Oral Maxillofac Surg (2009) 13:177–179
DOI 10.1007/s10006-009-0162-8

CASE REPORT

Improper reduction and fixation of bilateral anterior mandibular fractures: a case report

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Published online: 28 July 2009

Abstract
Introduction Biomechanical principles for osteosynthesis are emphasized upon in oral and maxillofacial surgery residency programs.
Discussion Our case was referred from another specialty which had treated the patient for bilateral fractures of the anterior mandible. The gross malunion and other findings in this reported case serve to remind students and surgeons alike that principles of fracture reduction and fixation must be respected.

Keywords Parasymphysis fracture · Inadequate fixation · Miniplate · Osteosynthesis · Muscle pull · Torsion · Malunion · Open bite

Semirigid fixation of mandibular fractures with the use of miniplates and screws offers some advantages, in select cases, over rigid fixation and maxillomandibular fixation [1, 2]. A striking difference in the application of semirigid miniplates, when compared with rigid systems of osteosynthesis, is the use of monocortical versus bicortical screws [3]. Monocortical screws engage only one cortex and, being self-tapping, eliminate the need for using a screw tap in the drilled hole, but their reduced anchorage also makes fixation less capable than bicortical screws of resisting muscle forces especially if principles of fixation are not respected. Champy and colleagues, using in vitro experimental models and mathematical studies at Strasbourg, determined ideal lines of osteosynthesis based on the initial work of Michelet et al. [1–3]. They also highlighted a second parallel line of osteosynthesis in the anterior mandible due to the torsion moments present anteriorly [3, 4]. We present an unusual case of failure of mandibular parasymphysis fracture treatment—caused by violation of several principles of treatment.

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Report of a case

A 12-year-old female was referred to our oral and maxillofacial service bearing a postoperative discharge note that simply stated “malunion”. History elicited from the parents revealed that the child sustained injury to the lower jaw in a road traffic accident 8 weeks earlier. She was then treated at a hospital. Clinical examination revealed a gross, bilateral occlusal step in the parasymphysis region of mandible. On an orthopantomogram, a bilateral parasymphysis fracture with central segment malunited in an inferiorly displaced position was noted (Fig. 1). The left side had been fixed with a single four-hole plate with only two screws used: one per side of the fracture line. On the right side, a five-hole plate had been used, with two screws placed on each side of the fracture line. An anterior open bite was also appreciated.

With this fixation, the patient was unable to masticate efficiently and was in constant pain and discomfort. The lips were incompetent due to anterior open bite and bimanual palpation revealed mobility of the anterior mandibular fragment. There was evidence, clinical and radiographic, of loss of the canine on the left side and of the first premolar on the right side. We were unable to determine whether these teeth had been avulsed during the traumatic injury or had been removed at the hospital.

Based on the unacceptable occlusion, poor esthetics, and local discomfort, a decision to correct the malunited fracture was made. Under general anesthesia, after reopening the

Fig. 1 Bilateral parasymphysis fracture of mandible with gross displacement of fragment as a consequence of inadequate and improper fixation

previous incision in the labial sulcus, we removed the plates and screws and proceeded to osteotomize the fragment. Having mobilized the anterior fractured fragment, arch bars were placed to achieve intermaxillary fixation and immobilize the teeth in occlusion. Fixation across the fractured right parasymphysis consisted of a six-hole miniplate secured with five screws and a four-hole miniplate secured with three screws. For the left parasymphysis, a five-hole miniplate with five screws along with a position screw near the lower border were placed (Fig. 2). Postoperatively, the patient recovered normal oral function and occlusion.

Discussion

Fractures of the mandible in children are uncommon [5]. When they do occur, there are special considerations for treatment of fractures in the child patient due to (a) remaining growth potential, (b) the presence of developing tooth buds in various stages of eruption, (c) incomplete root formation, and (d) unreliable cooperation from the child patient. Pediatric jaw fractures are thus often managed successfully with closed reduction and indirect fixation using acrylic splints and maxillomandibular fixation (MMF) [5]. In the patient who presented to us for retreatment, there were three reasons why we chose to treat with open reduction and internal fixation rather than closed reduction: First, the deciduous teeth had been replaced by permanent dentition but since root formation was not complete, MMF would have risked tooth extrusion. Second, the spaces created by loss of teeth at the fracture site would make immobilization with arch bars and/or wires difficult. Third, the patient presented with a grossly displaced fragment and open bite after initial surgery and we did not wish to risk a recurrence after retreatment.

Fig. 2 Reduction and immobilization of fractured fragment and placement of functionally stable fixation

