Clinical Note

Intermaxillary Fixation of Mandibular Fractures using a Bilayer Thermoforming Plate

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Abstract: Mandibular fractures have a high incidence among maxillofacial fractures. Intermaxillary fixation (IMF) is used to treat mandibular fractures and one common procedure involves fixation using steel wire and a splint (wire fixation). This wire fixation offers strong fixing force, but often requires in-hospital management for potential response to the complications such as vomiting. Other difficulties include invasiveness to the patient and the large burden placed on the surgeon during wire fixation. We had been performing IMF using a bilayer thermoforming plate (BTP), and we have good results. This type of IMF employs a bite plate that reproduces the occlusal pattern prior to injury on the basis of models of the maxilla and mandible, and it can be detached on its own. Sufficient fixation was achieved during IMF without bone separation or occlusal deviation. IMF using a removable BTP might be a treatment option that prevents a decrease in quality of life and allows well-maintained oral hygiene without lowering the quality of meals.

Key words: Mandibular fractures, Intermaxillary fixation, Bilayer thermoforming plate, Bite plate

Introduction

Mandibular fractures have a high incidence among maxillofacial fractures. Intermaxillary fixation (IMF) is used to treat mandibular fractures and one common procedure involves fixation using wire fixation^{1,2)}. This wire fixation offers strong fixing force, but often requires in-hospital management for potential response to the complications such as vomiting³⁾. Other difficulties include invasiveness to the patient and the large burden placed on the surgeon during wire fixation⁴⁾.

To address these issues, our department has been performing IMF using bilayer thermoforming plate (BTP)⁵⁾. This type of IMF employs a bite plate that reproduces the occlusal pattern prior to injury on the basis of models of maxilla and mandible⁶⁾. We report our experience of 26 patients who underwent IMF using a BTP together with a discussion of the literature.

Materials and Methods

Subjects

The subjects were 94 patients diagnosed with mandibular fractures after consulting our department during the two years and 11 months from January 2014 to November 2016. After excluding patients indicated for open reduction and internal fixation from among these 94 patients, we ultimately examined 26 patients indicated for treatment involving IMF alone (16 men and 10 women; mean age: 38.3 ± 3 [range: 6–70] years).

Methods

We evaluated patients who had undergone IMF using a BTP for

achievement of sufficient IMF and maintenance of factors such as feeding and oral hygienic management during IMF.

Preparing the BTP

A BTP is composed of a two-layer structure including an external hard surface and internal soft surface. Because the internal surface is soft, as a feature, an area extending beyond the maximum bulge portion of the tooth is covered by the plate. This is experience to provide strong IMF because a larger area is covered by the plate. The plate is also self-detachable when needed. This allows a patient to remove the BTP for meals even during the IMF period and also facilitates, which can be difficult in the condition of wire fixation (Fig. 1).

IMF using a BTP

An impression of the maxilla and mandible is taken and the occlusal position that should be fixed is confirmed on a plaster model. Thereafter, maxilla and mandibular plates are created using thermoplastic resin. The maxilla and mandibular plates are fixed and worn by the patient in the confirmed occlusal position. At this point, the occlusal position can be guided towards the position that should be reduced in accordance to the soft internal plate, even in patients with slight occlusal deviation.

Successful reduction of the occlusal position is confirmed once the patient is wearing the BTP and the patient is instructed to wear the plate all day except during feeding and oral cleaning.

Representative cases

In case 1, A 25-year-old woman sustained an injury when she fell over while riding a bicycle. The following day, she visited her local plastic surgery clinic and was informed that she had fractures of the left mandibular condyle and body of the mandible. She was subsequently referred to our department. Subcutaneous blood spots and swelling were

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Figure 1. Pictures of BTP
Left: BTP mounted on plaster model. Right: Inside of BTP.

Figure 3. Intraoral photographs taken while wearing the BTP and after one month after treatment in Case 1
Left: The intraoral picture of the treated mandible using a BTP preformed with a model.
Right: Intraoral picture one month after treatment. No occlusal deviation was visible. Moreover, no gingival redness and swelling or exacerbation of periodontitis were apparent.

Figure 4. Initial findings in Case 2
A, B: (A) Facial photograph of the first visit. (B) No occlusal deviation was visible in intraoral findings.
C: Panoramic radiograph taken at the initial examination. A fracture line was visible in the left mandibular condyle (white circle).
D: CT taken during the initial examination. A fracture was visible in the left mandibular condyle (white circle), similar to the panoramic radiograph.

visible in the injured chin, but the facial features were symmetrical. Panoramic radiograph and computed tomography (CT) revealed fractures of the left condylar process and body of the mandible (Fig. 2). An intraoral examination revealed no obvious occlusal deviation and she was indicated for non-invasive fixation.

Fixation was done with IMF using a BTP, which was worn for two weeks. She was instructed to wear the BTP all day during the IMF period except for during feeding and oral cleaning.

