

Dilemma in pediatric mandible fractures: resorbable or metallic plates?

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ABSTRACT

BACKGROUND: The aim of this study was to compare the efficiency of resorbable and metallic plates in open reduction and internal fixation of mandible fractures in children.

METHODS: Thirty-one patients (mean age, 8.05 years; range 20 months-14 years) were operated on various fractures of the mandible (26 [60.4%] symphysis- parasymphysis, 12 [27.9%] condylar-subcondylar fractures, 5 [11.6%] angulus and ramus fractures). Twelve patients were treated with resorbable plates and 19 patients with metallic plates. Mean follow-up time was 41 months (11–74 months) in the metallic hardware group and was 22 months (8–35 months) in the resorbable plate group. Both groups were investigated for primary bone healing, complications, number of operations, and mandibular growth. The results were discussed below.

RESULTS: Both groups demonstrated primary bone healing. Minor complications were similar in both groups. The metallic group involved secondary operations for plate removal. Mandibular growth was satisfactory in both groups.

CONCLUSION: Resorbable plates cost more than the metallic ones; however, when the secondary operations are included in the total cost, resorbable plates were favourable. As mandibular growth and complication parameters are similar in both groups, resorbable plates are favored due to avoidance of potential odontogenic injury, elimination of long-term foreign body retention and provision of adequate stability for rapid bone healing. However, learning curve and concerns for decreased stability against heavy forces of mastication accompanied with the resorbable plates when compared to the metallic ones should be kept in mind.

Key words: Mandibular fractures; metallic plates; resorbable plates.

INTRODUCTION

Management of pediatric mandible fracture is substantially different from adult injuries. Evaluation and approach of pediatric mandibular fractures require several issues to be considered. Presence of tooth buds and potential injury to future growth are among the issues complicating management.^[1–4] Duration of the operation, general anesthesia, and type of

the hardware are all the factors taken into consideration.

Majority of pediatric mandibular fractures can be managed with closed techniques using short periods of maxillomandibular fixation or training elastics alone.^[5] Performing open reduction and internal fixation of mandibular fractures in pediatric patients may not always be necessary. Lingual splints have been used successfully for pediatric mandibular fractures.^[6–8] It is an effective and safe procedure in selected cases.^[9]

High osteogenic potential of pediatric mandible allows non-surgical management to be successful in younger patients with conservative approaches.^[10] Maxillofacial surgeons generally justify the use of plate- and screw-type internal fixation to be reserved for difficult fractures.^[5] Specific subsets of mandibular fractures, including displaced fractures of the body or angle, fractures of the condylar neck with significant barriers to movement, complex fractures, and fractures in non-toothbearing areas necessitate open reduction and internal fixation.^[11]

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The use of resorbable plates is an increasingly attractive option in the treatment of pediatric mandibular fractures.^[11] It is both well-tolerated and effective. It enables realignment and stable positioning of rapidly healing fracture segments while obviating any future issues secondary to long-term metal retention (Fig. 1).^[12]

Major concerns for using resorbable materials in the maxillo-facial region are the strength of the material and its ability to withstand masticatory forces, and the extent of inflammation as the materials begin to degrade.^[13]

We used both systems of metallic and resorbable hardware for fixation of pediatric mandible fractures. Limited number of cases and follow-up demonstrated no difference between the stability and healing capacity of the two systems. Resorbable materials have the advantage of avoidance of secondary removal operations. Limited number of long-term studies and high cost when compared to the metallic hardware are among the drawbacks of biodegradable systems. However, ongoing studies demonstrating the advantages of the resorbable plates indicate that they are going to be preferred more in the future.

MATERIALS AND METHODS

The study consisted of thirty-one pediatric mandible fracture cases arriving to our clinic between 2000 and 2011. Resorbable plates (2.0 mm PLLA/PGA Lactosorb system, Jacksonville, Florida, USA) were used in twelve patients (ages, 20 months-11 years; mean, 6.9 years) and metallic plates in nineteen (ages, 4-14 years; mean, 9.2 years). Follow up of the metallic plate group was 41 months (11-74 months) and of the resorbable

