



AUTO-TRANSPLANTATION: AN INTERIM TREATMENT MODALITY (CURRENT UPDATES)

Dr. Niketa Sahu*

Post graduate , Department of Pedodontics & Preventive dentistry K.D. Dental college & hospital, Mathura (U.P). *Corresponding Author

Dr. Sonal Gupta

Professor & Head, Department of Pedodontics & Preventive dentistry K.D. Dental college & hospital, Mathura (U.P.)

ABSTRACT

Paediatric dental patients demand special care and wider vision while treatment planning due to ongoing growth of jaw bones and existing permanent tooth buds within the bone. Tooth loss is very common even in younger age patients due to extensive tooth decay or as a result of traumatic dental injuries. Implants are in high demand to restore the lost tooth but use of implants is limited to adults or older age group. Thus auto-transplantation may be an intermediate or permanent treatment option to such cases due simple, less time consuming and cost effectiveness. Sidewise auto-transplantation maintains the bone dimensions to make it available further treatment on failure. Present review article include all the required facts about auto-transplantation.

KEYWORDS : Tooth replantation, implant, hypo-mineralization, ankylosis

INTRODUCTION:

In today's dentistry, dental implants are in demand due to its highly durable and successful outcomes. But its indication is limited to adult patients. In a patient with mixed dentition or patients of younger age groups, auto transplantation can be a preferred treatment option.¹

Auto-transplantation is a controlled, sterile avulsion and re-implantation of a tooth into a distant site in the same person. Auto-transplantation is an advantageous procedure for young patients as it permits the normal growth of jaw as well as of dentition. This procedure does not affect alveolar bone growth including its width and height so if treatment is not a success, implants will be an available option at the later stages of life.²

Indication:

Hopeless teeth: A tooth that cannot be saved; or indicated for extraction. It may be due to extensive tooth decay with grade II or III mobility, tooth showing furcal or huge periapical radiolucency in specific cases.

Permanent first molars erupt at the age of 6-7 years. Frequency of hypo-mineralization in relation to permanent first molar is 3-40 % as per the reports.^{3,4} Arrow⁵ in his study concluded hypomineralized permanent first molars showed 14 times higher chance to be affected with occlusal caries in comparison to normally mineralized tooth. Permanent molar tooth bears the high masticatory load while in function; absence of this tooth within the arch may compromise the stable occlusion. Wisdom tooth can be used to replace this tooth.¹ Filie BGHM and Celio MR⁶ and Ratheesh R et al⁷ reported such cases of successful transplantation of mandibular left third molar to replace un-restorable mandibular left 2nd molar. Nimčenko T et al⁸ presented a series of 15 cases of autotransplantation.

Traumatised tooth (avulsion): Complete displacement of tooth out of the socket. Dental injuries are reported with a prevalence of 0.5-3%. Anterior teeth (especially maxillary central incisors) are the mostly affected during such injuries.⁹ Loss of maxillary central incisors at adolescent age may compromise quality of life of a person. Restoring the beautiful smile with auto-transplantation is a great idea.

Hypodontia: One or more missing teeth in the dentition. Tooth agenesis generally follows the order: mandibular third molars, followed by mandibular second premolars.¹⁰ Auto-transplantation may provide esthetically and functionally better results in such cases.

Atypical tooth eruption: It may present an indication for auto-transplantation. Generally ectopic eruption is treated with surgical exposure followed by orthodontic intervention. But when a tooth is severely mal-positioned (mostly seen with maxillary canines, affects about 2% of population), orthodontic correction may be quite challenging.¹¹ Therefore, in such cases auto-transplantation can be simplified mode of treatment to get faster results. Kalaskar RR¹² presented a case where impacted permanent lateral incisor was placed to its natural position. In some cases spare supernumerary tooth can

also be used as donar tooth to acquire better function and esthetics. Tirali el al¹³ presented a case where malaligned central incisor was replaced with a supernumerary tooth and shown successful outcomes. Other etiologic factors are root resorption (body of the cells attack and destroy a part of a tooth), large endodontic lesions, cervical root fractures, and localized juvenile periodontitis.¹⁴

Factors affecting the success rate:

Patient selection:

- Medical history: Healthy young patient with no systemic and metabolic disorder (Uncontrolled diabetes is also a significant contraindication)
- Co-operative patient with good oral hygiene practices
- Smoking must be avoided, as this will reduce the vascularity eventually delay the healing process.²

Donar tooth:

