The use of a single titanium microplate in displaced pediatric parasymphysial mandibular fractures

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Abstract  Objective: The objective of this study was to evaluate the use of one titanium microplate in the fixation of displaced pediatric parasymphysial mandibular fractures.

Materials and methods: The study was conducted on 7 children in the mixed dentition stage with displaced parasymphysial fracture. Patients' age ranged between 5 years 9 months and 8 years 4 months with an average of 7 years 1 month. Fractured bone segments were exposed, reduced and then fixed using 1.5 linear microplates at the inferior border of the mandible using monocortical screws, with 1.5 mm in diameter and 5 mm in length. Stainless steel wire was used as a tension band by ligating the teeth around the fracture line. Patients were followed up for occlusion and stability clinically and radiographically (panoramic X-ray and CT).

Results: According to clinical and radiographic post-operative follow-up, none of the patients showed displacement of the fixed bony segments.

Conclusion: The present study concluded that using one microplate with 1.5 monocortical microscrews and dental tension band by a stainless steel wire could be adequate for fixing displaced pediatric parasymphysial mandibular fractures. This technique has the following advantages: decreases the amount of titanium used, decreases the risk of injury of the roots and teeth buds, and decreases the cost and time of surgery.

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1. Introduction

Fractures of facial bones and mandible are uncommon in the pediatric age group compared to adults. The impact of craniofacial trauma in pediatric population is minimized due to the light weight and small size. The force of impact is absorbed by the forehead and the skull rather than the face since the ratio of cranial volume to facial volume is greater in children than adults (8:1 at birth, 4:1 at 5 years versus 2:1 in adults).
Besides, pediatric facial bones are more resistant to fractures due to their higher elasticity, poor pneumatization by sinuses, thick surrounding adipose tissue, and stabilization of the mandible and maxilla by the unerupted teeth (Eppley, 2005; Hardt and Gottsauner, 1993; Das et al., 2006; Haugrh, 2000; Martins et al., 2003).

Excluding the nasal bones, the mandible is the most frequently fractured facial bone in the pediatric patient. One third of pediatric trauma patients with facial fractures have a mandibular fracture (Eppley, 2005; Norholt et al., 1993). The treatment of pediatric mandibular fractures is controversial and complicated by many factors such as tooth eruption, short roots, developing tooth buds and growth, specially at the mixed dentition stage (Posnick et al., 1993; Davis et al., 2001).

Rigid fixation is a technique used in the management of facial fractures that has developed for more than 20 years. Used primarily in adults for proper restoration of three dimensional form and function, it has become the standard of care for adult facial trauma victims. However, use in children is somewhat controversial (Eppley, 2005; Martins et al., 2003; Oji, 1998).

Many studies have been done on infant animals showing that plate fixation across midfacial and cranial sutures lines may result in growth retardation along these suture lines. Since these studies were performed on infant animals with rapid facial growth patterns, it was difficult to draw firm conclusions with regard to human children. But these studies did highlight the fact that rigid fixation should be used cautiously in children and only if other means of reduction and fixation were not achievable. If proper reduction of facial fractures is not achievable by other means, rigid fixation should be performed because the alternative of improper correction is unacceptable (Eppley, 2005; McGuirt and Salisbury, 1987).

The goal of treatment should be an accurate, functional, aesthetic three-dimensional restoration of pre-injury form and function. If this requires rigid fixation with plating, then this must be done using monocortical screws at the inferior border of the mandible to avoid damaging the underlying teeth (Eppley, 2005; Hardt and Gottsauner, 1993; Martins et al., 2003; Davis et al., 2001; McGuirt and Salisbury, 1987).

The commonly used osteosynthesis techniques for the fixation of parasymphysial fractures is to use two miniplates, one at the inferior border of the mandible and the other is above it as a tension band to withstand the torsion forces in this area of the mandible.

The objective of the study was to evaluate the use of one titanium microplate in the fixation of displaced pediatric parasymphysial mandibular fractures.

2. Materials and methods

The study was conducted on 7 children (4 males and 3 females) diagnosed clinically and radiographically (panoramic X-ray and CT scan) to have displaced parasymphysial fractures which needed open reduction and fixation (Figs. 1 and 2). Patients were selected from the patients of Mansoura Dental College outpatients and Zagazig University Hospital patients during September 2004-August 2006. Cases that had any other line of fracture were excluded from the study. Patients’ age ranged between 5 years 9 months and 8 years 4 months with an average of 7 years 1 month. Fractured right parasymphysial side was recorded in 5 patients (3 males and 2 females) while in the left side was recorded in 2 patients (1 male and 1 female). The etiology of the fracture was a fall in 5 patients (4 males and 1 female) while car accident was the cause in 2 female patients (Fig. 3).
Under general anesthesia using naso-tracheal tube, a stainless steel wire was used as a tension band by ligating the teeth around the fracture line. Then through an intraoral incision, fractured bone segments were exposed, reduced and when proper occlusion was achieved, the reduced bony segments were fixed using one linear microplate at the inferior border of the mandible using monocortical screws of 1.5 mm in diameter and 5 mm in length. Four monocortical screws were used in each patient, 2 on each side of the fracture line (Fig. 4).

