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The successful auto-transplantation of the third molar was initially reported by Fong in the year 1953. Auto-transplantation is a feasible, fast and economical option for the treatment of non-salvageable teeth. This is possible only when a suitable donor tooth is available. The outcome of any surgical procedure carried out is dependent on careful case selection along with detail understanding of biological principles involved in the procedure.

Success rates reported in studies which are previously reported vary considerably, ranging from 74-100% for transplantation of third molars. The prognosis of auto-transplantation is generally good not only because of the probability of tooth integration in the alveolar bone, but also due to lack of any histocompatibility problem which is associated with other kinds of transplant.

Keywords: *transplantation, autogenous tooth transplantation.*

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Age Old Treatment with a Change: Auto Transplant of Natural Tooth

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There is no problem of availability of tooth which has to be transferred at the functional area as the third molars are considered to be vestigial tooth.

Keywords: transplantation, autogenous tooth transplantation.

I. Introduction

Auto-transplantation is the transfer of the one`s self tooth from one portion of the alveolar portion to another site in the same individual. Auto-transplantation is an age-old treatment which was first performed successfully by Fong in the year 1953. (1, 2) Auto-transplantation is not performed commonly these days owing to its surgical requisites. With the advent of the Osseointegrated implants, this treatment modality has further lost its charm. (1) The earliest of the auto-transplantation, performed in ancient Egyptian population where the slaves were forced to give their teeth to pharaohs. (3) The Osseointegrated implants since its advent have attained a lot of popularity and there has been vast research in this field. The auto-transplantation has not been advocated and researched by various authors. This is due to the fear of failure which is associated with the procedure of auto-transplantation and also the surgical difficulty of the same. (3) Auto-transplantation has various benefits which are to be considered and adequately informed to the patients and hence promoting this treatment. Its applicability is well accepted in patients, who are in younger, a growing age group where osseointegrated implants are contraindicated. With increasing incidences of early caries and loss of tooth, there is a need to understand and advocate auto-transplantation with its best potential and treatment modality. (1, 2) The paper aims at demonstrating the success of auto-transplantation and the treatment protocol which can be followed for adequacy of treatment.

II. Material and Methods

The patients are chosen with the utmost care, and adequate history was taken to rule out any chronic illness and medication that would interfere with the healing process. The patients who are chosen did not have any systemic debilitating conditions. Young patients are included in the study with age ranging from 19-26 yrs. Prime inclusion criteria is that the patient should have a non-restorable recipient tooth indicated for extraction along with a non-functional donor tooth. Those patients who are co-operative, with adequate oral hygiene maintenance are included in this study. The adequate width of bone and keratinized gingival tissue at the recipient socket serves as criteria for successful auto-transplantation.

The patient who had acute inflammation and unfavorable root morphology of the donor`s teeth are excluded from this study. The need for any other surgical treatment like cystic enucleation are excluded from this study. This study included patients who are treated from the year 1996 till the year 2014. All the patients whose data are inadequate are excluded from the study. The follow up was carried out on a minimum for one year to determine the success of the treatment.

Adequate treatment planning for the patients who are chosen for the auto-transplantation included the clinical and radiographic evaluation of both the donor tooth and the recipient site. Though CBCT serves as the proper imaging modality, considering the economic constraints of the patients OPG of all the patients are done preoperatively, and buccolingual/mesiodistal dimensions of both the recipient site and donor`s tooth is calculated. Dilacerations and unfavorable pattern of root formation as well as any associated lesion around the donor tooth is evaluated; and all those cases in which extraction of donor tooth requiring tooth

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sectioning or any other surgical procedure are excluded. Auto-transplantation is then performed, and modification of the technique used in accordance with the apex of the donor`s tooth, whether it is open apex or closed apex.