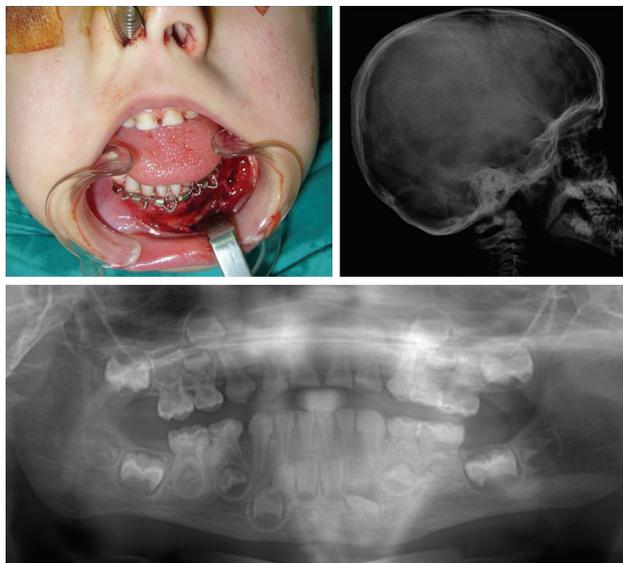


Figure 1. Upper left; Intraoperative view of the resorbable plate for fixation of parasymphysis fracture of the mandible in a 3-year-old patient. Upper right; A 1-year follow-up lateral craniography. Lower; A 1-year follow-up panoramic radiograph. Note the well-healed fracture sites.

plate group was 22 months (8-35 months). Both groups were compared according to infection rates, primary bone healing, mandibular growth and need for secondary surgery.

RESULTS

Thirty-one patients with 43 fractures of the mandible were enrolled in the study. Patient age ranged from 20 months to 14 years with a mean of 8.05 years. Fractures included 26 (60.4%) symphysis-parasymphysis fractures, 12 (27.9%) condylar-subcondylar fractures, and 5 (11.6%) angulus and ramus fractures. Metallic plates and screws were used in nineteen (62.7%) patients with 27 fractures and resorbable plates and screws in twelve (37.2%) patients with 16 fractures. Intermaxillar fixation were used in nine patients with metallic plates and in six patients with resorbable plates.

Fracture Union

No mobility in any fracture site was noted in either groups at the follow-up period. Follow-up was 41 months (11-74 months) in the metallic plate group and 22 months (8-35 months) in the resorbable plate group. There was no facial asymmetry in both groups in the follow-up period (Figs 2, 3).

Infection

Two of the 19 patients with metallic hardware demonstrated clinical signs of infection. One of the two responded well to oral antibiotherapy. However, the other one developed a submental fistula and recieved drainage and incision and finally plate removal at the postoperative 13th week. No infection was noted at the resorbable plate group. One patient with resorbable plate demonstrated granuloma formation at the subcutaneous tissue in the 4th postoperative month, which was excised with local anesthesia.

Malunion

Minor occlusal deformity was noted in one patient at the second week control which was corrected by an additional one-week use of light guiding elastics. The parasymphysis fracture of the patient was reconstructed with metallic hardware.

Revisional Surgery

There was no need for revisional surgery for fracture healing



Figure 2. Left; Two resorbable plates for a parasymphysis and symphysis fractures of the mandible in a 4-year-old patient. Right; An 18-month follow-up radiograph showing fracture alignment.

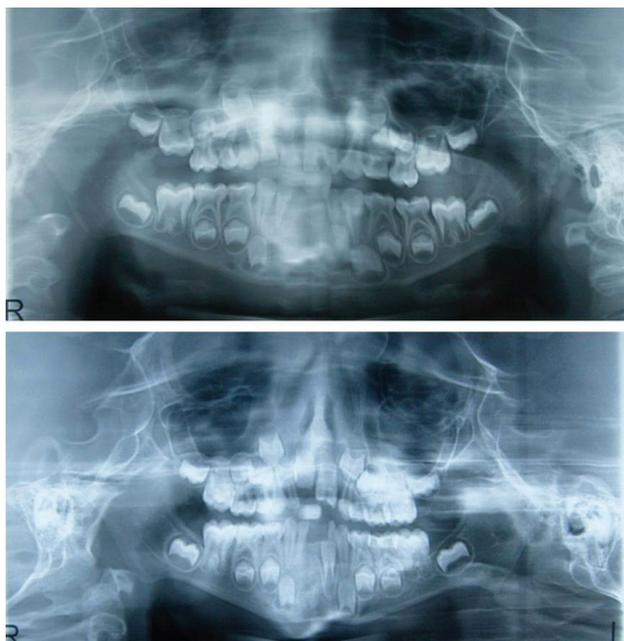


Figure 3. Upper; A 4-month follow-up of a symphysis-parasymphysis fracture with screw sites visible on panoramic radiograph. Lower; The screw sites are healed with less visible holes after a total of 9-month follow-up.

in both groups. Fistula that developed after infection in one patient was excised and sutured. Granuloma formation was excised in the resorbable plate group.

