Analysis of Reconstruction of Mandibular Defects Using Autogenous Bone Graft and/or Metallic Reconstruction Plate

Hideo Kurokawa, Yoshihiro Yamashita, Maki Yamashita
and Minoru Kajiyama

Second Department of Oral Surgery (Chief: Prof. Minoru Kajiyama)
Kyushu Dental College, Kitakyushu, Japan

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Mandibular reconstruction is important for providing good functional and cosmetic results after resection of the mandible. Mandibular reconstruction following excision of the mandible has been conventionally achieved by free bone grafting using autogenous bone, such as ilium or rib¹⁾. With the recent development of metallic plates for stabilization of the mandible, mandibular reconstruction with a combination of a metallic plate and a pedicled osteomyocutaneous flap or revascularized osteomyocutaneous flaps has been described for repairing defects following extensive segmental resection, unilateral resection, or hemiresection of the mandible²⁻⁴⁾. Although mandibular contour can be reestablished by these methods, they do not always produce satisfactory results in the restoration of occlusion and masticatory function.

This report describes our experience using various reconstruction procedures and the functional outcome is analyzed, with attention to associated early and late complication.

Patients and Methods

Reconstruction of mandibular defects was performed on 69 patients in our department during the 16 years from 1981 to 1996. The patient's ages ranged from 19 years to 72 years (mean, 53.3 years). The sex was 32 males to 37 females. Of the 69 cases, 43 were oral malignant tumors, sixteen were oral benign tumors, seven were odontogenic cysts and three were chronic osteomyelitis (Table 1). The extent of mandibular resection in the 69 cases is shown in Fig.1. There were immediate reconstruction on 55 cases and secondary reconstruction on 14 cases.

The amount of bone required was outlined and then cut using a tungsten carbide fissure bur or a high speed oscillating saw. The metallic plates of appropriate size were chosen based on preoperative cephalometric radiographs made in the posteroanterior, lateral, and occipitomenta directions. The plates were bent to the predicted curvature of the angle or mentum using a model or paper template as a guide. The adaptability was improved by repeated adjustment during operation. Holes in the mandibular stumps were made using a

Table 1 Histopathological diagnosis of 69 patients with mandibular reconstructions

Diagnosis		Case	
Malignant tumor	Squamous cell carcinoma		35
	Gingival cancer	29	
	Oral floor/Tongue cancer	5	
	Buccal mucosa-cancer	1	
	Osteogenic sarcoma		4
	Fibro-sarcoma		3
			1
		Total	43
Benign tumor	Ameloblastoma		15
	Ossifying fibroma		1
		Total	16
Odontogenic cyst	Odontogenic keratocyst		6
	Follicular cyst		1
		Total	7
Others	Osteomyelitis		2
	Others		1
		Total	3

Fig. 1 Type of mandibular defects.

drill and tap, and the plate was fixed with two or three screws on each end. Ten of 69 cases required a myocutaneous flap to close soft tissue defects: four patients had pectoralis major myocutaneous flaps, three had deltopectoral flaps and three had cervical island skin flaps.

To determine masticatory function, follow-up interviews were performed with 26 patients underwent immediate mandibular reconstruction after segmental mandibular resection or hemimandiblectomy, by Yamamoto's chart of masticatory efficiency⁶⁾.

Results

Following mandibular resection, the mandibular reconstruction with an autogenous bone

Fig. 2 Methods of mandibular reconstruction.

Fig. 3 Method of mandibular reconstruction with bone grafts.

Fig. 4 Method of mandibular reconstruction with metallic plates and/or bone grafts.

Fig. 5 Method of mandibular reconstruction with metallic plates and/or bone grafts.

Table 2 Prognosis after mandibular reconstruction using metallic plates and/or bone grafts

Complications	Cases	%
Inflammatory complication	9 / 69	13.0
Chronic perforation	2 / 47	4.3
Removal of metallic plates and/or bone	6 / 69	8.7

Fig. 6 Masticatory efficiency for patient with mandibular resection by Yamamoto's chart.

graft and/or a metallic plate was carried out in 69 patients: 30 patients were reconstructed with only a metallic plate for stabilization of the mandible, 22 patients with only an autogenous bone graft, and 17 patients with a combination of a metallic plate and an autogenous bone graft. An autogenous bone graft was used in 39 patients after mandibular resection (Fig. 2). Thirty three patients were reconstructed with an iliac crest bone graft, three patients with a rib segment, and three patients with a hydroxyapatite block (Fig. 3). The grafted bone was fixed to the stumps with stainless steel wires or miniplates. A metallic plate was used in 47 patients after mandibular resection. Thirty two patients were reconstructed with an AO or Leibinger reconstruction plate, thirteen patients with a stainless steel or titanium mesh tray, and two patients with a Kirschner wire. Moreover, in seventeen patients who were reconstructed with a combination of a metallic plate and an autogenous bone graft, a stainless steel mesh tray was used in eight patients, an AO reconstruction plate in five patients, and a Leibinger reconstruction plate in four patients (Fig. 4, 5).