Relationship between upper and lower teeth (occlusion) was recorded while patients were still under the effect of general anesthesia. Then it was recorded again while the patients were in the recovery room after regaining their muscle tone.

Clinical follow-up for infection, extrusion, stability and the occlusion were conducted at 7, 14, 21 and 30 days post-operatively. Panoramic X-rays and CT scans were done for the patients immediately post-operatively and 3 months post-operatively (Figs. 5–7).

For radiographic evaluation of bone stability, a line was drawn on the inferior border of the mandible in both panoramic X-rays and three-dimensional CT scan. The width of the tooth was used to detect the magnification percentage between X-rays (Figs. 5–7).

3. Results

There was no infection in any of the patients and there was no plate extrusion during the whole clinical follow-up period of 7, 14, 21 and 30 days.

Disturbance of occlusion was recorded in 3 patients (1 male and 2 females) in the first three post-operative days. By the 7th post-operative day, all the three patients showed improvement of the occlusion disturbance, approximating the same occlusion recorded during the operation.

By gentle manual examination of stability of the fixed fracture, all patients showed excellent stability. All the patients showed no displacement in any of the follow-up
4. Discussion

The incidence of maxillofacial fractures in children is confirmed as being generally rare although the incidence increases with age (Seiji and Tokuzo, 2002).

In our study, falls and traffic accidents were the two causes of fractured mandible in children and this agreed with the studies of Oji (1998), Seiji and Tokuzo (2002), Thoren et al. (1997), Guven (1992), Stylogianni et al. (1991), Kaban (1993) and Tanaka et al. (1993).

In our study, we found that boys had a greater likelihood of suffering fractures than girls because of their activities which was in agreement with the studies done by Posnick et al. (1993), Seiji and Tokuzo (2002), Thoren et al. (1997), Guven (1992) and Zachariades et al. (1990).

There are two philosophical approaches to management. One is conservative therapy with soft diet and/or minimal functional inter-maxillary fixation (IMF). This relies on the plasticity of the pediatric occlusion. The second approach applied in more complex fracture patterns in both the very young and the more adult patient, uses techniques standard to adult management. This includes rigid IMF and open reduction and internal fixation (ORIF) (Davison et al., 2001).

Recent literature reports showed a change in using ORIF in fracture stabilization (Hardt and Gottsauner, 1993; Davison et al., 2001; Anderson, 1995; Nixon and Lowey, 1990). The risks of facial growth disturbance in ORIF has not been supported (Norholt et al., 1993). The potential damage to tooth roots and follicles can be minimized with a careful technique which places bicortical screws in the lower mandibular border with monocortical screws placed in more superior plates (Davison et al., 2001; Nixon and Lowey, 1990). In our study, the use of one microplate with 1.5 monocortical screws at the inferior border of the mandible with a dental tension band appeared adequate for the fixation of Pediatric mandibular fractures. The procedure had the benefits of decreasing the amount of titanium used, decreasing the risk of injury of the roots and teeth buds, and decreasing the cost and time of surgery.

5. Conclusions

Using one microplate with 1.5 monocortical screws and dental tension band appeared adequate for the fixation of pediatric mandibular fractures. The procedure had the benefits of decreasing the amount of titanium used, decreasing the risk of injury of the roots and teeth buds, and decreasing the cost and time of surgery.

References

الملخص العربي

الهدف من هذه الدراسة: هو تقييم استعمال الشرائح الدقيقة المعدنية في تثبيت كسور منطقة الذقن من الفك السفلي في الأطفال. الخامات و الحالات التي استعملت للدراسة: تمت الدراسة على سبعة أطفال يعانون من كسور بالفك السفلي بمنطقة الذقن يصعب رد وثبيتها. هذه الكسور بالطريقة التحفظية. تم كشف الكسور جراحياً وتم التثبيت باستعمال شرائح التيتانيوم الدقيقة المعدنية (1.5) عند الحافة السفلية للفك السفلي مستعملين مسامير قصيرة (5مل) لعدم الاضرار بالأسنان المستديمة التي مازالت داخل العظام وربط الأسنان بسلك من الأستانلسيل. تمت متابعة المرضى اكلينيكياً لتقييم ثبات الكسور و ملاحظة تطابق الأسنان وأشعاعياً بأشعة البانوراما و الاشعة المقطعية بعد الجراحة مباشرة ثم بعد ثلاثة أشهر. النتائج: اثبتت النتائج الاكلينيكية والأشعة و ان تطابق الأسنان لم يتغير أثناء فترة التتبع. في حالة من الأمان استعمال شرائح التيتانيوم الدقيقة لتثبيت كسور الفك السفلي في الأطفال حيث ثبت فعاليتها في تثبيت العظام كما انها أقل خطورة على الأسنان المستديمة و على جذور الأسنان.