Autogenous tooth transplantation - Reality or Enigma; Report of 2 cases with review of literature

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A B S T R A C T

Autotransplantation of teeth has been carried out for many years, but with varying success rates. Due to which, this procedure is seldom regarded as an appropriate treatment option for patients with missing teeth especially with continued development of osseo-integrated implants. Since placement of implants in growing alveolar bone is controversial, transplantation of available teeth remains a suitable choice for replacing missing units in the young patient. This condition allows the replacement of lost teeth in children and young people that commonly has involved mandibular first molars due to caries, and anterior teeth due to trauma. Dental autotransplant has previously been viewed with uncertainty because of a lack of information on the topic and poor clinical results of reported cases. These poor results were due to a lack of understanding of the biological principles involved and poor clinical technique. Another barriers to acceptance of the technique has been the misconception that autotransplantation can only be successful when immature, developing teeth are transplanted. Success of autotransplantation should therefore be viewed in terms of tooth survival, with or without a root filling. Aim of the paper is to discuss outcome of two autotransplantation cases with review of literature.

Keywords: *Autogenous tooth transplantation, Tooth loss, Autotransplantation*

Introduction

Auto-transplantation is also defined as the transplantation of embedded, impacted or erupted teeth, from one site to another in the same individual into extraction sites or surgically prepared sockets.[1] It has been done for many years but with varying degrees of success. Clinical case reports of successful autotransplantation were done way back in 1950s when decayed first molars were replaced with transplanted

immature third molars. Since that time, an evidence of great success of transplanting number of teeth, especially premolars and canines have been attempted.[2] Autotransplantation has been used to replace missing teeth and teeth of poor prognosis. Autotransplantation of teeth ensures maintenance of alveolar bone volume by physiological stimulation of the periodontal ligament (PDL). Placement of osseo-integrated implants is also one of the alternative treatments for the same condition.[3] However the procedure causes bone and dental implants to fuse together and do not allow eruption of implant along with adjacent teeth, the concept of placement of osseo-integrated implants in growing young adolescents is warranted.[3] Autogenous transplantation of available teeth remains a suitable choice for replacing missing units in young patient and maintaining the PDL will be a suitable and attractive option in such cases.[1]

Clinical situations in which autotransplantation is indicated are trauma[4], impacted or ectopic teeth[2], replacement of congenitally missing teeth[5], dentoalveolar rehabilitation in cleft palate[6] and teeth of poor prognosis.[7]

Aim of this paper is to review and discuss clinical outcomes of two cases of autogenous tooth transplantation done in young patients with complete emphasis on treatment modalities.

Case report:

Case 1 - A 14 year old female patient reported to the outpatient Department of Pedodontics and Preventive Dentistry with a chief complaint of decay and pain in lower right back tooth region. Patient gave history of tooth decay since 1.5 years and pain in same tooth from one week. On observation, tooth no. 46 was showing gross carious destruction with positive pain on percussion. However overlying gingiva and mucosa in buccal vestibule was normal. Radiographic observation of the associated tooth revealed root bifurcation involvement due to caries and associated periapical radiolucency that made prognosis and survival of tooth after endodontic treatment poor. Radiological examinations also confirmed the suitability of both the donor and recipient sites (Fig. 1A).

Fig. 1A – clinical and radiographic view of 46 and 48

As patient was in growing phase and there was no other treatment option than extraction of 46, autogenous tooth transplant of extracted tooth with 48 (third molar of same side) was determined. Patient and parents were explained about autotransplantation of 46. After doing complete heamogram patient was referred to Department of Oral and Maxillofacial Surgery for treatment.

Surgical procedure - The surgical plan consisted of atraumatic removal compromised 46 preserving socket integrity of recipient site and extracting 48 (transplant / donor tooth) avoiding periodontal ligament (PDL) damage.[8] Under all aseptic conditions, after achieving anaesthesia, the surgical procedure for third molar removal was done, with utmost care to avoid injury to crown and developing root of 48 (Fig. 1B).

