AUTOTRANSPLANTATION OF TEETH WITH COMPLETE RHIZOGENESIS: A LITERATURE REVIEW

Bruna Ribeiro da **Silva**[1], Tatiana Kelly da Silva **Fidalgo**[2], Emmanuel João Nogueira Leal **Silva**[3*]

[1]Department of Endodontics, Grande Rio University (UNIGRANRIO), Rio de Janeiro, RJ, Brazil
[2]Department of Paediatric Dentistry, Rio de Janeiro State University (UERJ), Rio de Janeiro, RJ, Brazil
[3]Department of Endodontics, Rio de Janeiro State University (UERJ), Rio de Janeiro, RJ, Brazil

Palavras-Chave: Endodontia. Autotransplante. Rizogênese Completa.

RESUMO

Objetivo: O objetivo da presente revisão da literatura foi verificar as taxas de sucesso, assim como seus fatores predisponentes, do autotransplante dentário em dentes com rizogênese completa. **Métodos:** Uma busca eletrônica foi executada no PubMed usando *MeSH terms* e termos livres específicos. Inicialmente, um total de 115 títulos e resumos foram identificados. Um estudo adicional foi identificado como relevante após uma busca das listas de referência. Após a aplicação dos critérios de elegibilidade, apenas 8 artigos foram selecionados. **Resultados:** De forma geral, os estudos incluídos demonstram elevadas taxas de sucesso, baseado nos parâmetros estabelecidos, como manutenção do ligamento periodontal, cicatrização periapical e saúde periodontal. Além disso, os estudos selecionados na presente revisão apontaram que fatores como os protocolos de extração e reimplante, o tempo de proservação utilizado no estudo e o tempo no qual foi realizado o tratamento endodôntico do elemento transplantado, podem afetar a taxa de sucesso do autotransplante dentário. **Conclusão:** De acordo com a presente revisão de literatura pode-se concluir que embora ainda existam poucos estudos de autotransplante realizados em pacientes com rizogênese completa, a técnica tem se mostrado uma opção viável e com moderada taxa de sucesso para a substituição de elementos dentários perdidos.

Keywords: Endodontics. Autotransplantation. Complete Rhizogenesis

ABSTRACT

Objective: The objective of the present literature review tis o verify the success rates, as well as the predisposing factors, associated to success rates of dental autotransplant treatments in teeth with complete rhizogenesis. **Methods:** An electronic search was performed on PubMed database using MeSH terms and free terms. Initially, a total of 115 titles and abstracts. An additional study was identified as relevant after a search of reference lists. After eligibility criteria appliance, only 8 articles were selected. **Results:** In general, the included studies show high success rates, based on established parameters such as periodontal ligament maintenance, periapical healing and periodontal health. In addition, the selected studies pointed out that factors such as extraction and reimplantation protocols, the time of follow-up used in the study and the time in which the endodontic treatment of the transplanted element was performed, can affect the success rate of dental transplant therapy. **Conclusion:** According to the present literature review, it can be concluded that although there are still few studies of autotransplantation performed in patients with complete rhizogenesis, the technique has proven itself as a viable option with moderate success rate for replacement of lost dental elements.

Submitted: December 17, 2018
Modification: Febuary 5, 2019
Accepted: Febuary 7, 2019

***Correspondence to**:
Dr Emmanuel João Nogueira Leal Silva
Address: Dental School – Grande Rio University -UNIGRANRIO Endodontics Department. Rua Herotides de Oliveira, 61/902 ,Icaraí – Niterói – RJ – Brazil.
Telephone number: 55 (21) 83575757
E-mail: nogueiraemmanuel@hotmail.com

INTRODUCTION

Dental autotransplantation consists of the surgical transposition of a tooth from its original site to another, replacing a lost tooth which the dental treatment is not possible in the same patient.[1] Dental autotransplantation is a treatment option to reestablish the masticatory and aesthetic function of edentulous spaces.[2, 3] This technique presents advantages when compared to other therapeutic options (eg dental implants, fixed or removable prostheses), such as greater resistance to occlusal load, recovery of proprioceptive function, and maintenance of the periodontal ligament and bone.[2, 4, 5] In addition, the total cost of an autotransplant is lower than the other therapies previously mentioned, especially the dental implants.

