Mandibular reconstruction using 2-step bone transport in an irradiated cancer patient with type 2 diabetes mellitus


Abstract. This report describes mandibular reconstruction using a 2-step bone transport technique in a cancer patient with type 2 diabetes mellitus (DM) who received radiotherapy before ablative surgery. The bone, measuring 90 mm in length with the mandibular curvature and good alveolar form, was regenerated using a plate-guided method. Three implants were placed 21 months after completion of the first distraction and 14 months after the second distraction. These implants integrated successfully and have remained stable more than 2 years after loading. The results suggest that mandibular reconstruction using bone transport is possible after segmental osteotomy in irradiated cancer patients with DM, although a long treatment period is required.

Keywords: mandible; reconstruction; bone transport; irradiation; diabetes mellitus.

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Among the factors that interfere with distraction osteogenesis, irradiation effects have been relatively well described2,4,7. There are mixed results from the limited number of human trials. Metabolic abnormalities in type 2 diabetes mellitus (DM) also impair bone formation and turnover. Few reports in the literature address bone regeneration by distraction osteogenesis in patients with type 2 DM. This report describes an experience of mandibular reconstruction using 2-step bone transport in a patient with type 2 DM who had undergone radiotherapy.

Case report

A 55-year-old man had undergone 2-stage plate-guided bone transport to improve cosmetic and functional impairments after ablative surgery including segmental mandibulectomy from the right condylar neck to the ipsilateral canine region (Fig. 1a). Immediate reconstruction using a free-flap had failed because of severe postoperative infection, probably caused by uncontrolled type 2 DM, as the hemoglobin (Hb)A1c level was 7.1% at first presentation. Preoperative radiotherapy had been administered (Linac; 2 Gy/day, 5 fractions/week, cumulative dose 40 Gy).

A titanium reconstruction plate (Leibinger GmbH, Freiburg, Germany) with a square body in the center portion along which the transport disk was guided by a titanium miniplate bent to surround the plate from three directions was used. The plates were placed using a Multi-guide distraction device (Howmedica Leibinger GmbH, Freiburg, Germany), on 2 December 2003. Osteotomy was then performed to provide a 30-mm transport disk. After 14 days of latency, the transport segment was moved 0.5 mm/day for 120 days. Bone distraction of 60 mm at the distraction device and 50 mm on the outer surface of the mandible was accomplished by the end of the first step (Fig. 1b).

On 2 August 2004, the distractor was settled again for second bone transport. The original transport segment, 24 mm in length at this time, was divided into anterior and posterior blocks. A medium-sized titanium plate was placed over the distracted site between the divided posterior block and the remaining mandible to prevent relapse by wound contraction of the first distracted area and reaction against the second distraction. Latency period and distraction rate were...
similar to those of the initial procedure. At the end of the second step, 40 mm of movement had been accomplished (Fig. 1c). On 11 January 2005, the distractor was removed and a reconstruction plate was settled for bone consolidation (Fig. 2). The right condyle had become deformed and this would have resulted in functional difficulty even if a connection had been present to the transported stump by autogenous bone graft. Bone continuity was not accomplished. Insulin therapy was given using a sliding scale, and diet and exercise therapy were continued during the transport and consolidation periods. HbA1c remained within the range 5.8–6.3%. The patient, or his family, had sterilized the skin around the pins twice a day at home. A decubitus ulcer in the newly generated oral mucosa healed uneventfully following elimination of irritation from the opposite cusp.

On 11 January 2006, the 3 dental implants were placed in the mandible. The anterior implant was installed in the distracted area during the first step, with the center implant placed to the original bone block (posterior block at second step) and the posterior implant placed to the distracted area in the second step (Figs. 1d, 3). Initial stabilities, measured using the Ostell Apparatus (Integration Diagnostics, Gothenburg, Sweden), were 64 at the anterior implant, 69 at the center and 29 at the posterior. All implants were integrated at the second implant operation performed 5 months after placement, and the implant-retained overdenture has remained stable for >2 years.

Discussion

The reconstructed area in this patient, including the transported segment, had received 40 Gy of preoperative radiotherapy. Among various reports on distraction osteogenesis of the irradiated mandible, Sawaki et al.7 reported successful trifocal distraction osteogenesis in a patient who had undergone preoperative chemoradiotherapy, using 1 cycle of cisplatin and fluorouracil followed by 30 Gy of radiotherapy. In other clinical trial settings, such as with a postoperative radical dose of 60 Gy, the approach has not been rigorously assessed6. Given the results described here and the successful reports in the literature, distraction osteogenesis appears applicable for mandibular reconstruction in patients who have undergone low-dose preoperative radiotherapy with subsequent definitive surgery.

Few investigations in the literature have addressed bone regeneration by distraction osteogenesis in patients with type 2 DM. The authors found one experimental study using diabetic rats, in which new bone formation was significantly reduced compared with controls3. The authors adopted a 14-day latency period and a transport rate of 0.5 mm/day. A longer period was needed to accomplish full-span transportation, but the quality and quantity of regenerated bone were sufficient for implant therapy.

Only a few cases1,5,8 have been reported regarding implant created in mandibular defects reconstructed by means of transport distraction osteogenesis. In these reports, implants were placed 3–10 months after distraction in non-irradiated patients1,8 and >20 weeks.
after in the irradiated patient\textsuperscript{5}. In non-irradiated patients, implants were loaded 3 or 11 months after installation. In the present patient, 3 implants were placed 21 months after completion of the first distraction and 14 months after the second distraction. Initial stabilities increased at the distracted site after a longer waiting period. These successful results suggest that mandibular reconstruction using bone transport and implant therapy is possible after segmental osteotomy in irradiated cancer patients with DM, although a long treatment period is required.

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**References**

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