Pain

One patient with symphysis fracture and metallic plate demonstrated discomfort due to mild pain with plate feeling under the skin.

DISCUSSION

Diagnosis and management of mandible fractures in the pediatric patient population can pose multiple challenges to the oral and maxillofacial surgeon.^[14] There are some principles that must be addressed when dealing with pediatric mandible fractures. Pediatric mandible is a dynamic structure that undergoes significant changes during development. In order to avoid undesirable outcomes, management of mandibular trauma requires knowledge of these changes over time.^[15] Presence of multiple tooth buds throughout the substance of the mandible as well as the potential injury to future growth complicate the management of these fractures.^[1] One of the main principles is to use the least amount of foreign material.^[16] The use of rigid fixation in children is controversial and may cause growth retardation along cranial suture lines. Conservative approaches with non-surgical management may be successful in pediatric population due to the high osteogenic potential in this population.^[10] Children demonstrate a good healing capacity. These younger patients have the potential for restitutional remodeling, as opposed to sclerotic, functional remodeling seen in adults.^[1] The majority of pediatric

mandibular fractures can be managed with closed techniques using short periods of maxillomandibular fixation or training elastics alone. Generally, the use of plate- and screw-type internal fixation is reserved for difficult fractures.^[5] Lingual splint has been reported for the reduction, stabilization and fixation of a mandibular body fracture with a successful result.^[9]

Pediatric mandible fractures, which are seen less frequently compared to those of adults, require a specific and different treatment. Although less invasive methods are preferred mostly, internal fixation with open reduction should be considered when required.^[17] Rigid fixation of mandibular fractures results in a faster bone healing, both by compression and lack of mobility between fracture segments.^[18-23] Smartt et al. have demonstrated that open reduction and internal fixation, when used judiciously, are indispensable in the treatment of specific subsets of mandibular fractures, including displaced fractures of the body or angle, fractures of the condylar neck with significant barriers to movement, complex fractures, and fractures in non-toothbearing areas. Open reduction should be performed cautiously, with minimal manipulation of overlying soft tissues. When performed properly, it is a safe and versatile treatment modality.^[11]

Metal plate-screw systems enable adequate fixation in bone healing process. Yet, their effects like limiting bone growth especially in pediatric age group have prompted investigators to look for alternative fixation materials in the reconstruction of trauma and craniofacial anomalies.^[24,25]

The ideal fixation system for stabilisation of an osteotomy or bone fracture would provide adequate strength initially to permit bone healing during function, and then, decrease in strength so that there is increasing physiological force transference to the bone. Biodegradable polymers can provide that while metals cannot.^[13]

The most attractive characteristic of resorbable plates is that they obviate any potential impediments to long-term metal retention. They enable realignment and stable positioning of rapidly healing fracture segments. They are also quite well tolerated in this population.^[14] Yerit et al. have demonstrated advantages of resorbable materials in pediatric patients especially by faster mobilization and the avoidance of secondary removal operations. Primary healing of the fractured mandible was observed in all of the thirteen patients, and malocclusion and growth restrictions did not occur.^[26] Titanium plates need to be removed; whereas, resorbable plates do not. Resorbable plates are radiolucent and allow full visualization of the fractures on postoperative radiographs.^[23] They provide proper strength, and then, harmlessly degrade over time, until the load can be safely transferred to the healed bone. As there is no need for a removal operation, these biodegradable devices reduce the total treatment and rehabilitation time of the patient. Besides, they reduce costs related to this type of trauma.^[23]

The use of resorbable plates and screws for fixation of pediatric facial fractures is both well tolerated and effective. It enables realignment and stable positioning of rapidly healing fracture segments while obviating any future issues to long-term metal retention.^[12]

Mandibular growth is not affected as demonstrated by the present and several other studies.^[23] Complication rates are comparable with nonresorbable plate fixation.