Fig. 1B – surgical procedure for autotransplantation of 48

Donor tooth was stored in gauze soaked in povidone iodine and saline.[9] Extra-oral root canal therapy of extracted donor tooth 48 was not needed as root apices were incompletely formed.[10] Care was taken to preserve the buccal and lingual cortical plates of recipient site during the extraction of 46. The intra-alveolar septum was trimmed with a bone rongeur and extraction socket irrigated povidone iodine. 48 was transplanted in prepared socket and kept in infra-occlusion to prevent occlusal trauma to PDL and root during healing and provide space for the expected continued root development.[10] The transplanted tooth was splinted with adjacent teeth with the help of black braided silk suture for 2 weeks (Fig. 1C).[11]

Fig. 1C – Post-operative view of autotransplantation and deocclusion of 48

The surgical wound was sutured, joining the remaining part of the follicular sac to the gingival mucosa with 3-0 silk suture. Patient was given post operative instructions and advised to take soft diet for two weeks along with maintenance of good oral hygiene.

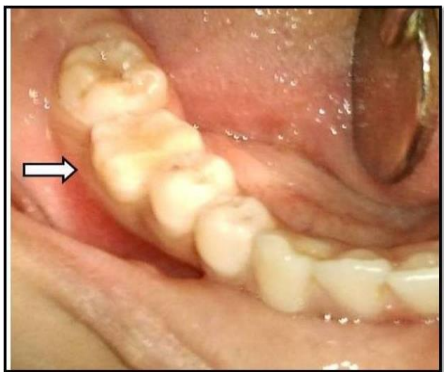


Fig. 1D – Six month follow up of autotransplanted 48 (clinical view)

Case 2 - A 25-year-old male reported to the Department of Oral and Maxillofacial Surgery with extensive caries and pain in lower left back tooth from 2 weeks. Clinical examination of the associated area revealed deep occlusal caries and pulpal necrosis with 37. Further examination of adjacent areas revealed healthy oral soft tissues. Radiological examinations of associated area

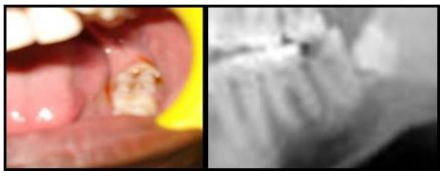
revealed gross carious destruction of 37 (Fig. 2A). 

Fig. 2A – clinical and radiographic view of 37 and 38

Tooth was non restorable and needed extraction. Radiograph also confirmed suitability of both the donor tooth and recipient sites for autotransplantation. Patient was explained about procedure of autotransplantation.

Surgical procedure - Although 37 had pulpal necrosis, no special pre-surgical preparation was undertaken. After doing complete heamogram the surgical plan was determined that consisted of atraumatic extraction of 37 preserving integrity of bony socket walls, i.e. the donor site and retrieval of 38 (the transplant tooth) without causing any damage to periodontal ligament (PDL). The surgical procedure was followed in the similar manner as explained in case 1(Fig. 2B).

Fig. 2B – surgical procedure for autotransplantation of 38

Extra-oral root canal therapy of donor tooth was not required as tooth was in developing condition and roots were not completely formed. 38 was transplanted at recipient site in infra-occlusion to provide space for expected continued root growth and development. Splinting and suturing protocols were followed similar to case 1. The surgical wound closure was done with 3-0 silk suture (Fig. 2C).

Fig. 2C – Post-operative view of autotransplantation and deocclusion of 38

Patients were given post operative instructions. Patient was advised to take soft diet and avoid chewing on the transplanted site for two weeks along with maintenance of good oral hygiene.

Follow Up - Follow up of transplanted teeth were carried out by the same oral surgeon to avoid observation bias. Transplanted teeth had been followed up at regular intervals and follow-ups visits included clinical and radiographical examination.

