Bull Tokyo Dent Coll (2009) 50(4): 199–203

Case Report

Transplantation of Human Tooth with Proliferating Periodontal Tissue —Long-term Clinical Follow-up Study—

Mikio Ota, Shigeki Yamamoto, Ken Takahashi, Tomoko Okuda-Tanaka, Takahisa Fujita, Yoshihiro Shibukawa and Satoru Yamada

Department of Periodontology, Tokyo Dental College, 1-2-2 Masago, Mihama-ku, Chiba 261-8502, Japan

Received 29 May, 2009/Accepted for publication 21 July, 2009

Abstract

A case report is presented on transplantation of a left third molar to replace a right second molar lost due to large furcation perforation. Two weeks after surgery, a reentry surgical procedure was performed on the furcation defect of the second molar to remove membrane and retrieve proliferating periodontal tissue. The left third molar and proliferating periodontal tissue were then transplanted into the bone defect of the right second molar. Radiographically, the transplanted tooth showed no root resorption over a 3-year period. The results indicate that teeth replanted with proliferating periodontal tissue have a favorable long-term prognosis.

Key words: Human tooth—Transplantation—Proliferating periodontal tissue—Ankylosis—Long-term prognosis

Introduction

Root resorption is a frequent complication in transplanted teeth. Teeth subjected to either long extraoral storage time or an unsuitable storage environment before transplantation are more prone to develop severe root resorption than are teeth transplanted immediately. A number of experimental studies have shown that this is caused by injury of periodontal membrane (PDL) cells during extraoral storage[6]. To successfully transplant a tooth, it is necessary to preserve cell activity in the remaining PDL and cementum of the transplanted tooth[3].

In an earlier study, Amar *et al.*[1] detected positive reactions for major matrix macromolecules in proliferating periodontal tissue in periodontal osseous defects under a barrier membrane. Katayama *et al.*[5] reported that proliferating periodontal tissue induced the formation of cementum on the root surface of transplanted teeth. They suggested that proliferating periodontal tissue promotes regeneration of periodontal tissue and prevents ankylosis and root resorption following transplantation of teeth.

The purpose of this study was to investigate the effect of proliferating periodontal tissue in human transplanted tooth.

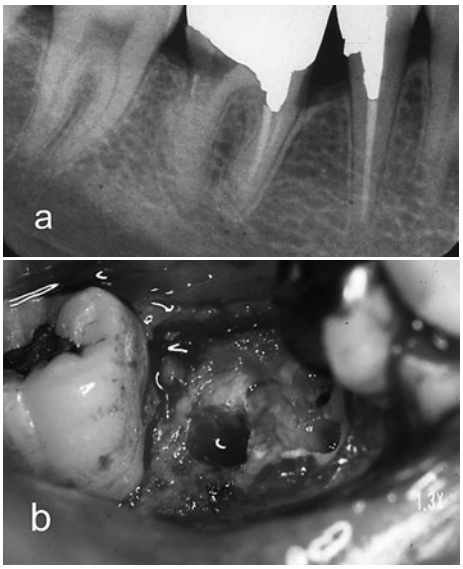

Fig. 1 Radiograph of mandibular right first molar showing large perforation of distal furcation (a). Note relevant large furcation perforation of defect (b).

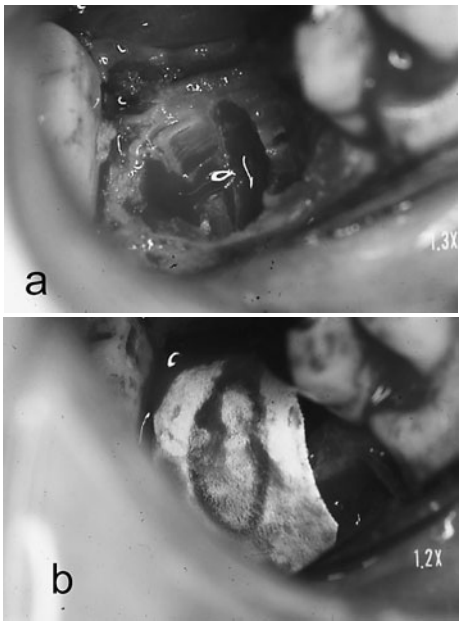

Fig. 2 Preparation of proliferating periodontal tissue Preparation of periodontal osseous defect in furcation of right first molar (a). An e-PTFE membrane covered periodontal osseous defect (b).

Case

1. Subjects

A male patient, 30 years of age, who was physically healthy and with no known systemic disease, participated in this study. The patient signed an informed consent form, and the study was approved by the Committee on Investigation of Human Subjects at Tokyo Dental College. This patient visited our department with the chief complaint of masticatory disorder due to absence of the mandibular right first molar. A radiograph of the mandibular right first molar revealed a large perforation of distal furcation (Fig. 1-a). The distal furcation of the right first molar was utilized for retrieval of proliferating periodontal tissue (Fig. 1-b). Presurgical preparation consisted of oral hygiene instructions, root planing and polishing. The patient achieved an oral hygiene index of $<20\%$ on the O'Leary index prior to surgery.