- Incomplete root formation (one-half to three-quarters root length as per the Moorrees root classification stage 5)¹⁵
- Wide apical foramen (more than 1 mm favourably 7 mm-9 mm)¹⁶⁻¹⁷
- Atraumatic extraction, preserving the Hertwig's epithelial root sheath¹⁸
- Minimal extraoral dry time (less than 1 minute); Physiologic storage media can be used.¹⁹
- Normal tooth morphology (single rooted tooth show higher chances of success)¹⁴

Motive behind all these considerations is to allow faster pulpal healing or revascularization, continued root development with vital PDL. Hertwig's epithelial root sheath has a continuous production of cells that separates a pulp to a dental follicle. Periodontal ligament cells in the root can work synergistically with the progenitor cells in the socket wall.¹⁹

Autotransplantation with a closed apical foramen has also shown good outcomes if early endodontic intervention is initiated that is within 14 days of post transplantation to limit the occurrence of inflammatory root resorption.¹⁵

An 87% survival rate and a 63.1% success rate were recorded in mature teeth with a closed apex with a follow-up of an average 10 years.²⁰

Most preferred Donar tooth:

- For anterior tooth: premolars (8-14 years of age)
- For posterior tooth: third molar (12-16 years of age)²

Recipient site

- The Recipient site should be free from acute infection and chronic inflammation.²¹
- Appropriate Bone dimensions covered with adequate tightly adapted attached keratinized support in all dimensions with.²

Above considerations will lead to stable transplanted tooth and limit the bacterial penetration in the recipient socket.¹

Clinical Skills

Auto-transplantation is a technique sensitive procedure which demands great clinical skills to manage all the crucial steps.¹

Surgical technique:

1. Local anaesthesia administration (children may require mild to moderate sedation)
2. Extraction at recipient site
3. Preparation of recipient site as per donar tooth with Surgical template/ donar tooth replica. TO reduce the extra-oral dry time of donar tooth acrylic or cobalt chrome replica can be used. Three-dimensional printing may provide accurate replica (customized pre-surgical tooth templates from a segmented cone beam image). Still availability of physiologic media during the surgery is necessary to improve prognosis.
4. Atraumatic extraction of donar tooth while preserving the periodontium
5. Positioning within the recipient socket
6. Stabilization with mattress suture or splinting. Rigid splinting or long duration splinting may lead to ankylosis.
7. Post operative instructions include good oral hygiene maintenance, soft diet till mobility get reduced, no chewing on the side of transplanted tooth.

Before attempting the surgical procedure proper stepwise treatment planning is necessary which may require thorough clinical and radiographic examination to evaluate donar tooth and recipient site compatibility such as medio-disatal, bucco-lingual and apico-coronal dimensions.^{2,22-23}

Nethander²⁴ suggested a two visit surgical technique with more than 90% success rate in a 5 years study of 68 teeth with complete apex. In this, recipient site is prepared in first visit while donar tooth is extracted and transplanted on the next visit which is 2 weeks later to the first one.

Success criteria:

- Clinical examination: Normal tooth mobility, normal tooth alignment within the arch, correct occlusion, normal periodontium surrounding in relation to transplanted tooth, patient satisfaction with no post operative complication and complaints, healthy pulp
- Radiographic examination: normal periodontal space, lamina dura, no signs of root resorption, continued root development, alveolar bone dimensions maintained.²

Potential complications :

The ultimate goals of auto-transplantation are pulp survival, periapical healing and the absence of root resorption or ankylosis. Inflammatory root resorption may be seen within a month due to microbial invasion which activates odontoclast cells to promote dentine resorption, can be treated with endodontic interventions.²⁵⁻²⁶

Replacement resorption or ankylosis is detected radiographically within few months of surgery as loss of periodontal space and lamina dura. Clinically ankylosis results in infraocclusion and a 'high metallic' percussive sound. Histological investigation revealed ankylosis is resulted from direct contact between osteoclasts of the bone and the root surface due to cementum damage.²

Decoronation technique: Malmgren and co-workers introduced this technique to treat ankylosis in children and adolescents. In this technique complete crown is removed and a part of root is removed till 2-3 mm below the marginal level. Remaining root is left in-situ. An endodontically treated tooth is debrided and left opens to fill with the blood coagulum. The remaining root acts as a template for osteoblastic activity which results in new bone formation. The main gain of this technique is the perpetuation of bone dimensions in growing individuals. The vertical bone is augmented during eruption of adjacent teeth via the dental-periosteal fibre complex. Age of the patient is a necessary consideration for vertical bone growth. Maximum growth can be expected before puberty in both male and females.²⁷⁻²⁸