The longevity and prognosis of dental autotransplantation with incomplete rhizogenesis teeth are well established in the dental literature, being comparable to those with dental implants.[2] However, unfavorable and / or contradictory survival rates of autotransplanted teeth with complete rhizogenesis have been reported.[4, 6] These success rates can be varied as they are influenced by different factors, such as case selection, patient age, type of transplanted tooth, storage, the receiving site, the surgical technique and the dentist's ability.

Due to the above mentioned reasons, it is clear that divergent failure rates reported in the dental literature can be directly influenced by differences in pre, trans and postoperative protocols. Therefore, it is important the knowledge about dental autotransplantation technique in teeth with complete rhizogenesis, as well as to understand which factors may be related to the success rates of this procedure. The aim of the present study was to review publications available in the scientific literature on the success of performing autotransplantation on teeth with complete rhizogenesis.

MATERIALS AND METHODS

Research Strategy

A systematic search was carried out in the PubMed database of the US National Library of Medicine with the combination of the following descriptors: "Autotransplantation", "Transplantation", "Teeth", "Root". The Boolean operators "AND" and "OR" were applied to combine the terms and create the search strategy. Reference lists of identified articles or literature reviews have also been searched to identify other potentially relevant articles.

Selection of studies

The titles and abstracts of all articles identified from the electronic search were independently evaluated by 2 collaborators (B.R.S. and E.J.N.L.S). Any disagreement between the authors was resolved through discussion.

Full-text copies of all remaining articles were obtained and further analysis was performed independently by each evaluator to determine whether or not the studies were eligible for this study based on specific inclusion and exclusion criteria.

The published studies were selected for inclusion based on the following criteria:

1. Studies in humans;
2. Use of dental autotransplant procedures;
3. Report of long-term success rates based on clinical and radiographic evaluation;
4. Studies in English.

The exclusion criteria were as follows:

1. Animal, in vitro or ex vivo studies and review articles;
2. Personal opinion;
3. Inadequate data from clinical and radiographic examination.

The researchers examined the remaining list of articles to reach a consensus that the inclusion and exclusion criteria were followed and that the major studies were included.

RESULTS

Initially, a total of 115 titles and abstracts were retrieved after an electronic search in both electronic databases using the specific combination of terms and keywords. It were identified 25 additional studies after a search of reference lists. After the first selection phase, 90 articles were excluded based on the pre-defined exclusion criteria.

The complete text of the remaining articles (n = 8) was obtained and submitted to independent judged by each of the evaluators.[7-11] The eight studies met the inclusion criteria and were included in the present literature review.

Table 1 presents the main results obtained in the articles selected for the present literature review.

The major of articles performed the surgical procedures according to Andreasen et al (1990).[4] Breflly, the donor tooth was submitted to extraction that was conducted carefully in order to do not damage the root surface. The socket was adjusted to receive the donor tooth using burs. Then, the transplanted tooth was inserted in the adapted socket in a infraocclusion position and the flaps were sutured and finally the the tooth was splinted.

Table 1: *Main results obtained from included papers.*

Study	Success rate	Reasons for failures	Follow-up period(years)	Mean age(years)	Technique	Endodontic treatment
SUGAI *et al.* 2010	88%	Radicular resorption; Periodontite; Root fracture.	3	39	Andreasen et al., (1990)[4]	After 3 weeks
AOYAMA *et al.* 2012	84.4%	Severe mobility; Severe inflamation; Periodontite; Repsortion.	5	40	Andreasen et al., (1990)[4]	After 3 weeks
YOSHINO *et al.* 2013a	68.3%	Radicular resorption; Clinical attachment loss.	5-15	43.7	Andreasen et al., (1990)[4]	After 3 weeks
YOSHINO et al. 2013b	89.9%	Clinical attachment loss;	3.4	NP	Andreasen et al., (1990)[4]	After 3 weeks
YOSHINO *et al.* 2013c	72.9%	Radicular resorption; Clinical attachment loss; Healing failure.	10	NP	Andreasen et al., (1990)[4]	After 3 weeks
YOSHINO *et al.* 2013d	75.4%	Radicular resorption; Clinical attachment loss; Radicular fracture, Dental caries.	5-15	55	Andreasen et al., (1990)[4]	After 3 weeks
YU *et al.* 2017	90.80%	Radicular resorption.	9.9	33.1	Complete exposure of the surgical site, an ostectomy was performed for minimally traumatic removal of the donor tooth. the recipient site was adjusted using dental implant drills and guided bone regeneration (GBR) was used when necessary. The suture and splint were performed.	At the 3–6-month recall, teeth were treated endodontically with calcium hydroxide if the teeth reacted negatively to sensitivity tests