2. Therapy

Preparation of proliferating periodontal tissue: a periodontal osseous defect was created around the furcation of the right first molar to induce growth (hereafter, referred to as proliferating periodontal tissue) under the membrane to be placed (Fig. 2-a). The defect was covered with an expanded polytetrafluoroethylene (e-PTFE) membrane (Fig. 2-b). Each membrane was trimmed to shape and draped over the alveolar ridge so as to completely cover the defect. The flap was replaced and sutured. This method of inducing proliferating periodontal tissue has been described previously by Sugimoto *et al.*[7]. Two weeks after surgery, a reentry surgical procedure was performed on the furcation defect to remove the membrane and retrieve proliferating periodontal tissues. Harvested tissue was kept moist in sterile saline until used (Fig. 3-a). Part of the proliferating periodontal tissue was also used for biopsy. The specimen

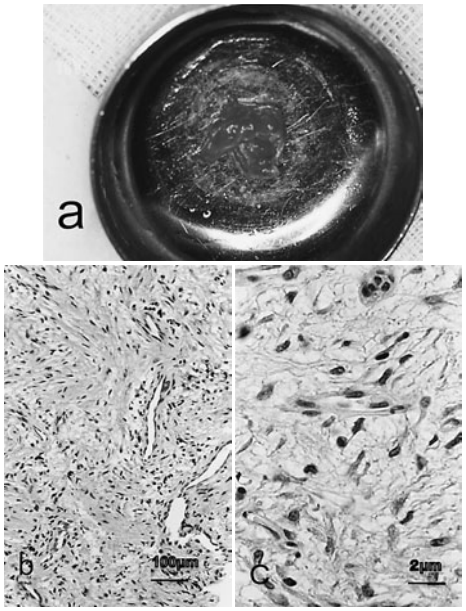

Fig. 3 Retrieved proliferating periodontal tissue (a). Biopsy of proliferating periodontal tissue showing newly formed connective tissue (b and c). Note abundant spindle-shaped cells and capillaries.

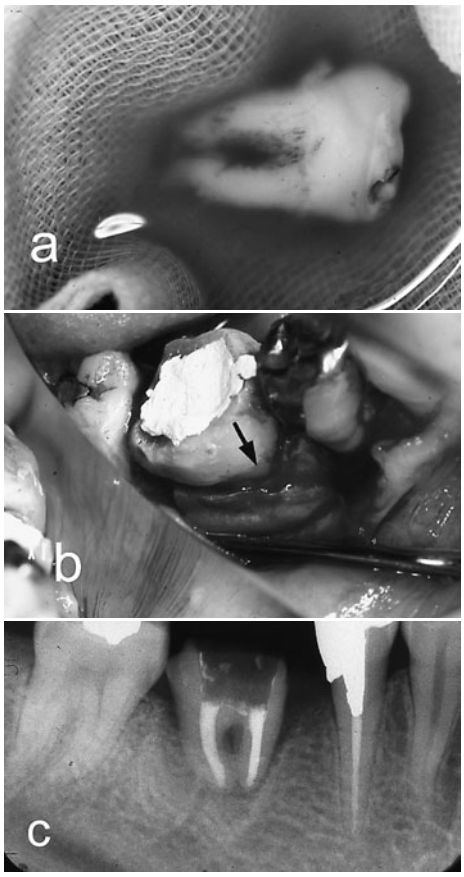

Fig. 4 Tooth transplantation procedure
Transplanted left third molar (a). Proliferating periodontal tissue (arrow) was placed in recipient cavity and left third molar was transplanted to same recipient cavity (b). Radiograph of mandibular left third molar immediately after transplantation (c).

was preserved in formalin, sectioned, stained with hematoxylin and eosin and viewed under low-power magnification. A tissue biopsy of the proliferating periodontal tissue revealed granulation. The proliferating periodontal tissue consisted of newly formed connective tissue composed of fibroblast-like cells and capillaries but no inflammatory cells (Fig. 3-b). This proliferating periodontal tissue showed the same results as that in the study of Amar *et al.*[1]. Abundant spindle-shaped cells, which are associated with growing capillaries, had invaded the newly formed connective tissue (Fig. 3-c).

The tooth transplantation procedure was as follows: under rubber dam isolation, the root canal of the left third molar was instrumented and filled with gutta-percha. The left third molar was then extracted with a forceps using rotary movements (Fig. 4-a). During this time, proliferating periodontal tissue was retrieved as described above. The root of the right molar with a large perforation of distal furcation was extracted to prepare a recipient bed. The recipient cavity was prepared by using implant drills and copious saline irrigation. After preparation was complete, proliferating periodontal tissue was placed in the recipient cavity using a curette (Fig. 4-b). Finally, the left third molar was transplanted into the same recipient cavity (Fig. 4-b). The flaps of this recipient region were then repositioned and sutured (Fig. 4-c).

