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Case report

An intraoral approach to minimize morbidity in a pediatric trauma case

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ABSTRACT

Background: *Maxillofacial fractures are rare in children. The treatment of fractures in children differs from that of adults due to the growth process of the jaw and dental development. The intraoral approach does not result in facial scars or nerve injury. Furthermore, it allows direct visualization of occlusion confirmation during the plate placement.* ***Purpose:*** *This case report describes a pediatric comminuted mandibular fracture that underwent open reduction with an intraoral approach.* ***Case:*** *A 13-year-old boy with a mandibular fracture was referred by the neurosurgery department. Clinical examination found a hematoma in the left submental region and discontinuity of the mandibular symphysis without a wound in the extraoral region. Coleman's sign and a vertical step between teeth 41 and 31 and teeth 33 and 34 with anterior open bite were found intraorally. A CT scan disclosed more than two fracture lines that involved the mandibular symphysis and a basal triangle fracture. The patient was diagnosed with a symphysis mandibular comminuted fracture with open bite malocclusion.* ***Case management:*** *Open reduction and reconstruction plate placement with an intraoral approach was performed under general anesthesia. The patient had no complaints during the two-month evaluation, and the plate was planned for removal in the third month postoperatively.* ***Conclusion:*** *In this case, open reduction with an intraoral approach was able to restore bone architecture without functional or aesthetic complications. This may be because the patient could be treated like an adult, as he had almost reached skeletal maturity due to his age. However, periodic observation is necessary to evaluate jaw growth.*

Keywords: *aesthetic; comminuted; intraoral approach; pediatric mandibular fracture*
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INTRODUCTION

Maxillofacial fractures in the pediatric age group are relatively rare, occurring at 1–15% of all facial fractures in line with increasing age. It is recorded that 44.4% of pediatric facial fractures occur in the mandible.[1–3] Comminuted fractures of the mandible in pediatric patients are less common. Their rare occurrence may be because the facial bones in children are more resistant to fracture due to their highly elastic thick adipose layer and stabilization of the maxilla and mandible by tooth germs.[2,4–6] A comminuted fracture is defined as the presence of multiple, or more than two, fracture lines that produce small pieces of bone in the same mandibular area.[7]

Despite the low incidence of pediatric facial fractures, they are often associated with other serious injuries. Fractures and their treatment can have long-term consequences due to incomplete facial growth and development.[8,9] In a study conducted by Zhou et al.,[10] 10% of pediatric patients with maxillofacial fractures experienced complications such as facial asymmetry, poor fracture repair, infection, facial scars, and plate displacement. In contrast, a study conducted by Allred et al.[11] claimed that, in 204 cases of pediatric maxillofacial fractures, the complications of mandibular fracture cases occurred in 8.1% and consisted of displacement of condyle fractures, malocclusion (open bite), mental nerve injury, and infection. Complications of pediatric

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mandibular fractures include growth disturbance and facial asymmetry, occlusal discrepancy, and temporomandibular joint ankylosis, generally found in mandibular condyle fractures.[5,8,12,13]

The treatment of pediatric mandibular fractures remains debatable due to ongoing bone growth in the patient. Therefore, minimal manipulation of the facial skeleton is mandatory to prevent unwanted sequelae resulting in detrimental effects to continued growth.[6,14] The treatment of pediatric mandibular fractures includes a soft diet, inter-maxillary fixation using an eyelet or arch bar, and circum-mandibular wiring with acrylic occlusal splints.[5,14] Alternative treatments are available, such as open reduction through both intra- and extraoral approaches with microplate, miniplate, or resorbable plate placement. Open reduction is indicated in cases of severe displacement with significant mobility in single fractures or fractures in the anterior region with a combination of mandibular condyle fractures, which require rigid fixation, and in circumstances where it is not possible to perform closed reduction.[5,6,14,15]

The intraoral approach is a preferred alternative that is commonly used in non-comminuted mandibular fractures as it does not result in facial scarring and has little risk of facial nerve injury. It also provides direct visualization of the fracture fragments.[16] The indication for open reduction and rigid internal fixation (ORIF) in comminuted fractures is to achieve pre-traumatic anatomical relationships if there is significant displacement of the fragments. This case report was aimed at reporting the case of a pediatric comminuted fracture of the left mandibular symphysis that underwent open reduction with an intraoral approach.

CASE

A 13-year-old boy was referred by the Neurosurgery department at Prof. Dr. Margono Soekarjo Hospital for a mandibular fracture with a history of moderate brain injury and loss of consciousness. His family said the patient fell off a motorcycle while riding without a helmet. The patient was treated at a local hospital and then referred for further treatment. During treatment at the Neurosurgery department, the patient received an injection of ceftriaxone 1g, intravenous paracetamol 1g, and injection of ranitidine 50mg. During the treatment, the patient experienced one seizure and received phenytoin. The patient was transferred to Oral Surgery for further treatment of his mandibular fracture.