All the patients in this study are treated in single stage. The steps of this treatment protocol are discussed in this section. With the help of Vernier caliper and OPG buccolingual and mesiodistal dimensions of donor tooth and recipient socket is calculated pre-operatively both clinically and radiographically. Atraumatic extraction of the tooth which is present in the recipient site was done. Inter-radicular preparation was done to achieve adequate space and also achieve a "snug-fit." The recipient site is contoured with a rongeur. Thorough curettage is done in cases of long-standing chronic infections. Apical portion of the socket bed is re-contoured where donor`s tooth has closed apex as it not only helps in providing an apical cushion or tension-free zone for the donor tooth but also helps in placing the donor tooth at infra-occlusal level.

For extraction of donor`s tooth, envelope flap was taken to expose the bone of the donor site and adequate bone guttering done to extract the donor tooth in Toto. The donor`s tooth was held with a blunt instrument above the cementoenamel junction (CEJ) to avoid injury to the periodontal fibers and preserve the hertwig`s epithelial root sheath. The tooth was then placed at the recipient site to evaluate the fit. The preparation if found inadequate, is modified with the help of a slow speed headpiece and vulcanite bur to achieve adequate fit. In cases where mesio-distal dimension of donor`s tooth is more than recipient socket, proximal splicing of adjacent tooth is done. In case where recipient socket's dimensions was more than donor tooth dimension, PRF + bone graft was used. We used inter-radicular bone as well as particulate bone grafts. When the desired fit was achieved then the occlusal level of the tooth was evaluated, and the tooth was intended to be placed at an infra-occlusal level to avoid any trauma that would occur during the function which would in-turn affect the healing process. In open apex cases, the tooth is placed 1.0 to 1.5 mm below the occlusal plane as the tooth would erupt with time and in closed apex cases, the tooth is placed 0.5mm. If needed, enameloplasty is done for adequate clearance. The tooth is then stabilized with the help of 2-0 silk sutures and perio-pack. In no case, RCT was done at the time of transplantation.

Follow up of all the patients done at one week, two weeks, one month, three months, six months, and 1 year postoperatively. Parameters for determining success included physiological mobility not more than 1 mm, periodontal pocket not more than 3 mm, root resorption and pulp vitality which are evaluated during follow up.