Comparison of tooth auto-transplantation:

Several treatment modalities are available to treat single missing tooth which have shown successful outcomes and survival rate. Such techniques involve single tooth implants, fixed partial dentures and resin bonded bridges.(Table.1)

Mode of treatment	Studies	Survival rates	Follow up
Auto-transplantation	Systematic review and meta-analysis by Rohof ECM ²⁹ (2018)	97.8%	5 years
	Systematic Review and Meta analysis by Atala-Acevedo C ³⁰ (2017)	98.21%	5 years
	Long term follow up study by Stange et al ³¹ (2016)	100%	12 years
Single Tooth Implants	Systematic review by Hjalmarsson L et al ³² (2016)	95.0%	10 years
	Systematic Review by Jung RE et al ³³ (2012)	97.2 %	5 years
Fixed Partial Dentures	Meta-analysis by Sharma P ³⁴ (2005)	92.0%	10 years
	Systematic review by Ken T et al ³⁵ (2004)	89.1%	5 years
Resin Bonded Bridges	Systematic review by Thoma DS et al ³⁷ (2017)	86.7%	5 years
	Systematic Review by Elliot A ³⁸ (2008)	87.7%	5 years

*Comparison of auto-transplantation survival rate of various treatment modalities (Table 1.).

Tooth Cryopreservation

Cryopreservation is a helpful tool in teeth auto-transplantation as this can provide more numbers of donar teeth in a healthy state. Here cells or tissues are preserved at lower negative temperatures 77K or -196°C (boiling point of liquid nitrogen) which suppresses the necrosis by ceasing the biological activities. In tooth cryopreservation dimethyl sulfoxide (DMSO) is used as co solvent.¹⁵

CONCLUSION

Auto-transplantation of teeth in growing patients has the potential to provide significant advantages from the cost-benefit perspective, less time consuming and immediate patient satisfaction. Auto-transplantation can be a viable option when orthodontic space closure is not predictable or practical in an adolescent patient, using an available or 'spare' immature donor tooth rather than a prosthetic restoration.

REFERENCES:

1. Nimčenko, T., Omerca, G., Varinauskas, V., Bramanti, E., Signorino, F., & Cicciù, M. (2013). Tooth auto-transplantation as an alternative treatment option: A literature review. *Dental research journal*, 10(1), 1–6. <https://doi.org/10.4103/1735-3327.111756>.
2. Ong, D., Iskovich, Y., & Dance, G. (2016). Autotransplantation: a viable treatment option for adolescent patients with significantly compromised teeth. *Australian dental journal*, 61(4), 396–407. <https://doi.org/10.1111/adj.12420>.
3. Cho, S. Y., Ki, Y., & Chu, V. (2008). Molar incisor hypomineralization in Hong Kong Chinese children. *International journal of paediatric dentistry*, 18(5), 348–352. <https://doi.org/10.1111/j.1365-263X.2008.00927.x>.
4. Soviero, V., Haubek, D., Trindade, C., Da Matta, T., & Poulsen, S. (2009). Prevalence and distribution of demarcated opacities and their sequelae in permanent 1st molars and incisors in 7 to 13-year-old Brazilian children. *Acta odontologica Scandinavica*, 67(3), 170–175. <https://doi.org/10.1080/00016350902758607>.
5. Arrow, P. (1998). Oral hygiene in the control of occlusal caries. *Community. Dent Oral Epidemiol*, 26, 324–330.
6. Filič BGHM, Filič HM, Célio MR (2015) Third Molar Transplantation: A Case Report. *Int J Oral Dent Health* 1:022. Doi: 10.23937/2469-5734/1510022.
7. Ratheshr, R., Rakkhi, S., Aadit, AK. (2019). Auto transplantation of A Third Molar: A Case Report. *IJDSIR*, 2(1), 248-253. https://www.researchgate.net/publication/332290676Auto_transplantation_of_A_Third_Molar_A_Case_Report
8. Nimčenko, T., Omerca, G., Bramanti, E., Cervino, G., Laino, L., & Cicciù, M. (2014). Autogenous wisdom tooth transplantation: A case series with 6-9 months follow-up. *Dental research journal*, 11(6), 705–710.
9. Sahu, N., Gupta, S., Khanduja, R., Gupta, S., Mann, S., & Devi, T. K. (2020). They Treat. But Do They Actually Know? Evaluation of Knowledge Status about Management Guidelines of Avulsed Tooth among General Dental Practitioners of Agra- Mathura Region: A Cross-sectional Survey. *Journal of Pierre Fauchard Academy (India Section)*, 34, 9-22. <https://doi.org/10.18311/jpfa/2020/24578>. <http://www.i-scholar.in/index.php/jpfa/article/view/195567#>
10. Kavadia, S., Papadiochou, S., Papadiochos, I., & Zafiriadis, L. (2011). Agnesis of maxillary lateral incisors: a global overview of the clinical problem. *Orthodontics: the art and practice of dentofacial enhancement*, 12(4), 296–317.
11. Bjerklín, K., & Bennett, J. (2000). The long-term survival of lower second primary molars in subjects with agnesis of the premolars. *European journal of orthodontics*, 22(3), 245–255. <https://doi.org/10.1093/ejo/22.3.245>.
12. Kalaskar RR, Bhaje P, Kalaskar AR, Sharma P. Autotransplantation: An alternative treatment for horizontally impacted permanent incisors: A case report with review of literature. *SRM J Res Dent Sci* 2020;11:91-4. doi: 10.4103/srmjds.srmjds 85 19. <https://www.srmjds.in/text.asp?2020/11/2/91/289173>.
13. Tiralí, E., Sar, C., Ates, U., Kizilkaya, M., and Cehreli, SB. (2013) Autotransplantation of a Supernumerary Tooth to Replace a Misaligned Incisor with Abnormal Dimensions and Morphology: 2-Year Follow-Up. *Case Reports in Dentistry*. Volume 2013, Article ID 146343, 5 pages. <https://doi.org/10.1155/2013/146343>. <https://www.hindawi.com/journals/crid/2013/146343/>
14. Muhamad A.H., Azzaldeen A. (2012) Autotransplantation of Tooth in Children with Mixed Dentition. *Dentistry* 2:149. doi:10.4172/2161-1122.1000149.
15. Andreasen, J. O., Paulsen, H. U., Yu, Z., & Bayer, T. (1990). A long-term study of 370