On subjective examination prior to surgery, the patient complained about dizziness and pain in the left lower jaw. Clinical examination found the patient to be in good general condition, with a GCS of 15. The extraoral examination found edema and hematoma in the submental area of the left mandible and the presence of mandibular bone discontinuity in the symphyseal and parasymphyseal areas of the left mandible. It also identified tenderness without a visible wound in the extraoral area. In addition, there was a Battle Sign at the left mastoid process (Figure 1). Intraoral examination revealed a hematoma in the sublingual area (Colman's sign), vertical steps between teeth 31 and 41, and teeth 33 and 34, segment mobility of teeth 31, 32, and 33, and the patient could not bite well (Figure 2). Malocclusion, an open bite in the anterior mandible, was also found. As the patient is underage, his parents agreed that his case could be published for scientific purposes.

Figure 1. Preoperative extraoral clinical photographs.

Figure 2. Preoperative intraoral clinical photographs.

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On examination, a computed tomography three-dimensional scan (CT3D) found a comminuted fracture of the left mandibular symphysis along with an epidural hematoma (EDH) on the left temporal. Comminuted fractures are described by the presence of more than two fracture lines in the region of the mandibular symphysis to the parasymphysis of the left mandible with a basal triangle fracture in the mandibular symphysis along with an EDH image in the left temporal region (Figure 3). The patient was diagnosed with a comminuted fracture of the left mandibular symphysis with open bite malocclusion and moderate brain injury.

CASE MANAGEMENT

The patient underwent ORIF with a 2.4 mm plate locking system for reconstruction using an intraoral approach (Figure 4). The surgery was performed under general anesthesia. Before the incision, 2% lidocaine with 1:200,000 adrenaline was injected at the vestibule of the anterior region of the mandible to provide a local vasoconstriction effect. A horizontal incision was made on the anterior labial vestibule, approximately 5 mm inferior to the mucogingival junction (Figure 4A). The mucoperiosteal flap was removed to expose multiple oblique fracture lines among teeth 31,

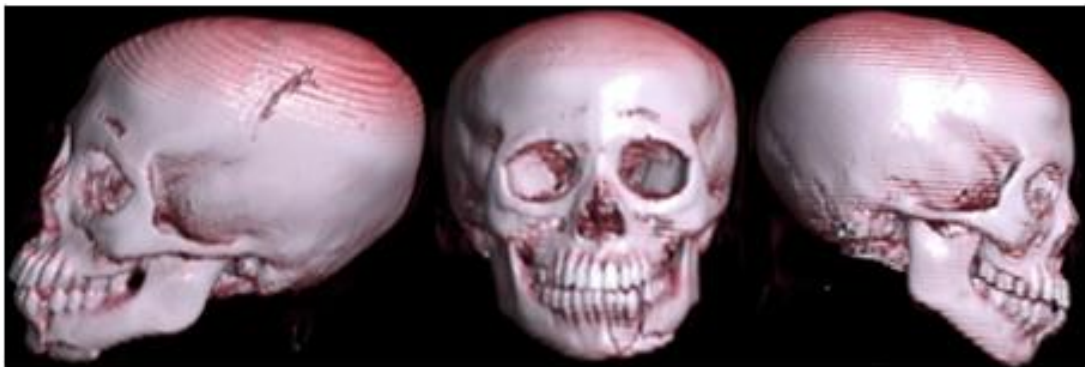

Figure 3. Preoperative 3D computed tomography radiographs.