The strong and thick outer cortex of the mandible provides osteosynthesis screws with good anchorage due to the compact bone [2]. Even though the thickness of cortex may be as little as 3 mm, its strength offers sufficient monocortical anchorage to screws [1]. Although rigid fixation is stable, dynamic compression plates can be palpable [3] and uncomfortable to a child or adolescent and might therefore require removal. Using miniplates for osteosynthesis has some advantages over rigid fixation systems. The smaller dimensions of these plates enable them to be adapted with greater ease to the contours of bone [3]. However, this reduced mechanical strength and consequent lack of rigidity makes it important for the surgeon to respect Champy's lines of ideal osteosynthesis when planning the location of bone plates. In 1976 at Strasbourg, Champy et al. used polarized light to examine the isostatic lines of tension that developed in a vertically loaded, cantilevered araldite bar [1, 2]. They determined that an osteosynthesis plate placed at the upper border effectively neutralized masticatory forces of 60 DaN in the molar region. Two plates would resist forces up to 100 DaN in the incisor region, due to the additional torsion induced by the parabolic shape of the mandible [2]. Although one thicker, more rigid plate might suffice, its palpable profile would defeat one of the advantages of miniplate osteosynthesis over rigid plating systems. Also, rigid plating might risk the "stress shielding" effect [1]. In the case reported, there was a bilateral fracture of the mandibular parasymphysis. Unlike maxillomandibular fixation, where the jaws are immobilized, with semirigid miniplate osteosynthesis limited early function is possible [3]. In fact, Champy et al. in their landmark article mentioned that each of the 183 patients in their series began a soft diet on the first postoperative day [1]. A bilateral fracture would, however, permit greater movement of the fractured segment. The lack

of a second plate in our patient, supposed to have been placed parallel to the first, across each fracture site permitted displacement of the anterior mandibular fragment, probably owing to contraction of the anterior bellies of digastric, geniohyoid, and the mylohyoid muscles during oral function. In the case reported, as the site of the fracture was parasymphysis, the inadequate hardware used was unlikely to have been able to resist flexion and torsion especially since the anterior mandible had fractured bilaterally. As a bilateral fracture carries a larger risk of displacement, we retained the arch bar postoperatively to act as a tension band.

After miniplates are adapted to bone contours, it is standard to place at least two screws on either side of the fracture site [2, 3]. On the left side of mandible, this patient had placement of only one screw per fragment. Unless at least two screws are placed per side of fracture, rotation of the fragment is likely to occur. While reoperating on this side, we used a position screw in addition to a miniplate. "Lag" or "position" screws rigidly hold segments of bone in a stable relationship and thus resist displacement by muscle forces [6].

The primary goals of fracture management include restoration of pre-injury occlusion, necessitating the achievement of MMF to place the teeth in proper occlusion, usually with arch bars and steel wires. Although MMF is released after placement of miniplate fixation, the arch bars are usually left wired to the teeth and they may, in conjunction with training or guiding elastics, help in "fine-tuning" mild occlusal discrepancies since miniplates are malleable [7]. In the case, we have reported that arch bars had not been placed either prior to or after initial surgery and this may have contributed to difficulties in achieving secure reduction. Also, as teeth in the line of fracture bilaterally were lost during trauma, reduction would have been technically more challenging, a strong indication for arch bars and MMF as a first step—that of fracture reduction—in the surgical operation.

The findings after initial surgery in this case highlight the pitfalls of fracture treatment if performed without respecting the principles of reduction, immobilization, and fixation. It has been stated that the use of bone plates for osteosynthesis is associated with an incidence of malocclusion thrice as much as that with MMF [5]. With miniplate systems that rely on Champy's lines of ideal osteosynthesis, there is only a passive noncompression fixation. Therefore, if principles are ignored by using inadequate and/or inappropriately located plates, failure of fixation is imminent when masticatory loads are applied. Training in residency must therefore emphasize on the biomechanical principles of reduction, immobilization, and fixation, and the need to restore occlusion. Indeed, it is worthy to note that in their series of 183 cases, with adherence to biomechanical principles, Champy et al. reported an incidence of malunion of just 0.5% [1]. In the case we reported, if these principles had been adhered to during primary surgery itself, the expenditure and morbidity of corrective secondary surgery could have been avoided.

References

1. Champy M, Loddé JP, Schmitt R, Jaeger JH, Muster D (1978) Mandibular osteosynthesis by miniature screwed plates via a buccal approach. J Maxillofac Surg 6:14–21
2. Champy M, Pape HD, Gerlach KL, Lodde JP (1986) The Strasbourg miniplate osteosynthesis. In: Krüger E, Schilli W (eds) Oral and maxillofacial traumatology, vol. 2. Quintessence, Berlin, pp 19–43
3. Frost DE, Tucker MR, White RP (1991) Small bone plate techniques for fixation of mandibular fractures. In: Tucker MR, Terry BC, White RP, Sickels JEV (eds) Rigid fixation for maxillofacial surgery. Lippincott, Philadelphia, pp 104–122
4. Gerlach KL, Erle A (1999) Surgical management of mandibular fractures. In: Booth PW, Schendel SA, Hausamen J-E (eds) Maxillofacial surgery, vol. 1. Churchill Livingstone, Edinburgh, pp 57–78
5. Chacon GE, Larsen PE (2004) Principles of management of mandibular fractures. In: Miloro M, Ghali GE, Larsen PE, Waite PD (eds) Peterson's principles of oral and maxillofacial surgery, 2nd edn. Decker, Hamilton, pp 401–434
6. Shetty V, Caputo A (1992) Biomechanical considerations in oral and maxillofacial surgery. In: Bell WH (ed) Modern practice in orthognathic and reconstructive surgery, vol. 3. Saunders, Philadelphia, pp 1956–1995
7. Heslop IH, Cawood JI, Stoelinga PJW, Becker R, Blekinsopp P, Boyne P, Williams JLl (1994) Mandibular fractures: treatment by open reduction and direct skeletal fixation. In: Williams JLl (ed) Rowe and Williams' maxillofacial injuries, vol. 1, 2nd edn. Churchill Livingstone, Edinburgh, pp 341–385