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Advancements in Clinical Applications of Autogenous Tooth Transplantation

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Abstract

Autogenous tooth transplantation, also known as autotransplantation, a form of dental surgery, involves the transfer of a tooth or its components from one site to another within the same individual. This technique has gained significant attention in recent years due to its potential to preserve the patient's own dental structure, maintain aesthetics, and avoid the need for prosthetic replacement, and minimize the need for allogenic materials. This review aims to provide an in-depth analysis of the current state of autogenous tooth transplantation, including its introduction, indications and contraindications, surgical procedure, postoperative considerations, and factors influencing the outcome.

Keywords

Autogenous Tooth Transplantation; Indications; Contraindications; Postoperative Considerations.

1. Introduction

Autogenous tooth transplantation is a complex dental procedure that aims to replant a tooth in a new location within the same patient's oral cavity. It is a reconstructive procedure which is considered as an alternative to single implants for the replacement of a compromised tooth[1].This method promotes improved mastication, speech, dentofacial development, aesthetics, and arch form integrity by enabling unhindered alveolar growth and root development[2]. This technique has evolved over time to become a viable option for treating various dental conditions, such as severe trauma, congenital defects, and failed implant sites. The purpose of this review is to provide a comprehensive understanding of the current clinical applications and advancements in autogenous tooth transplantation.

2. Indications and Contraindications

The most common indication for autogenous tooth transplantation is to transplant a non functional third molar to the position of a missing or severely damaged first or second molar that cannot be preserved[3]. For non-restorable teeth with extensive caries or periodontal disease, trauma-induced avulsion or luxation of a tooth with incomplete root development, the autogenous tooth transplantation will be a good choice. However, studies have shown that chronic apical inflammation in the recipient area is not an absolute contraindication for autogenous tooth transplantation, and autogenous tooth transplantation can be performed after appropriate treatment of inflammation[4, 5]. In addition, for maxillary sinus perforation caused by the extraction of the maxillary first molar, if there is a suitable donor tooth in the mouth, tooth transplantation can be used to repair the missing tooth while closing the perforation[6, 7].

If the following situations exist, it is not recommended to undergo autogenous tooth transplantation: Severe periodontal disease affecting both donor and recipient sites; Active infection at the donor or

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recipient site; Poor patient compliance or dental hygiene; Uncontrolled oral infections at either the donor or recipient site; Insufficient bone quality or quantity at the recipient site for stable fixation; Inadequate periodontal ligament for supporting the transplanted tooth.

3. Surgical Procedure and Postoperative Considerations

3.1 Surgical Procedure:

The process of autogenous tooth transplantation, also known as the transfer of a tooth from one area of the oral cavity to another, involves several critical steps. The surgical procedure begins with the administration of local anesthesia to ensure the patient's comfort and minimize discomfort during the procedure. Next, the tooth to be harvested is isolated and prepared using a surgical drill or osteotome to carefully extract it from its socket. This process is crucial to minimize damage to the surrounding bone and periodontal tissues. Following tooth harvesting, the recipient site is prepared either with or without bone grafting. The purpose of this step is to create a suitable environment for the reimplantation of the tooth and to ensure a stable foundation for its reintegration into the jawbone. The extracted tooth is then carefully reimplanted into the prepared recipient site. This is followed by appropriate fixation using a suitable technique to secure the tooth in its new position and promote proper healing. In recent years, digital technology has been innovated, and the use of computer-aided surgical simulation (CASS) in autogenous tooth transplantation is becoming more and more frequent. The application of digital guides in the preparation of artificial alveolar sockets not only improves surgical precision but also shortens the surgical time and simplifies the procedure, making autogenous tooth transplantation a controllable technique[8]. It is important to note that autogenous tooth transplantation is a complex procedure that requires expertise and experience from a qualified dental professional.

3.2 Postoperative Considerations

The success rate of autogenous tooth transplantation depends on several factors, including the pre-operative factors, the age, transplant site[9], the health of the donor tooth, the quality of the recipient site, and the skill and experience of the surgeon. After undergoing autogenous tooth transplantation, there are several post-surgical considerations that patients should be aware of to ensure a successful outcome and optimal healing. This includes maintaining strict oral hygiene to prevent infection and maintain a healthy environment for healing.These guidelines are crucial for maintaining the health of the transplanted tooth and preventing potential complications. The following are the key points to follow: 1) Oral Hygiene: Maintaining good oral hygiene is essential. 2) Dietary Changes: It is recommended to avoid hard or crunchy foods that could displace the transplanted tooth or irritate the surgical site. 3) Avoidance of Tobacco and Alcohol: Both smoking and consuming alcohol can slow down healing and increase the risk of infection. Therefore, it is advisable to refrain from these habits during the recovery period. 4) Medication Compliance: Patients are also administered antibiotics to prevent any potential infection and manage pain as necessary with appropriate medication. 5) Regular Follow-Up Visits: Regular follow-up appointments are necessary to monitor the progress of healing and ensure the success of the procedure. These visits will also allow for any necessary adjustments or additional care to be provided.6) Protective Measures: Avoid participating in activities that could potentially cause trauma to the transplanted tooth, such as contact sports or using a mouthguard while playing a musical instrument. 7) Symptom Monitoring: Be aware of any signs of infection, such as swelling, redness, pain, or discharge at the surgical site. If you experience these symptoms or any discomfort, contact your dentist immediately for further guidance or treatment.

