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Perspective

New era of tooth autotransplantation. Part I: Thoughts on clinical aspects

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Autotransplantation of teeth (ATT) is to replace a missing tooth with an autogenous one.[1,2] During the fifties, the literature suggested a 50 % success rate of ATT and this technique was not accepted widespread due to the unpredictable result.[3] With the better understanding of biology and clinical technique, the success rate was increased to 90 % in the nineties.[4,5] Despite high success rate of ATT, the ATT is still not a popular treatment choice for missing teeth comparing to fixed prosthesis dentures or dental implants. In this article, we aimed to propose some considerations during clinical procedure of ATT based on scientific evidences, in order to clarify some doubts about ATT and to achieve a more reliable outcome.

The power of periodontal ligament (PDL)

The key to successful ATT treatment lies in the amount of residual PDL of donor tooth.[4,5] To preserve the most viable PDL, atraumatic extraction of donor tooth with only using dental forceps by gripped the crown is important. Usually it takes times, but being patient is the key. Using orthodontic devices, such as separator, to loosen the tooth before surgery is helpful. Minimizing the extraoral time of donor tooth is crucial to prevent the dry-out or damage of PDL.[6] Having a prepared, ready-to-accept recipient socket before donor tooth extraction can reduce the fitting attempts which may harm the PDL. It is important to avoid any contact with the root surface to prevent damage to the PDL. Therefore, simultaneous root canal therapy on the donor tooth during the operation is no longer recommended.

Don't wish pulp luck

The only chance for pulp revitalization after the ATT is when the size of apex foramen is larger than 1 mm,[7] however, in the case of adult patient, the apex is always closed. Therefore, it is suggested to perform a quick pulp extirpation within 2 weeks after transplantation.[5] Removing the pulp tissue in the chamber is a crucial step since it can prevent the toxin accumulation from the remaining necrotic pulp which may lead to inflammatory root resorption. Root canal therapy should be processed within 4 weeks after transplantation when the donor tooth is gradually stable. Clinicians can also perform root canal therapy before the ATT, but it should be emphasized that improper access open into the pulp chamber may damage the structure of tooth and cause crown fracture during extraction.

Just fix the root

Clinicians are used to choosing the tooth with immature root as the candidate for ATT. However, it should be noted

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that only 21 % of transplanted teeth with immature root can grow into normal root length.[8] Beyond that, the donor tooth with immature root can rarely be found in adult patient's mouth. It's also more clinically reasonable to select a donor tooth with well-formed root. After the donor tooth passive sitting in the prepared recipient socket, the tooth is secured with a criss-cross suture which is removed in 2 weeks. The purpose of the suture is to provide a short-term, light occlusal contacted physiological fixation, since more rigid or long-period fixation may increase the possibility of tooth ankylosis or replacement root resorption. If the donor tooth is not stable, splinting the donor tooth with semi-rigid wire by composite resin is also a choice. However, the moisture from the operation site can compromise the quality of resin bonding.

Let the bone grow

In most of ATT cases, the donor tooth remains highly mobile at 2 weeks. The stability will increase after 4 weeks since the soft tissue is now healed. The gap between donor tooth and recipient socket will gradually filled with new bone which can be observed on radiographic film about 3—4 months. In general, new bone formation will occur in the gap, because the closed environment are full with sufficient blood supply and osteoblasts differentiated from PDL cells.[9] If the donor tooth has reduced PDL or bone dehiscence is noted, the regeneration technique with membrane or enamel matrix derivative can be considered. Additional graft material is usually not necessary in most well-selected cases.