Table 1: *Main results obtained from included papers.*

Study	Success rate	Reasons for failures	Follow-up period(years)	Mean age(years)	Technique	Endodontic treatment
ABELLA *et al.* 2018	91.7%	Severe inflamation; Tooth mobility.	2	41.5	The teeht was luxated passively with fórceps. The recipient socket was prepared a little larger than the donor using surgical round burs. A 3D tooth replica was used for guiding template. the transplanted teeth were stabilized with nonabsorbable surgical sutures and a wire splint.	Before surgery. In cases of impossobility to treat before, the root canal treatment was started 2 weeks after transplantation.

Note: NP – Non-provided

DISCUSSION

The present literature review had as main objective to evaluate the success rate reported in the studies that carried out the technique of dental autotransplante with complete rhizogenesis. In addition, the factors reported in these studies that may affect the success rates of this therapeutic modality were also evaluated.

The success rates of the selected studies varied, with the lowest success rate of 41% found in the study of Yoshino et al. 2013[11] and the highest success rate of 91.7% reported by Abella et al. 2018.[9] The difference of success between the different studies can be justified by different factors such as the technique used during the extraction and reimplantation protocols and the follow-up period. Different authors used varied techniques for extraction procedure and during the dental reimplantation. These differences may also explain the different success rates observed among the studies. An example of how the protocol can directly influence the success of therapy is demonstrated in the study of Yu et al. 2017.[12] In this study, dental reimplantation was performed with and without guided bone regeneration and treatment had different success rates: 93.3% with absence of guided bone regeneration and 88.9% with guided bone regeneration. Regarding the follow-up period, while Abella et al. 2018[12] had a success rate of 91.7% in a follow-up period of only two years, Yoshino et al. 2013[11] demonstrated a tendency to decrease the success rate with the increasing follow-up period. These authors reported that the success rate in the first 5 years was 100%, reducing to 72.7% in 10 years and to 54.5% after 15 years of follow-up.

Other factors pointed out by the studies is suggest to present a direct influence on the success rate of dental reimplants, such as the age and gender of the patient, and the endodontic treatment monitoring in the transplanted elements. However, divergences were found between studies. Yu et al. 2017,[12] demonstrated that age was an important factor for the failure rate, and the risk of loss of the transplanted tooth is higher in elder patients. In contrast, Yoshino et al. 2013[11] did not observe significant changes in the success rate of dental transplantation in patients of different ages. Regarding the gender factor, all studies report that there is no significant difference in success rates in male or female patients, except the study Yoshino et al. 2013,[10] the author suggests that women have a higher success rate in dental transplant therapy than male patients. The authors justify this difference in the fact that female subjects is more

collaborative in dental treatments and also presents better oral hygiene habits.

Regarding endodontic treatment, due to the revascularization is not expected the endodontic treatment is usually recommended before surgery or 2 weeks after transplantation. Aoyoma et al. 2012[7] reports that although endodontic treatment is performed after surgery, it presents a risk for transplantation, since the risk of infection remains in the transplanted tooth. Also, Abella et al. 2018[9] states that endodontic treatment should be performed prior to surgery if possible and 2 weeks after surgery if the tooth is not accessible for the procedure. These authors emphasize that a treatment performed before 2 weeks can cause damage to the periodontal ligament and if performed then the dental element can develop into a state of pulp necrosis and consequent periradicular lesion with possibility of apical inflammatory resorption. It is important to state that all authors recommend performing endodontic treatment in all cases of dental transplantation of teeth with complete rhizogenesis, since they suggest that revascularization of these teeth are improbable.

Two types of sequelae may occur after performing the dental transplant technique: root resorption and dental ankylosis. Root resorption may occur mainly in cases where extraoral time is significant, or by local factors such as inflammation and lesions on the root surface. Specific treatments of root resorption involve the use of intracanal medications and the monitoring of the tooth. Even in the cases of ankylosis, although it cannot be considered a physiological condition, it does not necessarily result in tooth loss. One way to prevent the occurrence of ankylosis is stabilization of the transplanted tooth using semi-rigid restraint. This type of restraint allows slight movement of this tooth during the post-surgical period. When the tooth is stable in the alveolar bone, it is not necessary invasive interventions.