- **1 Week post-transplantation:** for suture removal and base line periapical radiograph.
- **2 week post-transplantation:** removal of splinting and radiographs showed no signs of any periapical pathology.
- **12 weeks post-transplantation:** Clinically no tooth mobility, pain, periodontal pockets & condition of

gingiva; and radiographically detection of periapical pathology, pulp canal obliteration, stage of root development or root resorption. (Fig.1D and Fig. 2D).

Fig. 2D – Six month follow up of autotransplanted 38 (radiographic view)

Discussion

Biological Principles of healing after autotransplantation –

The understanding of the healing process of a transplanted tooth is imperative to its success. The preservation of favourable periodontal ligament (PDL) on the donor tooth is the critical factor for success.[12] Reattachment occurs in about 2 weeks after autotransplantation between the PDL connective tissues of the donor root surface and walls of recipient socket. The type of healing of transplanted tooth is dependent on the surface area of the damaged root to be repopulated. Smaller is the damaged PDL surface, healing achieved is by cemental healing. However larger is the damaged PDL surface, more will be the root surface resorption followed by apposition of bone rather than dentine.[13] Genetically, PDL cells can differentiate into fibroblasts, cementoblasts and osteoblasts.[14] Thus, it becomes important to minimise inflammation and enhance reattachment of PDL cells for proper differentiation. This inflammation can be minimised by precise trimming and tight suturing of recipient flap gingival cuff around the transplanted tooth to prevent ingress of infective agents.[13] Inflammatory pulpal response of transplanted tooth can be minimised by initiating root canal treatment 2 weeks after transplantation for fully developed donor teeth. This is done to minimise trauma to the PDL in initial reattachment healing phase.[15] In case of donor tooth with incomplete root formation, preservation of Hertwig's epithelial root sheath is important to ensure pulp regeneration, root maturation and eruption.[16] Ideally, the donor tooth with its maximum root length and apical opening > 1mm radiographically, has potential for pulp regeneration. This will ensure that a sufficiently long root can still be preserved even root development is curtailed prematurely after autotransplantation.[16]

Factors affecting success of autotransplantation –

An optimal sequence would be to perform the extraction of tooth from the recipient site on same day that donor tooth is removed for transplantation. If tooth has to be extracted from the recipient site earlier due to toothache, infection, or other reasons, then the transplantation should be scheduled within a 1

month.[17] As the time interval between extraction from recipient site and transplantation increases, more resorption of bone occurs at the recipient site and there will be less support for the donor tooth.[9]

Success factors of tooth transplantation following the clinical and radiographic criteria will be: healing of PDL, no progressive root resorption, healing of gingival tissue and alveolar bone[13], healing of pulp and continued root development[15] (except for endodontically treated teeth)[12], tooth with vital pulp (or obliteration)[15] or endodontic treatment with a good outcome, normal periodontal space[13], and no other signs of infection threatening the transplant the supporting alveolar bone.[18]

Viability of PDL fibres

Clinically, it appears that satisfactory healing takes place in transplanted teeth when there is no root resorption, maintenance of PDL space and apparently normal tooth mobility.[13] In transplantation, usually the PDL fibres on the walls of the surrounding prepared sockets are absent. However it must be recognized that, the intact and vital PDL be will be attached to the root surface and to the bony walls of recipient sockets playing an important role in healing.[13] For optimal healing, it is also important to consider role of the PDL attached to the donor tooth in the formation of gingival tissue and alveolar bone. Healing of dental pulp and the continuation of root development are expected when a donor tooth is in developing stages.[16] Hertwig's epithelial root sheath (HERS) is present on developing teeth, and capillary vessels regenerate through this apical foramen while periodontal tissue inside of the epithelial root sheath proliferates into pulp canals. When the dental pulp does not heal after transplantation of developing teeth, root canal therapy is necessary.[16] If pulp obliteration is rapid, preventive endodontics might be safer than expectation, to avoid risk for perforations later if periapical problems develop.[15]

