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CASE REPORT

Autotransplantation Using Rapid Prototyping in Patient undergoing Intravenous Bisphosphonate Therapy: Case Report

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Introduction

Autotransplantation can be a beneficial tooth replacement option in addition to the conventional dental implant. Addition of cone beam computed tomography (CBCT) and rapid prototyping may mitigate some of the shortcomings of traditional autotransplantation approaches [1, 2]. In this case, digital planning and rapid prototyping of a donor tooth replica were implemented to reduce extraoral time, reduce periodontal ligament (PDL) cell damage, ensure optimal tooth socket fit in order to improve autotransplantation predictability and success.

Case Presentation

An 18-year-old male presented with a lower right first molar (LR6) distolingual crown fracture below the gum line (Fig. 1). The patient had been diagnosed with type 1 osteogenesis imperfecta (OI), a bone fragility genetic disorder, and received monthly IV infusions of pamidronate since age 5. Panorex revealed an unerupted LL8 with near complete root formation, which was identified as a candidate for autotransplantation (Fig. 2). The fractured LR6 tooth was deemed nonrestorable and the patient opted for autotransplantation of the unerupted LL8 to the LR6 site, with subsequent root canal treatment.

This study utilized CBCT data for the fabrication of a 3D-printed tooth replica. A CBCT scan was imported into 3Shape Implant Studio software (3Shape, Copenhagen, Denmark), and the region of interest encompassing the desired tooth was isolated and segmented. This digital model was then exported in a compatible file format (.STL) for 3D printing. The tooth replica was fabricated using stereolithography (SLA) technology, which employs a UV laser to selectively cure a photopolymer resin, building the model layer by layer [3]).

The patient was given amoxicillin 2 g and chlorhexidine rinse 0.12% 1 h preoperatively. They were anesthetized with 2% lidocaine 1:100 k epinephrine. The LL8 tooth was accessed via crestal incision, then luxated and elevated to be removed when appropriate. Rotary instruments were not used in order to prevent thermal and mechanical damage to the donor tooth root surface. The fractured LR6 molar was extracted with flapless removal using elevators and forceps (Fig. 3). The replica LL8 was placed in the recipient socket for initial try-in and was off-axis and > 4 mm hyper-occlusive. The socket is modified with a rongeur and hand instruments to remove interradicular septal bone to achieve proper fit with the replica LL8. There was passive fit in occlusion with the replica tooth, confirmed with shimstock and occlusal paper, and there was mechanical retention (Fig. 4).

Once the recipient site was sufficiently refined, the donor tooth was extracted and placed immediately into the recipient socket. Total ex vivo time was < 30 s. Occlusal relationship was confirmed with shimstock and occlusal paper. The donor tooth was dynamically seated by asking the patient to bite on a wooden tongue blade to seat the tooth hypo-occlusally to reduce occlusal trauma (Figs. 5, 6). There were mechanical retention and stability, which eliminated need for sutures and other external stabilization. The patient was prescribed amoxicillin 500 mg twice/day, chlorhexidine 0.12%

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Fig. 1 Preoperative photograph showing distolingual crown fracture of LR6

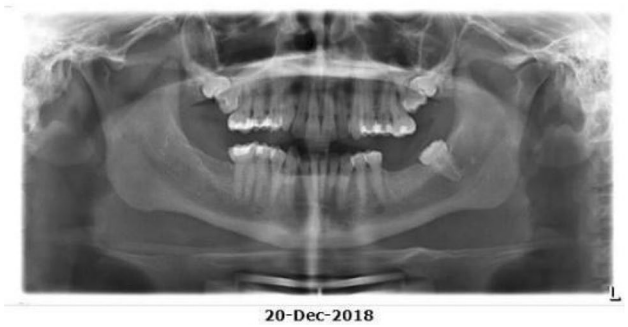

Fig. 2 Panorex of patient dentition, showing unerupted LL8 with near complete root formation

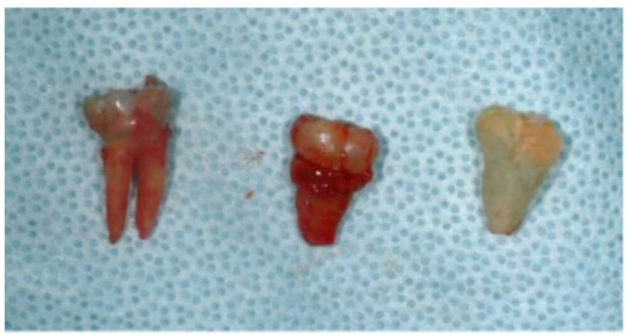

Fig. 3 Extracted LR6 tooth compared to LL8 donor tooth and replica LL8 donor tooth (left to right)

rinse for 7 days and over-the-counter pain medication as needed.