Results

Fixation was maintained with a soft stainless

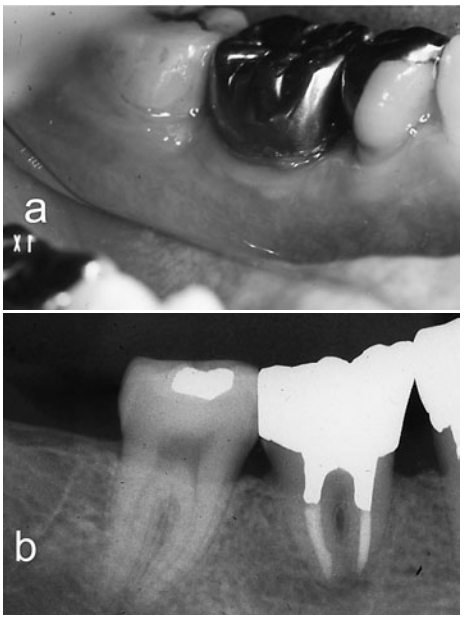

Fig. 5 Photograph (a) and radiograph (b) of transplanted tooth as assessed at 3 years after surgery

steel wire for 4 weeks. A clinical view at 3 years after removal of fixation is shown in Fig. 5-a. Although observation time was extended over 3 years, the tooth transplanted with proliferating periodontal tissue showed no signs of root resorption (Fig. 5-b). The patient underwent a maintenance regimen with monthly recall sessions until 3 months post-surgery, with a personalized frequency of recalls thereafter. Each session included reinforcement of oral hygiene instructions and supragingival plaque removal. Subgingival scaling was performed during recall sessions 6 months after surgery (Fig. 5-a).

Discussion

Transplantation is a suitable method for replacing a missing or lost tooth, provided that a suitable transplant exists. One requirement for a potential transplant is that the tooth should be of limited value in the dentition. Third molar transplantations are, therefore, popular as, even if the transplant is lost, the occlusion will remain the same as it would have done had the procedure never been performed.

In the present study, the Andersson's index[2] was used to assess radiographs of the transplanted tooth. The structures in the resorption cavities were classified according to Andersson's index[2] as either radiolucency, showing inflammatory root resorption, or as bone, indicating replacement resorption. Under radiograph examination in this study, a score of 0 was achieved, indicating no resorption and normal periodontal space. This showed that the proliferating periodontal tissue prevented ankylosis and root resorption following transplantation.

Data previously obtained in animals and from biopsies of avulsed and transplanted teeth in human beings have revealed that, in the course of healing following transplantation, replacement resorption occurred over a wide area in roots exposed to air for 60 minutes before transplantation[4]. These studies suggest that dentoalveolar ankylosis will occur in areas of the root where the PDL has become necrotic during the extraoral period. In contrast, Katayama *et al.*[5] reported that replacement resorption of transplanted teeth decreased in the region that received the proliferating periodontal tissue. In the absence of proliferating periodontal tissue, ankylosis was complete in the area between the root surface and the alveolar bone in regions exhibiting osteocytes at an early stage in the healing process. This means that, in the early stage of ankylosis, osteocytes accumulated adjacent to the root surface. On the other hand, in the proliferating periodontal tissue group, multiple layers of fibroblasts adhered to the root surface in the early stage of attachment. In the late stage of healing, new cementum and PDL tissue formed on the root surface of transplanted teeth.

In conclusion, proliferating periodontal tissue improves the outcome in the transplantation of teeth. This procedure may offer an excellent alternative to implantation.

Acknowledgement

We would like to thank Associate Professor Jeremy Williams, Tokyo Dental College, for his assistance with the English of this manuscript.

References

1) Amar S, Petrungaro P, Amar A, Van Dyke TE (1995) Immunolocalization of bone matrix macromolecules in human tissues regenerated from periodontal defects treated with expanded polytetrafluoroethylene membranes. Arch Oral Biol 40:653–661.
2) Andersson L, Bodin I, Sörensen S (1989) Progression of root resorption following replantation of human teeth after extended extraoral storage. Endod Dent Traumatol 5:38–47.
3) Andreasen JO (1986) Periodontal healing after replantation and autotransplantation of incisors in monkeys. Int J Oral Surg 10:54–61.
4) Blomlöf L, Lindskog S, Hammarström L (1986) Periodontal healing of exarticulated monkey teeth stored in milk or saliva. Scand J Dent Res 89:251–259.
5) Katayama A, Ota M, Sugito H, Shibukawa Y, Yamada S (2006) Effect of proliferating tissue on transplanted teeth in dogs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 101:110–118.
6) Oikarinen KS, Seppa ST (1987) Effect of preservation media on proliferation and collagen biosynthesis of periodontal ligament fibroblasts. Endod Dent Traumatol 3:95–99.
7) Sugimoto S, Ota M, Shibukawa Y, Yamada S (2005) Formation of new periodontal ligament around transplanted teeth proliferating tissue in periodontal osseous defect under barrier membrane. Biomed Res 25:179–187.

Reprint requests to:
Dr. Mikio Ota
Department of Periodontology,
Tokyo Dental College,
1-2-2 Masago, Mihama-ku,
Chiba 261-8502, Japan
Tel: +81-43-270-3953
Fax: +81-43-270-3955
E-mail: moota@tdc.ac.jp