There were complications in 11 cases (15.9 %), and these are summarized in Table 2. They can be divided into inflammations, dehiscence and infection at the plate site, and noninflammations due to mechanical stress in the plate or the grafted bone. Relating the inflammatory complications to the localization of the plate or the grafted bone showed the lowest rate after reconstruction of the mandibular body. Reconstruction of the ramus gave the most complications. The plate exposures occurred in two cases with a relatively large resection of the mandible including the mandibular angle or the ramus. There were 5 cases of infection near the plate or the grafted bone. However, These cases were successfully treated with local care without extraoral plate exposure. Five of the 11 complications were successfully treated without plate or grafted bone removal.

The masticatory function after mandibular reconstruction in 26 cases with segmental resection of the mandible or hemimandiblectomy is shown in Fig. 6. In 21 of 26 patients (80.8 %), a denture was used. The mean point of the masticatory function after mandibular reconstruction in 9 patients with hemimandiblectomy was 42.7 ± 18.9 point, which was significantly lower than the 94.4 ± 12.9 point in 17 patients with segmental resection of the mandible.

Discussion

Several methods of reconstruction have been used, with varying degrees of success. These include extrasketal (external) fixation, steel or titanium mesh, nonvascularized bone grafts, Kirschner wire, darcon mesh, autogenous frozen mandible, osteomyocutaneous flap, titanium-coated hollow-screw reconstruction plates (THRP), cancellous bone, and rigid fixation with metallic plates⁶⁻⁸⁾. The main goals of reconstructive efforts are to improve function, form, and quality of life while minimizing serious risk to the patient¹⁾.

Although the ideal mandibular replacement has yet to be discovered, qualities of such a prosthesis would permit 1) easy application with minimal additional operating room time, 2) provision of a solid arch with which the maxilla can articulate, 3) no compromise of

cancer curability, 4) closure of soft tissue defects and bone gaps, 5) minimal cosmetic deformity, and 6) satisfactory function^{1,9,10)}. Moreover, the choice depends on the histologic diagnosis of the tumor and the location and extent of the mandibular defect¹⁾. In our department, metallic reconstruction plates have been used for immediate mandibular reconstruction in malignant tumor cases, and iliac bone or alumina ceramics have been used for permanent reconstruction of benign tumors¹²⁾. The advantages of the metallic plate are as follows: 1) it can be easily shaped and adapted to any type of mandibular defect, 2) it is really available and economical, and 3) it has sufficient structural rigidity to maintain the mandibular fragment in proper position and the teeth in the proper occlusion^{11,12)}.

After mandibular reconstruction, most patients complained of various abnormalities of mandibular movement, sensory discomfort of the flap in the oral cavity, and a feeling of unadaptability of the prosthesis owing to changes in the supporting tissues of the mandible^{13,14)}. In our cases, there was no relationship between plate exposure and reconstruction with a mucocutaneous flap. Therefore, the cause was considered to depend on the condition of the lining skin over the plate or the shape of the plate. The shape of the plate should be planned to avoid excessive pressure on the soft tissues surrounding it¹⁵⁾. We have found that preparation of a plate smaller than the actual size of the mandible and placement of the plate on the medial side, together with contour adjustment of the plate and manipulation during the operation, help to prevent plate exposure. Moreover, in immediate reconstruction of the posterior region of the mandible following segmental resection, our use of a metallic plate or a myocutaneous flap and bone graft produced a relatively favorable postoperative course, as did delayed reconstruction using an autogenous iliac bone or rib segment. We therefore believe that delayed bone grafting after immediate fixation using a metallic plate to bridge the mandibular defect may be a safer procedure.

Restoration of mandibular continuity is the major purpose of reconstruction with a metallic plate and/or substitute bone material. Restoration of mastication using a prosthesis in such situations is difficult^{14,15)}. In patients having teeth on the unaffected side, this method of repair, though not adequate to achieve perfect restoration of mastication, is relatively satisfactory¹⁴⁾. In edentulous patients, restoration of the masticatory function is very difficult. Autogenous bone grafts are more useful than bone substitutes in supporting a prosthesis¹⁴⁾. In our cases, 21 of the 26 patients (80.8 %) have good mandibular function. Therefore, these reconstruction was helpful restoring masticatory function.

Conclusion

The functional outcome of 69 patients who had mandibular resection and were reconstructed with a metallic plate and/or a bone graft was retrospectively analyzed. There were complications in 11 cases (15.9 %): postoperative inflammation or infection occurred 9 times, plate exposure twice. Six cases of the plate and/or the grafted bone had to be removed prematurely due to the complication. A prosthesis was used more frequently by patients when reconstruction was performed using a metallic and a bone graft. These

reconstruction was helpfull for restoring mandibular contour and masticatory function. Improved mandibular function and esthetics may allow future patients to be offered easily reconstruction routinely.

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再建用金属プレートおよび自家骨を用いた 下顎欠損の再建についての検討

黒川 英雄・山下 善弘・山下 真紀
梶山 稔

九州歯科大学口腔外科学第2講座（主任：梶山 稔教授）

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私たちは、下顎骨切除を行い金属プレートおよび骨移植による下顎骨再建を施行した69症例について、その機能的評価を検討した。合併症は11例（15.9％）に認められた。その内訳は、手術後の炎症あるいは感染が9

例、プレートの露出が2例であった。そのうち、6例はプレートあるいは移植骨を除去した。補綴物は下顎骨再建後によく使用されていた。また、今回の下顎骨再建では下顎豊隆や咀嚼機能の回復に有用であった。