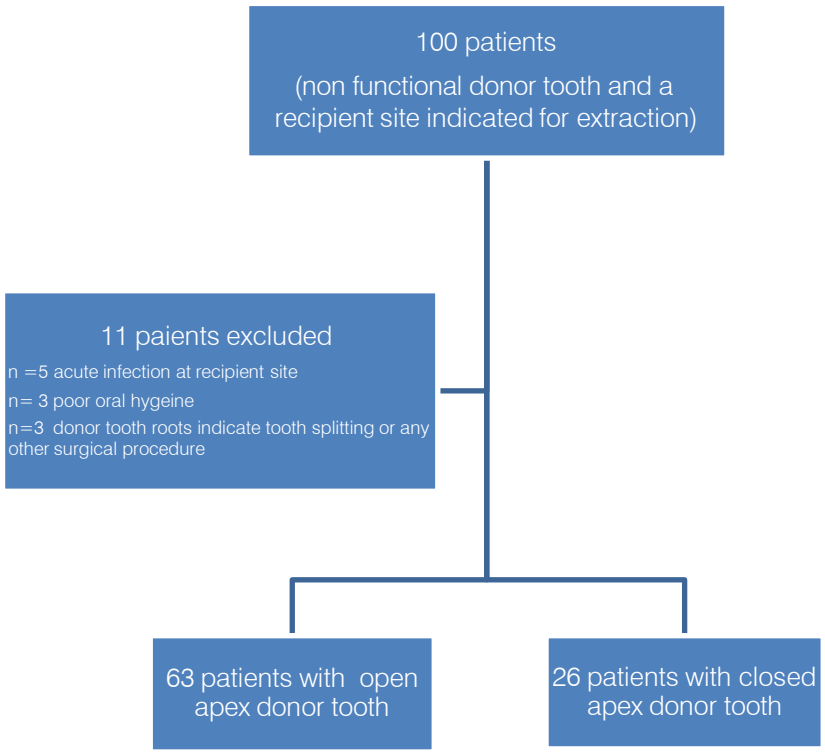


Figure 1

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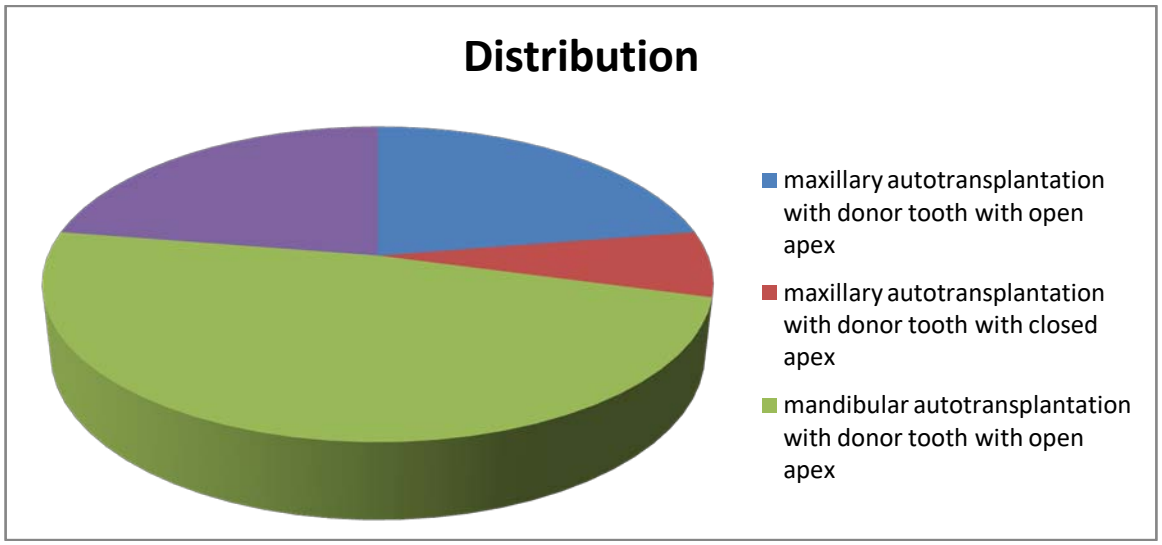


Figure 2

III. Results

89 auto-transplantation of molars was carried out of which 26 were upper molars and 63 lower molars. All the teeth were evaluated radiographically and clinically for any mobility, discoloration, and other reasons for failure. There was no associated pain after the transplantation of teeth and resorption of the root which would indicate for the need of root canal therapy. None of the teeth were root canal treated whether the tooth was having a closed apex or an open apex. There were four teeth which were removed post-surgically because of failure of the tooth to gain stability which hence gave a survival rate of 95.51%. The minimum follows up of patients were for six months, and the maximum follows up for about two years was done. There was no tooth which on follows up showed signs of resorption.

Table 1

Auto-transplanted tooth	Complications	Management
Maxillary tooth transplantation • Total tooth transplanted: 26 • Complications seen in: 6 cases in total including failure	• Failure : 3 cases • Periodontal pocket > 5mm : 3 cases	• Extraction of the teeth • Periodontal therapy Maintenance of oral hygiene
Mandibular tooth transplantation • Total tooth transplantation: 63 • Complications seen in: 4 cases in total including failure	• Failure : 1 cases • Periodontal pocket >5 mm : 3 cases	• Extraction of the teeth • Periodontal therapy Maintenance of oral hygiene

Even after adequate periodontal management of teeth, one transplanted tooth is extracted due to post-operative mobility after six weeks, 15 patients had to undergo RCT out of which 12 had closed apex at the time of transplantation. Periodontal pocket > 5 mm was seen in 30 cases during the initial follow up period but in later stages, periodontal health of 24 patients improved but rest six patients still had pocket depth > 5mm. Tooth resorption is noted in 1 case. Ankylos is occurred in 2 patients. Hence the survival rate dropped to 94.38%, which is lower to the success of the Osseointegrated implants but still significant for adopting the auto-transplantation as a regular procedure. Extra-oral dry time of donor`s tooth is as minimal to 2 mins with a maximum of 12 mins.