A re-evaluation at one month after injury also showed no occlusal deviation or separation of the fracture line. She was also capable of opening her mouth during oral cleaning, indicating no exacerbation of periodontitis and well-maintained oral hygiene (Fig. 3).

In case 2, A 70-year-old woman sustained an injury when she fell

Figure 2. Initial findings in Case 1
A: Photograph of occlusion during the initial examination. No occlusal deviation is visible.
B: Panoramic radiograph taken during the initial examination. A fracture line is visible in the left mandibular condyle (white circle).
C, D: (C) CT taken during the initial examination. A fracture line that was indistinct on panoramic radiograph is visible in the body of the mandible (white circle). (D) A fracture line is visible in the left mandibular condyle (white circle).

Figure 5. Intraoral photograph and panoramic radiograph taken one month after injury in Case 2
Left: No occlusal deviation is visible. Moreover, no gingival redness and swelling or exacerbation of periodontitis were apparent.
Right: The panoramic picture showed the remodeling (or healing) of the fractured bone at the left condylar head.

down some stairs. She visited her local emergency medicine department on the same day and was informed of a fracture to the left mandibular condyle. She was subsequently referred to our department on the following day. Panoramic radiograph and CT revealed a fracture to the left temporomandibular condyle (Fig. 4). An intraoral examination revealed no occlusal deviation and she was indicated for non-invasive fixation.

Fixation was done with IMF using a BTP, which was worn for two weeks. She was instructed to wear the BTP all day during the IMF period except for during feeding and oral cleaning.

A re-evaluation at one month after injury also showed no occlusal deviation or separation of the fracture line on panoramic radiograph. She was also capable of opening her mouth, indicating no exacerbation of periodontitis and well-maintained oral hygiene (Fig. 5).

Results

Evaluation of IMF treatment using a BTP

All 26 patients examined in this study, including the two patients in the representative cases, were possible to wear the BTP all day. All patients evaluation after two weeks of fixation showed no occlusal deviation or dehiscence of the fracture line, so patients was instructed to wear the BTP only at night for one week. All cases had inadequate maintenance force including detachment of the fixation appliance and mouth-opening during sleep and IMF was well-maintained unless the patients removed the plate by themselves for feeding and other oral activities. Furthermore, all the patients were able to receive treatment at an outpatient clinic and consume meals of a soft vegetarian diet and had good oral hygiene. IMF was also successful and no separation of

the fracture line or occlusal deviation was seen. There were no cases of prolonged treatment, and there were no cases requiring retreatment.

Discussion

A variety of fixation methods are generally used in IMF for mandibular fractures^{1,2}). An in-hospital management system is recommended for potential emergency responses to nausea and vomiting as complications of IMF. In-hospital treatment is therefore required during the IMF period, which disrupts the social lives of patients.

By contrast, IMF using a BTP allows self-detachment of the plate, which allows patients to remove the fixation appliance by themselves in an emergency and receive treatment at home. This results in less disruption to social life during the IMF period⁵).

Falci *et al.*⁷) described concerns including the prolonged duration of IMF surgery, and deterioration of oral hygiene as a result of IMF exacerbate periodontitis, difficulties in nutrition management due to feeding restrictions, and needle puncture accidents during wire fixation. By contrast, IMF using a BTP is less invasive to patients because only an impression is taken, and results in no needle puncture accidents because no wire is used. Furthermore, the IMF is self-detachable, which allows patients to remove the fixation appliance to eat. Oral hygiene, which is difficult to maintain IMF, was also well-maintained in all the patients examined in this study.

The drawbacks of IMF using a BTP include poor maintenance force in the teeth acting as fixation anchors and inadequate fixation^{5,6}). However, none of the patients in this study had inadequate maintenance force including detachment of the fixation appliance and mouth-opening during sleep and IMF was well-maintained unless the patients removed the plate by themselves for feeding and other oral activities. Moreover, sufficient fixation was achieved without separation at the fracture site or an increase in occlusal deviation.

IMF using a BTP is not indicated for patients with few teeth or patients requiring major reduction. However, sufficient fixation force can be achieved in patients with a large number of remaining teeth who require IMF alone and in patients who require minor reduction. Moreover, because the fixation appliance is easy for patients to remove by themselves, oral hygiene can be well-maintained on an outpatient basis and quality of life is not significantly decreased because patients

can open their mouths to eat. This suggests that IMF using a BTP is useful in selected patients.

Moving forward, we plan to investigate the use of BTP in open reduction and internal fixation by taking advantage of the easy removability of IMF appliances using a BTP. We will confirm the occlusal pattern using a BTP in a conventional bite plate to verify the intraoperative occlusal position and will use this BTP as is in postoperative IMF. This should allow safe perioperative airway management due to the easy removability of the IMF appliance.

Conflict of Interest

The authors have declared no conflict of interest.

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