



## Bare bone graft with vascularised iliac crest for mandibular reconstruction

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### ABSTRACT

**Background:** “Bare bone graft” with a vascularised iliac crest is a procedure involving no soft tissue for intraoral lining, and the intraoral defect is covered with epithelial cells through secondary healing of the exposed bone.

**Methods:** A vascularised iliac crest flap is transferred to a segmental mandibular defect intraorally in the position of the osteotomized stump upwardly. Granulation tissue is usually observed on the stump of the bone graft about 1 week after surgery. When sufficient granulation is observed after approximately 4 weeks, “resurfacing” is performed to prevent interference of hypergranulation tissue with epithelization. Resurfacing involves wiping the granulation tissue from the surface of the bone and covering with a plastic prosthesis fitted to the alveolus.

**Results:** A total of 11 patients underwent bare bone graft with a vascularised iliac crest. Resurfacing was performed at an average of 2.1 times for each patient. All wounds in the oral cavity were completely epithelialized from 2 weeks to 3 months after surgery. Complications with the recipient side occurred in four patients.

**Conclusions:** Bare bone graft with the iliac crest is one favourable option for mandibular reconstruction utilising the particular shape of the bone without the attached soft tissue.

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## 1. Introduction

Mandibular reconstruction includes the principles of “bridging of the defect, “occlusal rehabilitation” and “aesthetics”. Bridging of the defect is achieved with the placing of a graft to produce longitudinal stability between the residual mandibular segments. The restoration of the occlusion requires dental implants or a denture (Adel et al., 2008). For both types of artificial teeth, healthy bone with a high alveolar ridge and a non-mobile (muco-) epithelium are necessary. The aesthetics of the reconstructed mandible is dependent on its contour.

For mandibular reconstruction, many different vascularised bone grafts have been described and used (Taylor et al., 1979; Hidalgo, 1989; Urken et al., 1998; Cordeiro et al., 1999). Urken concluded that the iliac crest is the best material for mandibular reconstruction when considering the desirable characteristic of the bone grafts (length, width, height, and contour) (Urken, 1991). In clinical practice the iliac crest has generally been replaced by the

fibula osteocutaneous flap. One of the reasons for this is that the skin paddle of the iliac crest is too bulky for alveolar reconstruction and has an unstable blood supply.

In Japan, the bare bone graft was described by Oh-iwa in 2003 (Oh-iwa et al., 2003). This procedure allows alveolar reconstruction with a vascularised iliac crest graft. In this procedure the iliac bone is grafted as bare (i.e. uncovered) bone into the oral cavity. The graft is not covered by a soft tissue flap and epithelialisation occurs gradually in the postoperative period. In this paper we describe our modified bare bone graft with using an iliac crest free bone graft.

## 2. Material and Methods

### 2.1. Surgical procedure

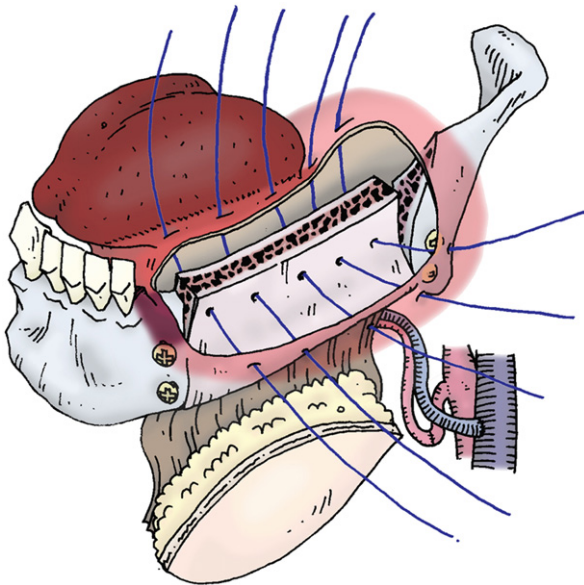
The bare bone graft using the iliac crest is suitable for immediate or delayed reconstruction in patients with segmental mandibular defects. Surgery is performed with a two-team approach. A vascularised iliac crest flap is harvested through a conventional technique with or without a skin paddle. The skin paddle and the attached adipose tissue are used for covering the skin defect and for filling by the de-epithelialised soft tissue after neck dissection. In

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addition the attached soft tissue is of use for prevention of a postoperative orocutaneous fistula.

After completion of the segmental mandibulectomy, the iliac crest is fixed to the defect intraorally (Fig. 1) with lag screws or titanium plates to the resected bone ends. If a more acute curve of the bone graft is needed an osteotomy of the graft is performed. When such an osteotomy is performed, only the lateral wall and crest are cut, and the medial wall, where the vascular pedicle attaches, is preserved and “green stick” fractured if necessary. If the wedge defect after bending the bone is large, a non-vascularised wedge bone graft is placed into the defect with moderate compression. After bone fixation, vascular anastomosis is performed and the graft is re-vascularised.