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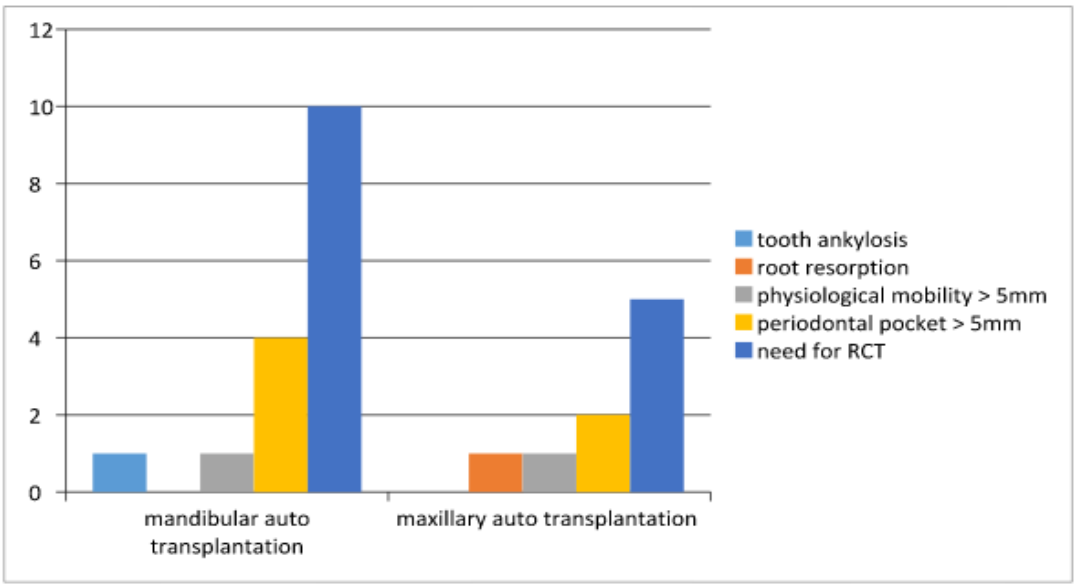


Figure 2

Complications followed by auto-transplantation during one year follow up.

IV. Discussion

Dental rehabilitation should be achieved after the loss of one or more teeth with several techniques, including removable partial dentures, fixed prosthetic framework, Osseo-integrated implant placement, or auto-transplantation. The success rate of autogenous tooth transplantation ranges from 50-80%.(8) The variable success rate is due to the increased rate of dental root resorption and improper preparation of the tooth and also factors that which are considered for proper healing in the auto-transplanted tooth. The incidence of dental root resorption after transplantation has declined over time with advances in materials and more studies which focused on root preparation and maintenance of viability of the periodontal (PDL)fibers of donor`s tooth. Tsukiboshi reported a 90% survival rate and an 82% success rate in 250 cases observed for six years which is similar to the results obtained in our study. (5)

Treatment planning of auto-transplantation is a multidisciplinary approach in which the patient selection is the most important criteria. The analysis of the recipient site includes the calculation of the mesiodistal and buccolingual width of the tooth which also can be done clinically with the help of Vernier caliper. (3) In cases where immediate auto-transplantation is planned, the procedure is carried out within 14 days owing to shrinkage of buccolingual dimension post-extraction. The analysis of edentulous space can be done using trans-gingival probing. Adequacy of the cover of bone on all the sides and keratinized gingiva is mandatory for stabilization of tooth at the recipient site. (LASKIN) The most recent development in the analysis includes the computer-aided rapid prototyping with the help of 3-dimensional tomography. This analysis used in the tooth auto-transplantation can help in determining the amount and type of preparation of the recipient site which would indirectly help in reducing the amount of time extra-orally and hence enhance the success of auto-transplantation. (8)