As we are experienced more with the use of resorbable hardware, we observed that the fixation strength of the resorbable hardware is not as powerful as that of the metallic hardware. Our first cases were reconstructed with 2-mm resorbable plates. It may be difficult to place the plates of this thickness in children younger than 5 years of age. It is also quite difficult to place the plates beneath the nerve in cases of parasymphysis fractures. Usually, there is not enough place for two plates. We hesitated using 1.5 mm plates, but there are examples of its usage in the literature.^[12]

Muscle activity in mandibular ramus is considerable,^[13] and it is better to advise the patients to be cautious while chewing, especially in the first 4 weeks. Children's adaptability to masticatory function increases with the development.^[27] Due to traumatic stress and pain, children usually adapt to soft diet better than adults. We did not offer a different diet to patients with the resorbable hardware. Both groups followed the same principles postoperatively. However, if concerns about resorbable plate stability occurs, some precautions can be taken; additional intermaxillary fixation to open reduction, prolongation of soft diet regimen, and/or more visits postoperatively to earlier detection of the plate instability.

It is not faulty to say that we use resorbable plates to make unfavorable fractures favorable and keep the fracture edges in proper position. This is a kind of conservative approach, that is, we are in between a rigid fixation with metallic plates and maxillomandibular fixation alone.

The pediatric patient's ability to heal and recovery of function are much better compared to adults. Despite these advantages, certain unique characteristics should be appreciated.^[12] With a meticulous approach to these patients, final success is not so far away. The dilemma of pediatric mandible fractures is to choose the right therapy with the right hardware. Resorbable plates have been favoured in our clinic since we began to use them. We believe that with more studies performed in the future, resorbable plates will be preferred more than metallic plates and will be the first line in treatment of rigid fixation of mandibular fractures in the pediatric population.

Conflict of interest: None declared.

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ORJİNAL ÇALIŞMA - ÖZET

Pedriatrik mandibula kırıklarındaki ikilem: Eriyen plaklar mı yoksa metal plaklar mı?

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AMAÇ: Bu çalışmanın amacı çocuklardaki açık redüksiyon ve internal fiksasyon ile tedavi edilen mandibula kırıklarında, emilebilen ve metal plakların etkinliğini karşılaştırmaktır.

GEREÇ VE YÖNTEM: Yaşları 20 ay-14 yıl (ortalama 8.05 yıl) arasında değişen 31 hasta mandibulanın farklı yerlerindeki kırıklar nedeniyle ameliyat edildi (26 [%60.4] simfisiz-parasimisiz, 12 [%27.9] kondil-subkondil, 5 [%11.6] angulus ve ramus). On iki hasta eriyen plaklarla, 19 hasta ise metal plaklarla (titanyum) tedavi edildi. Ortalama takip süresi metal donanım kullanılan grupta 41 ay (11–74 ay), eriyen plak kullanılan grupta ise 22 ay'dı (8–35 ay). Her iki grup primer kemik iyileşmesi, komplikasyonlar, ameliyat sayısı ve mandibuladaki büyüme açısından incelendi. Bulgular aşağıda tartışıldı.

BULGULAR: Her iki grupta primer kemik iyileşmesi saptandı. Her iki gruptaki minör komplikasyonlar benzerdi. Metal donanım kullanılan grupta pak çıkartılması için ikinci operasyonlar gerçekleştirildi. Her iki gruptaki mandibula gelişimi tatmin ediciydi.

TARTIŞMA: Eriyen plaklar metal donanımlı plaklardan daha pahalı oldukları görüldü. İkinci operasyonların maliyeti göz önünde bulundurulduğunda ise eriyen plaklar daha avantajlıydı. Mandibula büyümesi ve komplikasyon parametreleri heriki grupta benzer olduğundan, eriyen plaklar; olası diş hasarının önlenmesi, uzun süreli yabancı cisim varlığının olmaması ve hızlı kemik iyileşmesi için gerekli olan yeterli sabitlik sağlaması gibi hususlara bağlı olarak tercih edilmektedir. Buna rağmen, emilebilir plakların kullanılması hususunda bir öğrenme periyodunun gerekliliği ve metal plaklarla karşılaştırıldığında, çiğneme kaslarının karşıt gücüne karşı düşük sabitlik sağladıkları gibi endişeler akılda tutulmalıdır.

Anahtar sözcükler: Eriyen plaklar; mandibula kırıkları; metal plaklar.

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