- autotransplanted premolars. Part IV. Root development subsequent to transplantation. *European journal of orthodontics*, 12(1), 38–50. <https://doi.org/10.1093/ejo/12.1.38>.
16. Tsukiboshi M. (2002). Autotransplantation of teeth: requirements for predictable success. *Dental traumatology : official publication of International Association for Dental Traumatology*, 18(4), 157–180. <https://doi.org/10.1034/j.1600-9657.2002.00118>.
 17. Andreasen, J. O., Paulsen, H. U., Yu, Z., Bayer, T., & Schwartz, O. (1990). A long-term study of 370 autotransplanted premolars. Part II. Tooth survival and pulp healing subsequent to transplantation. *European journal of orthodontics*, 12(1), 14–24. <https://doi.org/10.1093/ejo/12.1.14>.
 18. Andreasen, J. O., Kristerson, L., & Andreasen, F. M. (1988). Damage of the Hertwig's epithelial root sheath: effect upon root growth after autotransplantation of teeth in monkeys. *Endodontics & dental traumatology*, 4(4), 145–151. <https://doi.org/10.1111/j.1600-9657.1988.tb00313.x>
 19. Andreasen J. O. (1981). Periodontal healing after replantation and autotransplantation of incisors in monkeys. *International journal of oral surgery*, 10(1), 54–61. [https://doi.org/10.1016/s0300-9785\(81\)80008-7](https://doi.org/10.1016/s0300-9785(81)80008-7).
 20. Watanabe, Y., Mohri, T., Takeyama, M., Yamaki, M., Okiji, T., Saito, C., & Saito, I. (2010). Long-term observation of autotransplanted teeth with complete root formation in orthodontic patients. *American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics*, 138(6), 720–726. <https://doi.org/10.1016/j.ajodo.2009.03.043>.
 21. Marques-Ferreira, M., Rabaça-Botelho, M. F., Carvalho, L., Oliveiros, B., & Palmeirão-Carrilho, E. V. (2011). Autogenous tooth transplantation: evaluation of pulp tissue regeneration. *Medicina oral, patologia oral y cirugia bucal*, 16(7), e984–e989. <https://doi.org/10.4317/medoral.16926>
 22. Garcia-Calderón, M., Torres-Lagares, D., González-Martín, M., & Gutiérrez-Pérez, J. L. (2005). Rescue surgery (surgical repositioning) of impacted lower second molars. *Medicina oral, patologia oral y cirugia bucal*, 10(5), 448–453.
 23. Czochrowska, E. M., Stenvik, A., Album, B., & Zachrisson, B. U. (2000). Autotransplantation of premolars to replace maxillary incisors: a comparison with natural incisors. *American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics*, 118(6), 592–600. <https://doi.org/10.1067/mod.2000.110521>.
 24. Nethander G. (1994). Periodontal conditions of teeth autogenously transplanted by a two-stage technique. *Journal of periodontal research*, 29(4), 250–258. <https://doi.org/10.1111/j.1600-0765.1994.tb01219.x>.
 25. Fuss, Z., Tsesis, I., & Lin, S. (2003). Root resorption--diagnosis, classification and treatment choices based on stimulation factors. *Dental traumatology : official publication of International Association for Dental Traumatology*, 19(4), 175–182. <https://doi.org/10.1034/j.1600-9657.2003.00192.x>.
 26. Hinckfuss, S. E., & Messer, L. B. (2009). An evidence-based assessment of the clinical guidelines for replanted avulsed teeth. Part I: Timing of pulp extirpation. *Dental traumatology : official publication of International Association for Dental Traumatology*, 25(1), 32–42. <https://doi.org/10.1111/j.1600-9657.2008.00727.x>.