Successful transplantation requires approximation between the shape and size of the donor`s tooth and the receptor site. It also has been postulated that maxillary transplants have high risk of failure due to the wide variation in the size and shape of the teeth. The proximity of the maxillary antrum to the molar sockets also plays a role in determination of success. (1) Whereas fabrication of a “dummy third molar” either using plaster, ivorine, or hard wax waa described by Hernandez et al. in 1988. The tooth was used to take an impression of the recipient socket before extracting the “real” donor tooth. This technique avoided delay and unnecessary extra manipulation before insertion of the transplanted tooth. (9)

With the help of OPG dimensions of the recipient site and donor, 82% of cases showed snug fit of donor`s tooth on recipient site. In another 12% of cases, there was minimal discrepancy between the mesiodistal space at the recipient site and mesiodistal dimensions of donor`s tooth, where appx. 5 mm proximal splicing of adjacent tooth is done. In another 6% of cases, the recipient space was more than the dimensions of donor`s tooth; PRF along with bone graft was used in these cases.

One of the reasons for the high success rate seen in our study was the age group of the study sample, which was between 19-26 years. Young age patients show a high regenerative capacity of the PDL fibres. With increasing age difficulty with the extraction of

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tooth increases due to increased mineral density of mandibular bone. Also, the osteogenic potential of bone formation decreases.

In the earlier studies, donor`s tooth was extracted first followed by extraction of recipient tooth. But in our study, we advocated extraction of recipient`s tooth first followed by recipient site preparation. It not only reduces the extra-oral time but also minimizes repeated trails of donor tooth on the recipient site. Insufficient buccolingual width in the recipient site can result in resorption of the alveolar ridge along with loss of buccal bone coverage leading to consequent loss of periodontal integrity. We removed the interdental bone after the extraction of the recipient tooth, and the recipient site was debrided. Some of the authors have documented that curettage affects the vitality of PDL fibers. Though none of the cases included in our study had acute/severe infection we still advocated thorough curettage in cases of long-standing chronic infections. As infection in the recipient site with long-standing decayed molars, impair bone regeneration and healing.

The tooth with 1/3rd to 2/3rd root completion can be transplanted with adequate success when compared to tooth whose root completion is less than 1/3rd because of increased chances of damage of PDL fibers. (3,4)A root completion less than 1/3rd may compromise the root development causing altered morphology of tooth. When the tooth roots are longer, they may encroach adjacent vital structures like maxillary sinus for the upper tooth and inferior alveolar nerve canal for the lower tooth. (3) The tooth with closed apex may require root canal therapy because of the decreased blood supply, which is not the case in a tooth with an open apex. (2,4) This increases the chance of revascularization hence increasing the chances of maintenance of tooth vitality. (3)However, the auto-transplanted teeth with obliterated pulp is kept in observation for a follow-up, and crown preparation is avoided. (10) The continuous laying down of osteodentine in the pulpal canals occurs with a time that shows either decrease or increase in size of the chamber. (11)

The success rate of auto-transplantation is extensively dependent on the PDL regeneration around the donor`s tooth. The periodontal ligament cells are extremely sensitive, and their survival ability is significantly reduced in cases where extra-oral dry time is prolonged. The viability of the PDL fibers is dependent upon the extra-oral dry time, which is considered in our study; hence, no external resorption was seen. The excess force which is transmitted during retrieval of the donor`s tooth also affected the vitality of PDL fibers which is of main concern during the performance of the procedure. (3,6)

Bae J. H et al. in the year 2010 postulated that the risk of failure is more in the maxillary tooth due to variation in size and shape of teeth and proximity to the maxillary sinus which is similar to the results obtained in our study. (7)

Splinting of the transplanted tooth is avoided in cases of snug fit by various authors. Semi-rigid splinting is preferred over the rigid splinting cause of increased chances of tooth ankyloses in rigid splinting and also root resorption due to indirect damage to PDL fibers. The various modalities for splinting are periodontal packs, suture splinting, ligature wires, composite splinting. The splitting is done above the CEJ to avoid injury to PDL fibers. (3)Semi-rigid splinting is advocated for 10 -14 days beyond which damage to the PDL fibers is noted. As an active phase of bone formation occurs between 4 to 8 weeks, followed by a quiescent period of 4 weeks in which the individual trabeculae become mature. Therefore, Tsukiboshi et al. reported that the tooth is fixed for between 2 weeks and two months depending upon mobility. (5, 6)