Splinting

Once the donor tooth has been transplanted to the recipient site, it is usually held in position to promote periodontal healing. Most reports advise flexible splinting for 7 – 10 days to be more appropriate as this allows for some functional and physiological movements of the transplant.[11] It is suggested that movement in periodontal ligament within physiological limits stimulates cellular activity and bone repair.[19] Splinting is not essential in autotransplantation but appears to be beneficial in most cases.[20] A suture may be used for stabilization to run across the occlusal surface of the transplanted tooth.[13] In some situation, stability of the transplant is doubtful e.g. in trauma cases when premolars are used as transplants to incisor region, bonded wires may be used for fixation of 1 – 2 weeks.[21]

Developmental stage of donor tooth

The stage of root development is one of the most important prognostic factors.[12] On this basis, unsuccessful transplantation can be considered as non-success rather than failure. Especially in adolescents, where osseo-intergated implants are warranted, this will be of importance.[3] The transplanted tooth may subsequently be replaced by an implant supported crown if the quality and quantity of supporting tissues allow it. Main reasons for failure are ankylosis and persistent external resorption.[22] Early diagnosis and endodontic treatment of pulpal infection can be expected to avoid the development of ERR (external root resorption) in transplanted teeth.[23] Immediate endodontic treatment after diagnosis of this resorption may arrest further development and improve the success rate. The influence of different splinting methods and fixation periods of transplanted molars have shown that rigid fixation significantly increased root resorption and ankylosis, compared with more flexible fixation (sutures).[11] At present, there is no treatment that can predictably stop the progression of RR (root resorption).[24] Teeth with ERR will have arrested alveolar bone growth and should be removed in young individuals to preserve height of the alveolar bone by decoronation procedure.[25] Teeth under root development are successful transplants while non-successful cases are found in full or late stages of root development.[26] The main challenge is to avoid root resorption that may lead to tooth loss. However, with the exception ankylosis of RR, teeth with root resorption may remain for several years and contribute to normal alveolar bone growth and development.[24] Hence, autotransplantation represents an important treatment option for missing and lost teeth in adolescents.

Root length of donor tooth

Root length plays a major role in a transplant success. Although the literature review showed successful cases report about transplant of teeth with completely developed roots[26]; the best donors are teeth with immature root development with wide open apex that provide a good prognosis with respect to pulpal healing.[15] The immature periodontal tissues adhered around developing roots are extremely susceptible to vascular, neural and other tissues reconnection, due to a lot of ions, amino acids and various cellular mediators that are responsible for nutrition and stimulation of proliferative and repair actions.[16] Many studies have emphasized transplants of third molars can be used to substitute prematurely lost first molars in case of tooth loss due to caries, trauma or periodontal disease.[9,11] For the same purpose, intentional replantation follows the same rules in order to allow appropriate restoration of a tooth that suffered invasion of biological width.

CONCLUSION

It can be concluded from above discussion that although autotransplantation has not been established as a traditional means of replacing a missing tooth, the procedure warrants more consideration. Studies have clearly demonstrated that autotransplantation of teeth is as successful as endosseous dental implant placement. For younger patients, autotransplantation may also be considered as a temporary measure. The transplant can replace missing teeth to ensure preservation of bone until growth has ceased and then, if necessary, the patient can become a candidate for implants. The Success of autotransplantation should therefore be viewed in terms of tooth survival, with or without a root filling. Future research in the existing data may strengthen current dogma and increases our confidence in choosing autotransplantation as an option in growing patient.

REFERENCES

1. Tanaka T, Deguchi T, Kageyama T, Kanomi R, Inoue M, Foong KWC. Autotransplantation of 28 Premolar Donor Teeth in 24 Orthodontic Patients. Angle Orthod 2008;78:12-9.

2. Thomas S, Turner SR, Sandy JR. Autotransplantation of teeth: Is there a role? Br J Orthod 1998;25:275-82.

3. Clokie CML, Yau DM & Chano L. Autogenous tooth transplantation: an alternative to dental implant placement? J Can Dent Assoc 2001;67:92-6.

