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Mini-Plate Fracture

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Summary

Mini-plate fracture was found in a case of the bone grafting after the segmental mandibular excision, and a case of osteomyelitis in the radiographic follow-up examinations. It was emphasized that usefulness of mini-plate would be evaluated by modification in shape and number of mini-plate used for fixation or reconstruction.

Introduction

Stabilization using mini-plate has been evaluated as routine method for treatment of fracture and bone defect since Champy et al[1] described mandibular osteosynthesis without intermaxillary fixation. The concept that mini-plate has advantages in all cases has been praised. However, trials of mini-plate is gave a serious consideration in bone graft after mandibulectomy and osteomyelitis. Fundamentally, usefulness of mini-plate could not be defined clearly in these cases. Therefore, the recognition that stabilizing could be realized in fixation of such cases is weakened. It is needed that stability of mini-plate could be ascertained and use of mini-plate could be recognized to be the best method of reconstruction of the mandible in the cause of its availability.

We are necessary to learn a lesson in order to recognize a risk to mini-plate and confirm usefulness of mini-plate in those cases from mini-plate fracture.

Materials and Methods

Case 1. On March 13, 1986, a 51-year-old woman was seen with a 3-month history of progressive and increasing ulcer of right tongue. The patient was diagnosed as carcinoma of the tongue and the floor of the mouth. Preoperatively the patient received chemotherapy consisted of vincristine and pepleomycin. Partial resection of the tongue and floor of the mouth and combined marginal mandibulectomy and lingual split as well as radical block dissection of the neck were performed on

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May 7, 1986. The defect of the tongue, the floor of the mouth and the alveolar region was reconstructed with a pectoralis major myocutaneous flap. On October 28, 1986 segmental mandibular excision was performed because of chronic osteomyelitis of the mandibular margin remained in previous surgical procedure, and the bone defect was reconstructed by use of a segment of the iliac crest with intact periosteum. Ensuring proper occlusion during the surgical intervention, three stainless steel mini-plates with four, four and six holes (Martin Medizin Technik, Germany) were manipulated with pliers to adapt onto the bone and applied to fix bone grafting to the remaining mandibular segment. The number of screws used was four, four and three in four, four and six holes, respectively (Fig. 1). The length of the screws was 7 mm in the mandible and 9 mm in the bone grafting. And the patient had a fixed appliances which the pontic region extended to the right canine, using the lower left incisor, canine, premolar and molar teeth as abutments. At present the patient is 7 years 6 months after mandibulectomy and remains free of recurrence, retaining mandibular arch configuration (Fig. 1).

Case 2. On June 26, 1993, a 66-year-old man was seen complaining retardation of wound healing after removal of the right lower third molar. Lateral radiograph showed a fracture of the angle of the mandible though the wound. On July 15, 1993, reduction and fixation of the mandible were performed. Two titanium mini-plates with six and eight holes (Martin Medizin Technik, Germany) were contoured to the bone surface and were placed on it, after excision of fibrous tissue accompanied with curettage of the wound, and freshening of the ends of the fracture. The number of

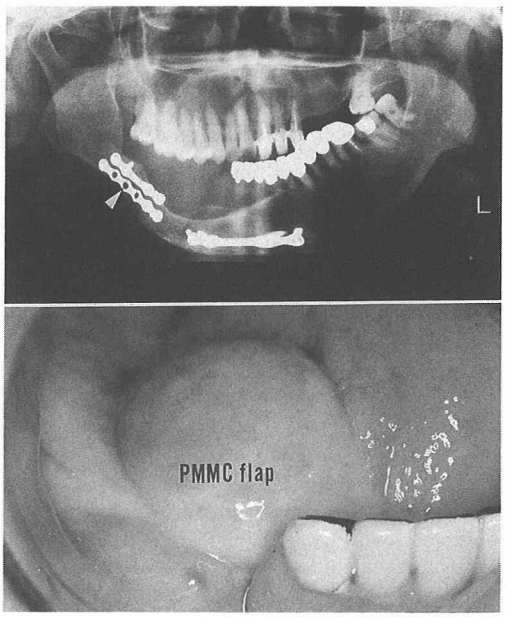

Fig. 1 Above: Showing mini-plate fracture (arrow) 7 years 5 months after reconstruction of mandible by use of the iliac crest.
Below: A pectoralis major musculocutaneous flap 7 years 10 months after transplantation in the tongue, the floor of the mouth and the alveolar region.
There is no inflammation and no functional disorders in the tongue movement and mastication.

screws used was two and three at either end of mini-plate with six and eight holes, respectively (Fig. 2). And the length of the screws was 7 mm. Proper occlusion was ensured during the surgical procedure. The postoperative course was uneventful and did not show wound dehiscence, retaining normal occlusion.

Records and radiograms in their progress were compared between case 1 and case 2.