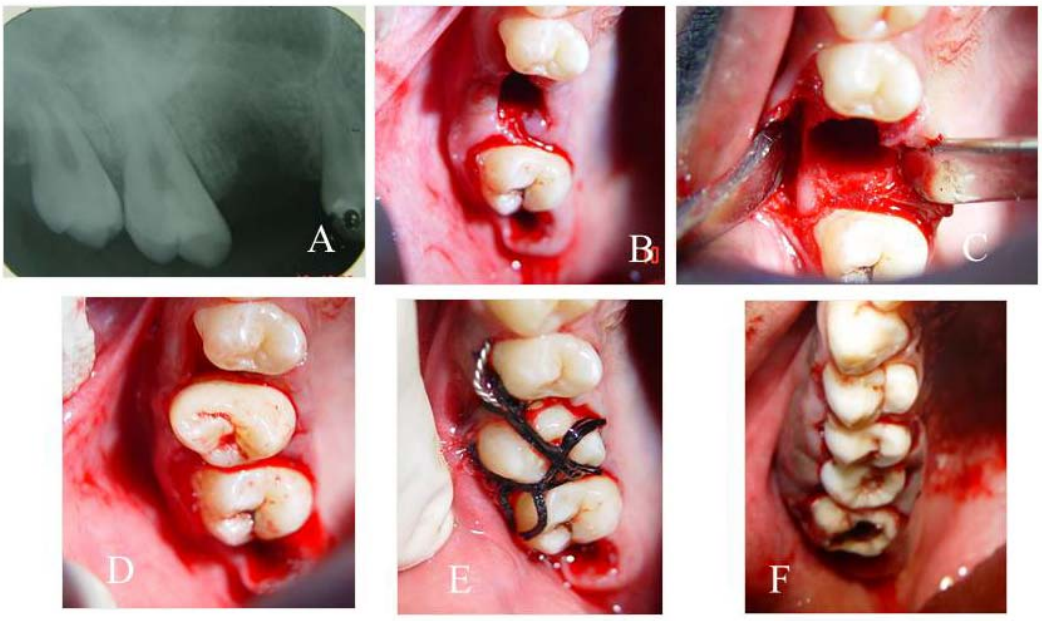
The tooth is placed infra-occluded in the recipient site after the placement of the donor`s tooth. The tooth if placed exactly at occlusion, after the transplantation will lead to force distribution along the root margins damaging the PDL fibers. For the success of auto-transplantation, a proper adaptation of the root surface of the transplanted tooth to the bony walls of the recipient site is of prime importance. Close contact of the transplanted tooth with the bone not only provides better blood supply and adequate nutrition to the PDL but also reduces the chances and probability of tooth ankyloses. (2, 3)

The odentectomy of the tooth is avoided in the cases of the auto-transplantation which required for adequate removal of bone. The amount of force for the delivery of the tooth out of the socket also should be considered. Hence sufficient removal of bone and proper handling is utmost important in these cases. There is a need for further long term studies in these cases for coming towards a proper sequencing and planning in auto-transplantation.

V. Conclusion

The auto-transplantation can be used successfully for patients if adequate treatment planning and assessment are done preoperatively. The success rate of auto-transplantation is significant, and hence, this modality can be used successfully. This treatment needs to be promoted further and assessed by surgeons and modified to increase the success of the same. The growth of jaw which is one of the factor considered for avoiding usage of Osseo-integrated implants can be the one which favors auto-transplantation in the patients which have not attained adequate growth.

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Photos: Case 1: Successful auto-transplantation of third molar on the site of extracted first molar

A. Preoperative post extraction radiograph of the surgical site
B. Clinical photograph of extracted socket
C. Preparation of socket
D. Placement of third molar in the socket of first molar
E. Stabilization of tooth in the socket
F. Post healing clinical photograph taken after 1 year

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