4. Factors Influencing Outcome

The success of autogenous tooth transplantation is influenced by several factors, including patient-related factors (e.g., age, health status, compliance), surgical factors (e.g., surgical technique, post-surgical care), and environmental factors (e.g., oral hygiene, diet)[10]. Proper planning, execution of the procedure, and post-surgical management are essential for achieving optimal outcomes. The

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survival rate of autogenous tooth transplantation appears to be influenced by the conditions of the donor tooth rather than the conditions of the recipient tooth. Although autogenous tooth transplantation can not completely replace implant treatment, it is meaningful in that it can slightly delay or at least earn the time until implant placement is possible[11]. Digital technology increases the predictability of the autogenous tooth transplantation procedure by increasing the accuracy of the neoalveolus morphology, reducing the extraoral time of the donor tooth, and preventing possible cementum lesions that might lead to complications[12]. The integration of autogenous tooth transplantation with simultaneous bone grafting has been studied extensively due to its potential to enhance the success rate and minimize donor site morbidity. This approach involves placing a bone graft at the recipient site before or during transplantation to improve bone quality and quantity, thereby facilitating better osseointegration of the transplanted tooth or its components. A study evaluated the clinical efficacy of Bio-Oss bone powder combined with concentrated growth factor (CGF) in repairing bone defects in autogenous tooth transplantation. The results reveals that Bio-Oss bone powder combined with CGF has good clinical efficacy in repairing bone defects in autogenous tooth transplantation. It promotes new bone formation, facilitates early stability of the transplanted tooth, and improves the success rate of autogenous tooth transplantation[13].The main reason for autogenous tooth transplantation failure is root resorption, manifested as loss of surface integrity of the root and persistent loss of hard tissue, whichi is mainly divided into inflammatory root resorption, replacement resorption, and root neck resorption[14]. Research has shown that damage to the periodontal ligament or pulp infection can lead to root resorption after autogenous tooth transplantation[15].

5. Dental pulp healing and its influencing factors

During the process of tooth transplantation and dislocation, the periodontal membrane and pulp tissue tear off and break. After the donor tooth is transplanted to the recipient area, its healing process involves the healing of periodontal membrane, pulp, cementum, and alveolar bone. The healing process is affected by the activity of periodontal membrane, development of tooth roots, pulp tissue and dental health status[16]. There are generally two outcomes for the pulp prognosis of transplanted teeth: one is pulp revascularization, and the other is pulp necrosis and infection. The size and sealing of the apical foramen can affect the regeneration of dental pulp tissue after transplantation. The enlarged apical foramen promotes the reperfusion of dental pulp blood flow at the apex, while the inverted filling and sealing of the apical foramen prevent dental pulp necrosis and infection from flowing into periodontal tissue. Regeneration of dental pulp tissue in the pulp cavity can be observed, and new connective tissue and bone like substance deposition can also be observed histologically[17]. The regeneration of pulp blood circulation after transplantation is closely related to the degree of periodontal healing and postoperative success rate of the transplanted tooth. Dental pulp revascularization is the process of transplanting new tissue into the root canal and replacing damaged tissue in the pulp cavity, thereby restoring the normal tissue structure and physiological function of the dental pulp-dentin complex. The ideal dental pulp regeneration is the new tissue cells are completely identical to the original parenchymal cells, which is also the best result of dental pulp healing in transplanted teeth. However, in pathological conditions, tissue regeneration is often incomplete, with irregular hard tissue or fibrous tissue replacing the original connective tissue[18]. Transplanted teeth also have a certain potential for pulp regeneration. After young permanent tooth transplantation, vascular recanalization occurs in the root of the tooth, and the root continues to develop. Even in teeth where the root development is complete, pulp healing can still be achieved.

6. Challenges and Future Directions

Despite the promising results, autogenous dental implantation, especially with simultaneous bone grafting, faces several challenges. These include the potential for donor site morbidity, the need for precise surgical technique, and the complexity of managing the healing process. Moreover, the long-

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term outcomes and the influence of biological factors on the success of the procedure are still areas of active research.

Future research should focus on developing more refined techniques to minimize donor site complications, optimizing bone grafting strategies, and exploring novel approaches to enhance osseointegration. Additionally, studies with larger sample sizes and longer follow-up periods are necessary to provide a deeper understanding of the long-term outcomes and the factors that influence them.

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