support.

Figure 2a. Age 12. OPG showing displaced right lower canine 43 by odontoma. Retained right lower deciduous canine 83.

Figure 2b. Occlusal XR showing displaced canine 43.

Figure 2c. Excision of odontoma and transplantation of impacted canine 43 to socket left by excision of deciduous tooth 85.

Figure 2d. Age 14. Two years post-op. Transplanted canine tooth 43 in good functional position.

Figure 2e. Periapical XR showing healthy periodontal ligamental space with no ankylosis nor resorption.

Figure 3a. OPG radiograph showing the dilacerated and displaced 12 and impacted 13

Figure 3b. Post-op OPG of intra-alveolar transplanted 13 after excision of 12.

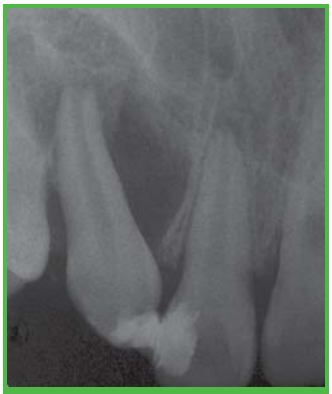
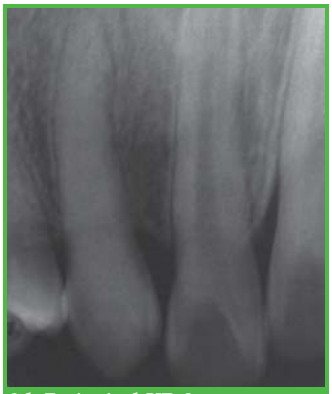


Figure 3c. Periapical XR highlighting the deficiency of mesial bone support adjacent to the transplanted 13, being the void left by the follicle of 12.



3d. Periapical XR 3-year post-op illustrating the deposition of alveolar bone next to the mesial surface of 13 with healthy PDL and lamina dura. Apex growth also completed with obliteration of pulp chamber and root canal.

Figure 3e. OPG 3-year post-op showing satisfactory alignment and position of transplanted 13.

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