4. Bowden DEJ and Patel HA. Autotransplantation of premolar teeth to replace missing maxillary central incisors. Br J Orthod 1990;17:21-8.

5. Kokich VG, Kokich VO. Congenitally missing mandibular second premolars:

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clinical options. Am J Orthod Dentofacial Orthop 2006;130:437-44.

6. Hillerup S, Dahl E, Schwartz O and Hjorting-Hansen E. Tooth transplant to bone graft in cleft alveolus. Cleft Palate J 1987;24:137-41.

7. Kristerson L. Autotransplantation of human premolars. A clinical and radiographic study of 100 teeth. Int J Oral Surg 1985;14:200-13.

8. Kristerson L and lagerstrom L. Autotransplantation of teeth in cases with agenesis or traumatic loss of maxillary incisors. Eur J Orthod 1991;13:486-92.

9. Raghoebar GM, Vissink A. Results of intentional replantation of molars. J Oral Maxillofac Surg 1999;57(3):240-4.

10. Andreasen JO, Paulsen HU, Yu Z, Ahlquist R, Bayer T, Schwartz O. A long-term study of 370 autotransplanted premolars. Part I. Surgical procedures and standardized techniques for monitoring healing. Eur J Orthod 1990;12:3-13.

11. Bauss O, Schilke R, Fenske C, Engelke W, Kiliaridis S. Autotransplantation of immature third molars: influence of different splinting methods and fixation periods. Dent Traumatol 2002;18:322-8.

12. Fuss Z, Tsesis I, Lin S. Root resorption – diagnosis, classification and treatment choices based on stimulation factors. Dent Traumatol 2003;19:175-82.

13. Andreasen JO, Paulsen HU, Yu Z, Schwartz O. A long-term study of 370 autotransplanted premolars. Part III. Periodontal healing subsequent to transplantation. Eur J Orthod 1990;12:25-37.

14. Vastardis H. The genetics of human tooth agenesis; new discoveries for understanding dental anomalies. Am J Orthod Dentofacial Orthop 2000;117:650-6.

15. Andreasen JO, Paulsen HU, Yu Z, Bayer T, Schwartz O. A long-term study of 370 autotransplanted premolars. Part II. Tooth survival and pulp healing subsequent to transplantation. Eur J Orthod 1990;12:14-4.

16. Andreasen JO, Paulsen HU, Yu Z, Bayer T. A long-term study of 370 autotransplanted premolars. Part IV. Root development subsequent to transplantation. Eur J Orthod 1990;12:38-50.

17. Zachrisson BU, Stenvik A, Haanæs HR. Management of missing maxillary anterior teeth with emphasis on

autotransplantation. Am J Orthod Dentofacial Orthop 2004;126:284-8.

18. Vilhja´lmsson VH, Knudsen GC, Grung B, Bardsen A. Dental auto-transplantation to anterior maxillary sites. Dental Traumatol 2011;27:23-9.

19. Sagne S, Thailander B. Transalveolar transplantation of maxillary canines, a follow up study. Eur J Orthod 1990;12:140-7.

20. Tsukiboshi M. Autogenous tooth transplantation: a revaluation. Int J Perio Restor dent 1993;13:121-49.

21. Czochrowska EM, Stenvik A and Zachrisson BU. The esthetic outcome of autotransplanted premolars replacing maxillary incisors. Dent Traumatol 2002;18(5):237-45.

22. Trope M. Root resorption due to dental trauma. Endodont Top 2002;1:79-100.

23. Heithersay GS. Invasive cervical resorption: an analysis of potential predisposing factors. Quintessence Int 1999;30:83-95.

24. Heithersay G. Invasive cervical resorption. Endodont Top 2004;7:73-92.

25. Malmgren B. Decoronation: How, why, and when? J Calif Dent Assoc 2000;28:846-54.

26. Moorrees CF, Fanning EA, Hunt EE Jr. Age variation of formation stages for ten permanent teeth. J Dent Res 1963;42:1490-502.