Two relevant aspects should be emphasized in the present review: the need of antibiotic therapy and the tooth splitting. The literature is controversial regarding the need of antibiotic therapy in cases of dental transplants. The studies included in this review demonstrated different results when antibiotic therapy was used or not. Since surgery is planned and performed under aseptic conditions, many authors does not recommend the use of antibiotic therapy. This is in agreement with the guidelines of the International Association of Dental Traumatology (IADT) for cases of avulsions[13]. Although dental transplants and cases of dental avulsion are different, in both cases there is a dislocation of the tooth in the alveolar bone - intentional or not - and a rupture of the vasculature and the fibers of the periodontal ligament. Therefore, both conditions can be comparable.

The reported splinting of the cases used in this review were performed to stabilize the transplanted teeth, in addition prevents the bacterial colonization, optimizing the teeth integration and preventing ankylosis. The studies demonstrated that the splint was performed with resin and orthodontic wire, absorbable suture yarns or the two materials together. Splinting should be performed to improve the chances of success, since it optimizes teeth integration. The splint performed in the studies was semi-rigid for the reasons cited above.

The success rates of autotransplantation as well as its long term survival rates will depends on several variables, such as the bone condition of patient, the surgical technique which includes the bone and periodontal preservation, the correct split choice, the endodontic treatment preformed at the proper moment, the patients homecare and patients' response. All these factors minimize the chance of ankilosys and inflammatory resorption and improve the tooth prognosis. [7]

CONCLUSION

Dental autotransplantation of teeth with complete rhizogenesis is a viable procedure for recovering function and aesthetics. This procedure presents a moderate success rates that varied among the studies. The success rates are increased when the dental reimplantation is performed using strict protocols. In addition, the follow-up period of 5 years is recommended.

REFERENCES

1. Tanaka T, Deguchi T, Kageyama T, Kanomi R, Inoue M, Foong KW. Autotransplantation of 28 premolar donor teeth in 24 orthodontic patients. Angle Orthodontist 2008; 78:12-9.
2. Tsukiboshi M. Autotransplantation of teeth: requirements for predictable success. Dent Traumatol 2002; 18:157-80.
3. Miller HM. Transplantation: a case report. J Am Dent Assoc 1950:40;237.
4. 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; 12:14-24.
5. Kim S, Lee SJ, Shin Y, Kim E. Vertical bone growth after autotransplantation of mature third molars: 2 case reports with long-term follow-up. J Endod 2015; 41:1371-4.
6. Kristerson L. Autotransplantation of human premolars. A clinical and radiographic study of 100 teeth. Int J Oral Surg 1985;14:200-13.
7. Aoyama S, Yoshizawa M, Niimi K, Sugai T, Kitamura N, Saito C. Prognostic factors for autotransplantation of teeth

with complete root formation. Oral Surg Oral Med Oral Pathol Oral Radiol 2012;114: S216-28.
8. Sugai T, Yoshizawa M, Kobayashi T, Ono K, Takagi R, Kitamura N, et al. Clinical study on prognostic factors for autotransplantation of teeth with complete root formation. Int J Oral Maxillofac Surg 2010; 39:1193–203.
9. Abella F, Ribas F, Roig M, González Sánchez JA, Durán-Sindreu F. Outcome of autotransplantation of mature third molars using 3-dimensional–printed guiding templates and donor tooth replicas. J Endod 2018; 44:1567-74.
10. Yoshino K, Ishizuka Y, Sugihara N, Kariya N, Namura D, Noji I, et al. Gender difference in tooth autotransplantation with complete root formation: a retrospective survey. J Oral Rehabil 2013b;40;368–74.
11.Yoshino K, Kariya N, Namura D, Noji I, Mitsuhashi K, Kimura H, et al. Suvival rate in Autotransplanted Premolars with complete Root Formation: A Retrospective Clinical Survey. Bull Tokyo Dent Coll 2013 a; 54:27-35.
12.Yu HJ, Jia P, Lv Z, Qiu LX. Autotransplantation of third molars with completely formed roots into surgically created sockets and fresh extraction sockets: a 10-year comparative study. Int J Oral Maxillofac Surg 2017; 46:531–8.
13. Andersson L, Andreasen JO, Day P, Heithersay G, Trope M, Diangelis AJ, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. Dent Traumatol 2012;28:88-96.