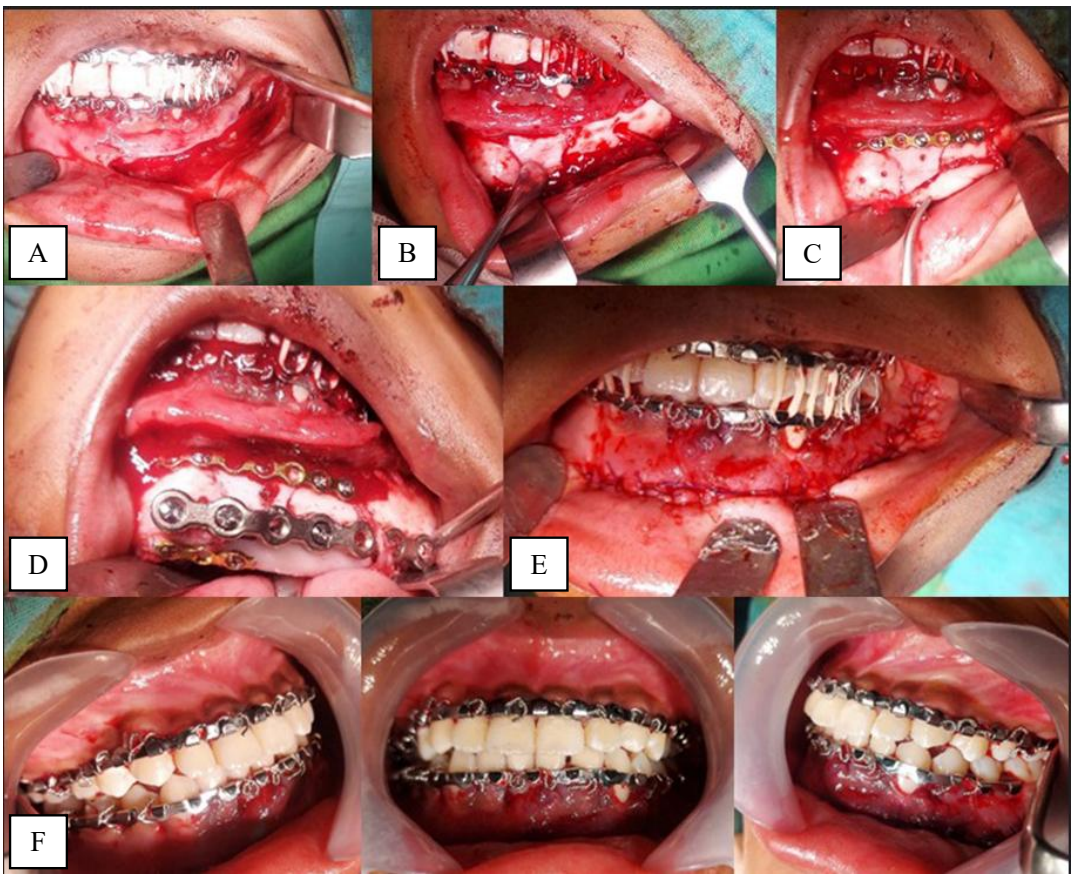

Figure 4. The course of surgery: A) Intraoral incision, B) Fracture fragment condition, C) Simplification of fracture fragments with 2.0 miniplate, D) Reconstruction plate placement, E) Flap closure, and F) Post-operative occlusion condition.

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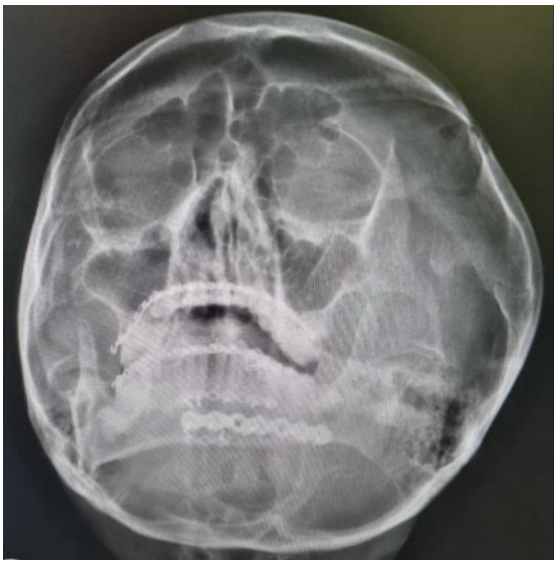

Figure 5. Post-operative Water's radiograph.

41, 33 and 34. There was a horizontal fracture line above the basal triangle fracture at the mandibular symphysis region.

Prior to reducing the fracture fragments, interdental wiring using an Erich arch bar was installed, and the installation of an intermaxillary fixation (IMF) was continued until occlusion was achieved on the buccal surface of the apical region of the tooth root. Subsequently, a 7-hole miniplate with 2.0 mm and 6 mm monocortical screws for simplifying the fracture fragments was adapted, then the reconstruction plate was attached to the inferior border of the mandible at the symphysis and parasymphysis of the left mandible with five bicortical screws (2.4 mm x 12 mm) (Figure 4D). The small bone fragments at the inferior margo region of the mandible were reduced and fixed with a 2.0 mm 3-hole miniplate system and two 8 mm screws to help to fix the fracture fragments. A two-layer suture was performed using catgut 3.0 thread, and IMF was removed before extubating the patient.