Results

There has been no clinical evidence of inflammation around the mini-plates since surgical operations, and radiographic examinations performed every one year in case 1 and every two or three months in case 2 have not shown any abnormalities although somewhat nonunion of the bones were seen. However, mini-plates fractures were found in radiographic examinations at March 14, 1994 in case 1 and January 25, 1994 in case 2. There were no distance between the bone ends and no elevation of fragment in both cases. Digital examination did not show evidence of mini-plate fracture and nonunion of the bone. The period between osteosynthesis and mini-plate fracture was

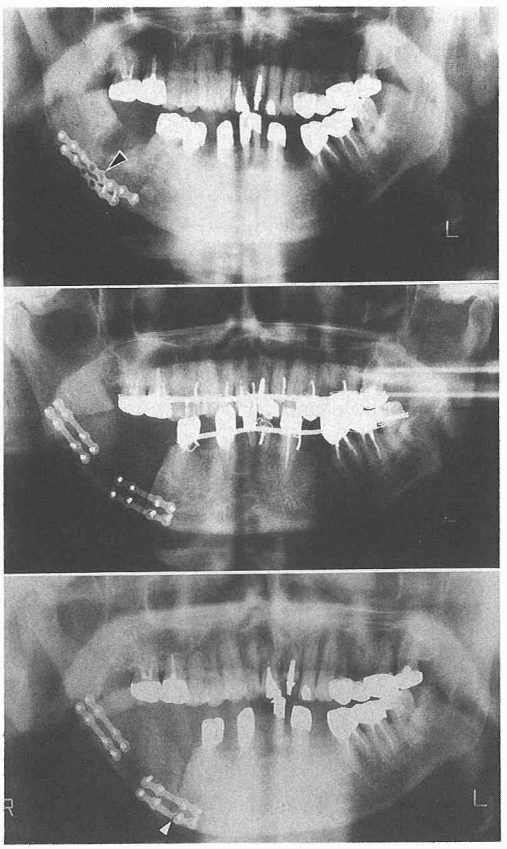

Fig. 2　Above : Orthopantomogram showing mini-plate fracture (arrow) 5 months after insertion.
Middle : Showing mini-plates fixed to the bone grafting and the mandible after removal of fractured mini-plate, segmental mandibular excision and reconstruction by use of the iliac crest.
Below : showing again mini-plate fracture at rim of the hole after 3 months.

7 years 5 months in case 1, and 6 months in case 2. In case 1 mini-plates were remained in place because of stability of the mandible. In case 2 mini-plates were removed and segmental mandibular excision was performed on March 1, 1994. Mandibular defect was reconstructed by use of a segment of the iliac crest. Four titanium mini-plates with four holes (Martin Medizin Technik, Germany) were bent in shape and applied to fix the bone grafting. The number of screws used was two at either end of mandible and bone grafting (Fig. 2). The length of the screw was 7 mm in mandible and 9 mm in the bone grafting. Intermaxillary fixation was also performed. However, mini-plate fracture was again observed in radiographic examination on June 6, 1994. Mini-plate was remained in place because of asymptom and stability of mandible. Its fracture was seen at rim of the hole in each case.

Discussion

Many cases have been treated with mini-plate since Champy et al[1] noted of its usefulness. It performs rigid fixation because of its high stability, gives no compression damaging of the alveolar inferior nerve, no necessity of intermaxillary fixation, and does not give rise to an infection. Moreover, there is no problem of exposed plates due to affinity to bone tissue and due to being covered by regenerated bone in healthy condition. Indication of mini-plate is fixation of bone transplants, and reconstruction of mandibular defects. Use of mini-plate is a simple and successful technique for shaping and stabilizing the bone component[2,3]. Cesteleyn et al[4] noted that mini-plate is useful to even dislocated and luxated fractures of the mandibular condyle. We found mini-plate fractures in a case of bone grafting after segmental mandibular excision due to carcinoma of the tongue and the floor of the mouth and another case of osteomyelitis. This is a problem difficult to pursue a benefit of mini-plate. Although it is very important to define which mini-plate should be used in shape and how mini-plate should be used in number in such cases in order to confirm its usefulness, these cases possess considerable risk, because the presence of osteomyelitis has a tendency to show a nonunion of the mandible, even if the plates was fixed solidly to control the pull of the muscles attached to the mandible and control the wedging force between the bone ends occurred by the muscles. A significant amount of strain energy may be built up in the mini-plate because of residual stress state at the bone ends which did not easily show bone production in such state. Causes of the mini-plate fracture might be a stress-induced fatigue crack, and the formed fracture of a mini-plate may require less energy for a fracture of another plate unless bone would be regenerated. Differing rates of mechanical fatigue produced by temporary bent in the adaptation on the bone surface and permanent structural change stressed or strained by muscles could play important roles in occurring fracture of above and below in case 2 or below in case 1 out of two mini-plates. The effect of mechanical fatigue may have important implications to the life of mini-plates under dynamic loading conditions accompanied with bone regeneration.

Our cases indicated that a rim of hole is broken in each case, suggesting that assessment is necessary in response to mechanical loading in the records of mechanical examination as well as more cases. And mini-plate is too valuable to be spoiled because of its fracture. We should define a reason that benefits which use mini-plates in these cases are justified, as use of mini-plate did not lead to unsatisfactory results in these cases. Indeed, it has been indicated to possess an ability to make fixation without any functional disorders and any infections as shown also in our cases. Two or more mini-plates seem to be indispensable to a bony fixation in mandibular osteomyelitis. Kameyama et al[5]. described that longitudinal strain of the mini-plate was small in the use of two

mini-plates in mechanical experiments. It may increase an ability of rigid fixation and achieve rehabilitation in even case which has a risk of fibrosis or dehiscence between the bone ends, if mini-plate strengthened at rim of the hole would be applied.

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抄録：ミニ-プレートの破折

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ミニ-プレートの破折が，下顎骨離断術後の骨移植症例と慢性下顎骨骨髄炎の治療後の症例で認められた．これらのことから，ミニ-プレートの有用性は，固定や再建のために付与した形態や使用枚数によって評価されることが認識された．