The exposed intraoral bone is drilled through the inner and outer cortex near the top of the osteotomized stump at intervals of about 1 cm transversely, and then sutures for mucosal fixation are placed through the mucosal stump of the lingual and buccal sides



**Fig. 1.** Schema of the bare bone graft with a vascularised iliac crest. The vascularised iliac crest is transferred intraorally to the position of the osteotomized stump upwardly. Suture is placed through the lingual and buccal sides of the mucosal stump and the bone. Next, the bone graft stump is covered with a collagen sheet and ointment gauze.

and the bone (Fig. 1). Next, the bone graft stump is covered with a collagen sheet and ointment gauze.

If the skin paddle is attached to fill the dead space of either the submandibular region or the neck, de-epithelialisation is performed, maintaining a small skin paddle for postoperative blood supply monitoring.

Postoperative graft viability is determined by monitoring the skin paddle, by hand-held Doppler ultrasound, or observation of oozing from the cancellous bone of the graft stump after scratching with a fine needle.

One week after surgery, the ointment gauze covering the bone graft is removed, and granulation tissue is observed on the stump of the bone graft. A contaminated cavity may sometimes be seen on the buccal side of the bone graft; in this case, irrigation of the cavity and debridement of necrotic tissue on the surface of the bone graft is performed. After 1–2 weeks, the cavity becomes smaller and the exposed bone is covered with granulation tissue. If granulation on the cortex of the graft is poor, the cortex is drilled to promote granulation, which is brought about by bleeding from the drill hole. When sufficient granulation (about 80% of the bone covered by granulation tissue) is observed, resurfacing is performed to prevent hypergranulation tissue interfering with epithelialisation. Resurfacing involves wiping the granulation tissue from the surface of the bone with gauze and covering with a plastic prosthesis fitted to the alveolus. The surface of the bone graft becomes epithelialised gradually under the prosthesis. If hypergranulation is observed again on the bone, resurfacing is repeated every 1–2 weeks. In many cases, the oral cavity is epithelialised completely 1–2 months after surgery as a result of resurfacing up to five times. After complete epithelialisation, a prosthesis made for the patient.

Drinking is permitted 3 to 5 days postoperatively, and eating food is started after removal of the ointment gauze in the oral cavity.

## 2.2. Patients

11 patients (5 males and 6 females; 32–78 years old, mean 58.8 years) underwent bare bone graft with a vascularised iliac crest between October 2005 and March 2009 (Table 1). The causes of segmental mandibular defect were immediate mandibular reconstructions after tumour excision ( $n = 7$ ), immediate reconstruction after removal of benign neoplasm ( $n = 1$ ), osteoradionecrosis ( $n = 1$ ), non-vascularised bone necrosis ( $n = 1$ ), and delayed reconstruction after trauma ( $n = 1$ ). Presurgical radiotherapy was administered in 6 patients (dose 40–62 Gy) including 3 cases of chemoradiation. There were 9 osteomusculocutaneous flaps and

**Table 1**  
Patient records.

Case	Age/ sex	Causes of mandibular defect	Presurgical treatment	Defect size <sup>a</sup>	Additional intraoperative operation	Osteotomy in the graft	Skin paddle
1	36F	Benign neoplasm of the mandible	–	L4–L8 5 cm	–	–	None
2	32F	Benign neoplasm/previous bone graft infection	–	L2–R7 7 cm	–	–	For submandibular augmentation
3	60M	Malunion after fracture	–	L1–R3 4 cm	–	–	None
4	63M	Osteoradionecrosis	RT 44 Gy	L5–R7 12 cm	–	1	For submental skin reconstruction
5	71M	Malignancy of the lower gum	CRT 62 Gy	R2–L8 9 cm	Ipsilateral MRND	–	For carotid cover
6	59F	Malignancy of the lower gum	RT 48 Gy	R2–L8 9 cm	Ipsilateral SOND + buccal skin resection	–	For buccal skin reconstruction
7	64M	Malignancy of the FOM	CRT 60 Gy	L6–R6 12 cm	Ipsilateral MRND + contralateral SOND + oral hemiglossectomy	1	For tongue reconstruction
8	68F	Malignancy of the lower gum	CRT 40 Gy	R3–R8 6 cm	Ipsilateral SOND	1	For carotid cover
9	58M	Malignancy of the lower gum	–	R2–L6 9 cm	Ipsilateral SOND	1	For carotid cover
10	58F	Malignancy of the lower gum	RT 40 Gy	R1–R Angle 8 cm	Ipsilateral SOND	–	For carotid cover
11	78F	Malignancy of the lower gum	–	R1–R Angle 8 cm	Ipsilateral SOND	–	For carotid cover

FOM: floor of the mouth, RT: Radiotherapy, CRT: chemoradiotherapy, MRND: modified radical neck dissection, SOND: supraomohyoid neck dissection.

<sup>a</sup> Defect size: L means left mandible, and R means right. The number means tooth number. And next diameter is the length of the defect at the lower margin of the mandible.

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