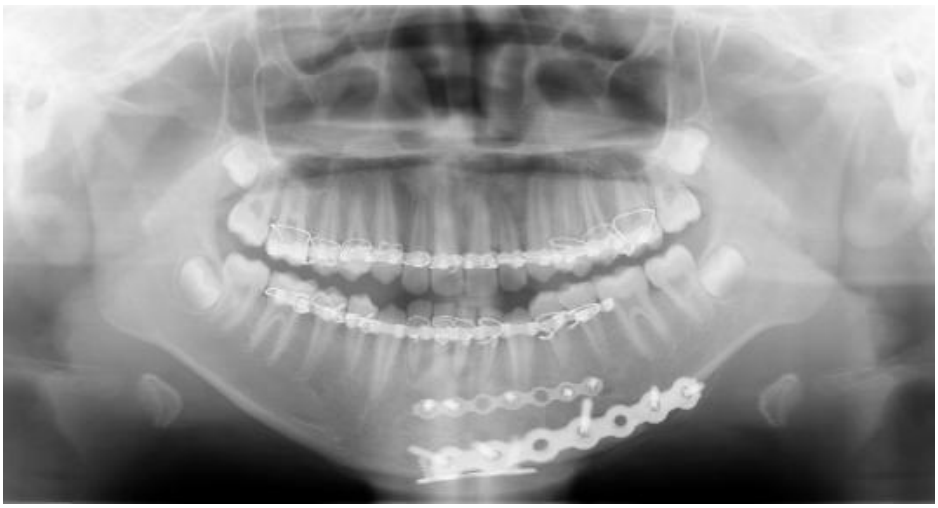

Figure 6. Panoramic radiograph two months postoperatively.

Figure 7. Extraoral photographs two months postoperatively.

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Figure 8. Extraoral photographs 2 months postoperatively.

The patient received an injection of ceftriaxone 1g/12 h, ketorolac 30 mg/8 h, ranitidine 50 mg/12 h, and dexamethasone 5 mg/12 h. The patient was allowed to have a peroral liquid diet after surgery. Water's radiographic examination was performed two days after surgery, and the patient was discharged from the hospital. Radiographic examination showed fairly accurate fragment reduction (Figure 5). The seven-day postoperative evaluation displayed good soft tissue healing, but the patient experienced bite problems. Therefore, an IMW using elastic traction was installed and utilized for two weeks. The occlusion was restored without causing a defect in the facial region.

The patient underwent routine follow-ups, and four weeks postoperatively, good bone and soft tissue healing had occurred, so the interdental wiring (arch bar) was removed. The panoramic radiographic examination (Figure 6) revealed no signs of infection or bone necrosis; neither was nonunion by the clinical examination. After two months of postoperative control, the patient had no complaints or mobility of the fracture fragments, and his face appeared symmetrical (Figures 7 and 8). The patient was scheduled for plate removal at three months postoperatively but failed to show up for the appointment.

DISCUSSION

Maxillofacial fractures in the pediatric age group are relatively rare, occurring at 1–15% of all facial fractures, with mandibular fractures being the most common facial fractures. Particularly in pediatric facial fractures, 44.4% occur in the mandible.[1,2] In children, mandibular symphysis fractures are rarely displaced and comminuted because the bone is relatively elastic, the presence of tooth germs holds or glues the fragments, and the adipose tissue is relatively thick in the maxillofacial region.[5,17] Increasing along with school age and peaks in puberty and adolescence, such fractures are more common in males than females worldwide, as they are in all age groups. Mandibular fractures are the most frequent in the condyle region, followed by the symphysis, mandibular angle, and mandibular body.[18,19]

The treatment of pediatric mandibular fractures differs from that of adults due to incomplete jaw growth and dental development. Factors that contribute to increasing the complications of mandibular fracture and growth treatment include the smaller size of the mandible, the presence of bony growth centers, and dense deciduous dentition with permanent tooth germs located adjacent to the mandibular and mental nerve.[19] The mandibular growth center is important for maintaining mandibular function and has a significant influence on future facial development. Therefore, restoration of mandibular continuity following a fracture is important for the sake of function and craniofacial development.[19,20]

The treatment of pediatric mandibular fractures remains debatable due to the ongoing growth of children. If without displacement and malocclusion, greenstick fractures only require close observation, a liquid/soft diet, and restriction of physical activity. It is highly recommended that conservative treatment with closed reduction for greenstick fractures or fractures with mild displacement be performed. Closed reduction and immobilization can be done with acrylic splints, circumferential wiring, and an arch bar or gunning splints.[14,19,21] The current standard of treatment in fractures with significant displacement is ORIF, but the use of open reduction in children is still controversial given that the effect of implanted hardware on the mandible of growing children is not fully known. Therefore, ORIF in children should be carefully considered and only if reduction and fixation by other methods cannot be done well.[2,13,16,19,20] In children who are 12 years and older, following the eruption of permanent teeth and mature root formation, the treatment can be the same as in adults.[13,21] Some techniques may work better than others, but none can be recommended for all situations.