Follow a digital flow-chart

Entering the new era of digital dentistry, we can achieve more accurate pre-surgical diagnosis, and prepare more precise recipient sites from the help of technology. Careful patient selection should be done using cone-beam computerized tomography (CBCT) in every case, in order to compare the geometry of donor tooth and recipient site. Additionally, an analog of the donor tooth can be created using 3-dimensional (3D) printing technology based on the stereo-lithography (STL) files from the CBCT data. A precise 3D analog is useful in preparing the recipient socket collaborated to the donor tooth, thus significantly reducing the extraoral time of donor tooth and minimizing the risk of PDL injury during the try-in process. Combining the computer-planned guided surgery system allows for more correct position of the recipient site in less time. Last but not least, CBCT image also reveal the complex morphology of root canal system for future root canal therapy. By using the digital flow-chart, the ATT can yield predictable clinical outcome with a high success rate.[10]

Always remember, the proper case selection and well-designed clinical procedure are important for ATT. Patients should expect the further root canal therapy along with prosthesis treatment. The possibility of replacement root resorption or ankylosis should be informed, however, the risk has been reduced thanks to understanding of the biological background and assistance of digital flow-chart. The radiographic check should be persisted at least for one year because the replacement root resorption or ankylosis may occur at 6—12 months.[4] Following the successful outcome of ATT, patients can expect a true biologically compatible

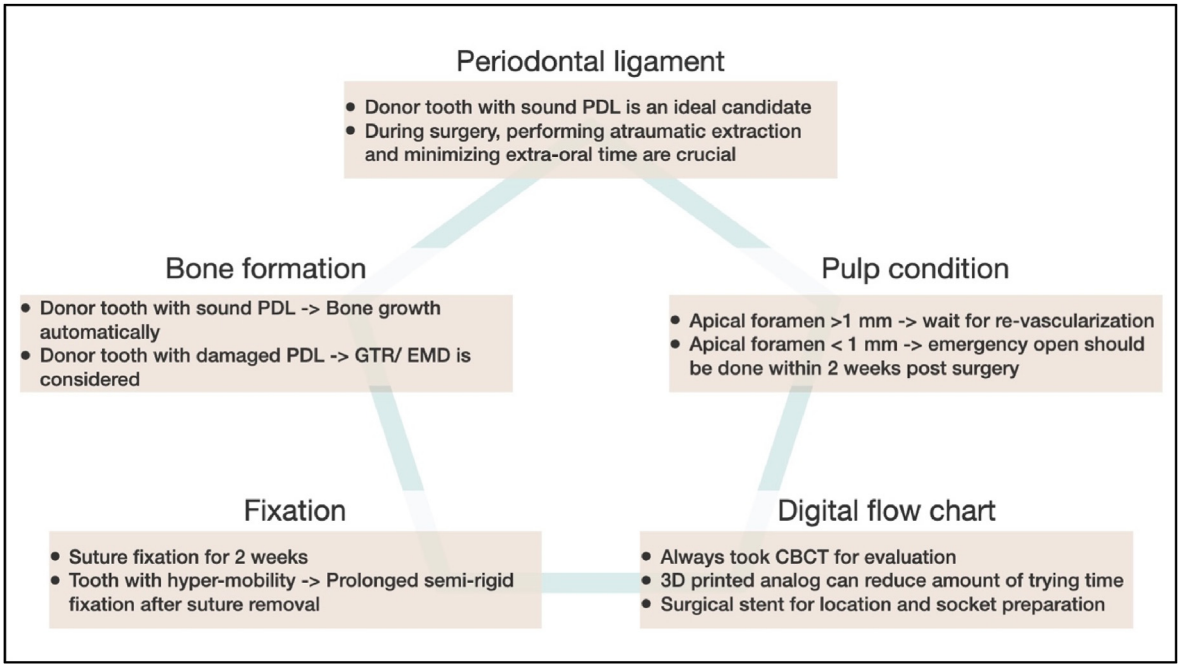

Fig. 1 Five clinical considerations about autotransplantation of teeth (ATT). During treatment planning and clinical procedures, it is essential to keep these principles in mind in order to achieve more predictable treatment outcomes and a higher success rate. PDL= Periodontal ligament; GTR = Guided tissue regeneration; EMD = Enamel matrix derivative; CBCT = Cone-beam computerized tomography.

replacement of missing tooth and a cost-effective treatment. By incorporating these clinical factors (Fig. 1), ***power to the PDL, don't wish pulp luck, just fix the root, let the bone grow, and follow a digital flow-chart***, we aim to establish ATT as a dependable treatment choice, offering an alternative to dental implants and fixed prosthesis dentures.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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