 27. Malmgren, B., Cvek, M., Lundberg, M., Fryholm, A. (1984) Surgical treatment of ankylosed and infrapositioned reimplanted incisors in adolescents. *Scand J Dent Res*.92,391–399. [https://www.jendodon.com/article/S0099-2399\(12\)01158-2/fulltext#](https://www.jendodon.com/article/S0099-2399(12)01158-2/fulltext#)
 28. Malmgren, B., Tsilingaridis, G., & Malmgren, O. (2015). Long-term follow up of 103 ankylosed permanent incisors surgically treated with decoronation—a retrospective cohort study. *Dental traumatology : official publication of International Association for Dental Traumatology*, 31(3), 184–189. <https://doi.org/10.1111/edt.12166>.
 29. Rohof, E., Kerdijk, W., Jansma, J., Livas, C., & Ren, Y. (2018). Autotransplantation of teeth with incomplete root formation: a systematic review and meta-analysis. *Clinical oral investigations*, 22(4), 1613–1624. <https://doi.org/10.1007/s00784-018-2408-z>.
 30. Atala-Acevedo, C., Abarca, J., Martínez-Zapata, M. J., Díaz, J., Olate, S., & Zaror, C. (2017). Success Rate of Autotransplantation of Teeth With an Open Apex: Systematic Review and Meta-Analysis. *Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons*, 75(1), 35–50. <https://doi.org/10.1016/j.joms.2016.09.010>.
 31. Stange, K. M., Lindsten, R., & Bjerklin, K. (2016). Autotransplantation of premolars to the maxillary incisor region: a long-term follow-up of 12-22 years. *European journal of orthodontics*, 38(5), 508–515. <https://doi.org/10.1093/ejo/ejv078>.
 32. Hjalmarsson, L., Gheisarifar, M., & Jemt, T. (2016). A systematic review of survival of single implants as presented in longitudinal studies with a follow-up of at least 10 years. *European journal of oral implantology*, 9 Suppl 1, S155–S162.
 33. Jung, R. E., Zembic, A., Pjetursson, B. E., Zwahlen, M., & Thoma, D. S. (2012). Systematic review of the survival rate and the incidence of biological, technical, and aesthetic complications of single crowns on implants reported in longitudinal studies with a mean follow-up of 5 years. *Clinical oral implants research*, 23 Suppl 6, 2–21. <https://doi.org/10.1111/j.1600-0501.2012.02547.x>.
 34. Tan, K., Pjetursson, B. E., Lang, N. P., & Chan, E. S. (2004). A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years. *Clinical oral implants research*, 15(6), 654–666. <https://doi.org/10.1111/j.1600-0501.2004.01119.x>.
 35. Sharma P. (2005). 90% of fixed partial dentures survive 5 years. How long do conventional fixed partial dentures (FPDs) survive and how frequently do complications occur?. *Evidence-based dentistry*, 6(3), 74–75. <https://doi.org/10.1038/sj.ebd.6400350>.
 36. Thoma, D. S., Sailer, I., Ioannidis, A., Zwahlen, M., Makarov, N., & Pjetursson, B. E. (2017). A systematic review of the survival and complication rates of resin-bonded fixed dental prostheses after a mean observation period of at least 5 years. *Clinical oral implants research*, 28(11), 1421–1432. <https://doi.org/10.1111/clr.13007>.
 37. Abt E. (2008). Survival rates for resin bonded bridges. *Evidence-based dentistry*, 9(1), 20–21. <https://doi.org/10.1038/sj.ebd.6400567>.