Minimal manipulation of the facial skeleton is mandatory to prevent unwanted sequelae.[6,14] In the presented case, open reduction was chosen, given that there was displacement and mobility of the fragments, leading to impaired occlusion. Chrcanovic[22] states that there is an indication for open reduction to be performed in comminuted fractures in severe injuries with significant displacement, in edentulous and partially edentulous patients with unstable occlusion, and in cases of multiple midface fractures that use the mandible as a guide for repositioning the fracture.

Open reduction alone provides numerous advantages, such as primary healing, three-dimensional stability, and

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shorter treatment time, but it stimulates the risk of tooth germs developmental injury and growth disturbance.[23,24] When ORIF is the treatment of choice in children, the plate is placed at the inferior border of the mandible to avoid injury to the tooth germ.[2,13,21] This case involved a 13-year-old patient whose permanent teeth in the mandibular symphysis and parasymphysis had erupted completely; therefore, there was no fear of injury to tooth germs during ORIF.[25] This age group is more likely to be treated as adults because growth disturbance rarely occurs as the mandible is almost fully matured, with minimal subsequent growth.[13,25]

Plate reconstruction was used because it is capable of bridging and stabilizing the comminuted gap between the proximal and distal segments. The use of load-bearing osteosynthesis in the comminuted area can prevent secondary infection and movement between fracture fragments.[26] Chrcanovic[22] concludes that the use of ORIF in cases of mandibular comminuted fractures produced good results with the use of load-bearing osteosynthesis; because of this, a reconstruction plate with load-bearing osteosynthesis properties was used in this case.

Case reports on comminuted mandibular fractures in pediatric patients are limited. The authors only found two case reports of comminuted mandibular fractures in children. First, Sharma et al.[14] reported a case of comminuted fracture of the angle to the left mandibular ramus and fracture of the right mandibular parasymphysis in a seven-year-old child who underwent ORIF using a 1.5 mm titanium plate, which resulted in occlusion and mouth opening, as well as good wound healing. Sharma et al.[14] recommend open reduction in cases of displaced mandibular fractures because it can provide primary healing, three-dimensional stabilization, and shorten treatment time. Second, de Carvalho et al.[27] reported ORIF using a miniplate for the treatment of comminuted mandible in a three-year-old child. Sheta et al.[28] suggest the use of a smaller plate in pediatric patients due to the smaller torsional force on the fracture segment. There has been no consensus on the type of fixation used.[28]

Intraoral access was chosen because this approach results in no facial scarring, has little risk of facial nerve injury, and provides direct visualization of the fracture fragments.[16] In addition, pediatric mandibular fracture treatment is aimed at restoring the bone structure to its pre-injury state with minimally invasive procedures and minimal aesthetic and functional disability, suggesting an intraoral approach is preferred.[4,14,19] The intraoral approach also provides room for the surgeons to allow direct visualization and confirmation of the desired occlusion during plate placement.[16,29]

The long-term management of maxillofacial plates in pediatric patients is still controversial, even when the patient is 13 years old. Some experts recommended routine removal, while others suggested removal was done only if there was a clinical indication.[20,25] Plate removal problems in pediatric patients have often been overlooked despite a number of researchers recommending plate removal two to six months postoperatively to minimize the potential for impaired growth and development.[6,21,25]

In the two months after surgery, the patient had no complaints, pre-traumatic occlusion was achieved, the face was symmetrical, and the wound was healing well. In this case, the patient could be treated like an adult because he had almost reached skeletal maturity; however, as the mandible had not finished growing, long-term evaluation was important. The plate was planned for removal by three months postoperatively to prevent possible impaired growth because skeletal maturity in the maxilla and mandible is reached at the age of 14–16 years in women and 16–18 years in men. The mandible is the last facial bone to mature, making it prone to have minimally impaired growth associated with trauma in the long term.[21] However, the patient did not present for further assessment, so long-term evaluation to see whether growth disturbances were present could not be carried out. This is a limitation of this case. Nevertheless, the patient and his family have been informed that if there are complaints related to occlusion or growth disorders, they can return for further evaluation.

In conclusion, in this case, open reduction with an intraoral approach was able to restore bone architecture without functional and aesthetic complications. This may be due to the age of this patient, who had almost reached skeletal maturity and could, therefore, be treated as an adult would. However, periodic observation is necessary to evaluate jaw growth.

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