The patient was seen by an endodontist two weeks after autotransplantation surgery. Upon examination, the tooth (now called LR6) was asymptomatic with no tenderness to percussion, palpation and biting. There was no swelling and no sinus tract. There was no mobility. Periodontal probing

Fig. 4 Replica tooth try-in showing passive fit in occlusion

Fig. 5 LL8 donor tooth seated in hypo-occlusive position to reduce occlusal trauma

showed no significant defect. The tooth did not respond to cold or EPT.

The 2 canals were cleaned and shaped up to size 25/04 using rotary endodontic files and disinfected with copious 6% NaOCl irrigation. Canals were dried and medicated with calcium hydroxide (UltraCal™ XS- Ultradent Products Inc.), and the access was sealed with a provisional restoration.

Four weeks later, the patient returned for completion of endodontic treatment. The tooth was asymptomatic, responded normally to all relevant endodontic testing with no visible swelling or sinus tract (Figs. 7, 8). The patient reported normal function on that side. The tooth was cleaned and obturated, and a definitive restoration was placed.

The patient was seen for 3-, 6- and 12-month recall visits. In each time, patient reported no history of pain or

Fig. 6 Periapical radiograph after autotransplantation

Fig. 7 4-week follow-up. Clinical photograph showing good healing and function, some redness at gingival margin

Fig. 8 4-week follow-up. Periapical radiograph of root canal treatment of donor LL8

Fig. 9 1-year follow-up. Periapical radiograph

discomfort. Clinical examination with all relevant endodontic testing was within normal, including normal percussion sound, no tenderness to palpation or biting, no mobility and no deep periodontal probing. Radiographic assessment showed gradual uneventful healing completed in about 6 months. 1-year recall radiograph showed complete bony healing with intact lamina dura and no widened periodontal ligament space and no sign of apical pathology and no resorption (Fig. 9).

Discussion

For a patient population with history of bisphosphonate therapy, autotransplantation can be a consideration for risk reduction of medication-related osteonecrosis of the jaw (MRONJ). Surgical placement of implants as well as presence of the implant itself can be risk factors for MRONJ [4, 5]. Many cases of implant-related MRONJ occur years after implant placement; several authors have postulated chronic inflammation from peri-implantitis as the cause [4, 5]. Autotransplantation may reduce risk of peri-implantitis and MRONJ in a young patient undergoing antiresorptive therapy over their lifetime compared to the alternative of a dental implant.

During treatment planning, the donor tooth's dimensions should be assessed to determine if the tooth will be able to adapt to the recipient site and if there is impingement on any anatomical structures [6, 7]. Digital planning helps with pre-examination of the donor tooth and recipient site to improve treatment success. This can help manage anatomic structures and simplify surgery to reduce donor tooth ex vivo time and facilitate donor tooth and socket fit [1, 2]. PDL traumatization and root surface trauma may cause root resorption and ankylosis, and consequent autotransplant failure [6, 8]. In most cases, preparation of socket can require > 30 min and fitting the donor tooth repeatedly can damage PDL cells and

the root surface [9]. In this case, rapid prototyping and use of a replica tooth for socket refinement limited donor tooth PDL cell damage and ex vivo time to < 30 s. The intimate tooth socket fit obviates the need for conventional stabilization techniques with wires or sutures and reduces the chances of the tooth being hypo-occlusal post-treatment.

Conclusion

Autotransplantation can be a beneficial treatment option for tooth replacement. Digital planning and rapid prototyping have the potential to facilitate donor and recipient compatibility, facilitate socket refinement, eliminate the need for intra-op tooth stabilization, reduce ex vivo time and improve autotransplantation treatment outcomes.

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Code Availability Not applicable.

Declarations

Conflict of interest The authors declare that they have no competing interests.

Ethics Approval Not applicable.

Consent to Participate Not applicable.

Consent for Publication Informed consent was obtained for publication of this case report and accompanying images.

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