The Use of a Kirschner Wire in the Treatment of a Comminuted Le Fort I Fracture: A Case Report

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ABSTRACT

Simultaneous fracture of the maxilla and cervical vertebrae rarely occurs in bicycling accidents. The following case report describes a simple technique for closed reduction of a severely comminuted maxillary fracture with shattering of the dentoalveolar process. The combination of a rigid external distractor halo frame on the skull, a Kirschner wire through the maxilla, and an intermaxillary wire fixation resulted in stable vertical and sagittal correction of the fragmented maxilla with adequate access and minimal manipulation and without necessitating removal of the cervical collar.

KEYWORDS: Kirschner wire, Le Fort I fracture, RED halo frame

The growth in popularity of bicycling in recent years is reflected in the number of cycling-related oral and maxillofacial injuries.¹ Trauma resulting in maxillofacial fractures carries a high risk of concomitant cervical spine injuries.²⁻⁵ We encountered a patient with a comminuted Le Fort I fracture in combination with fractures of four cervical vertebrae.

The treatment of choice for Le Fort I fractures is open reduction and internal fixation with miniplates.⁶ In our patient, this intervention was judged to be difficult and complex due to the unstable, polyfragmented character of the fracture with shattering over the dentoalveolar process of the maxilla. The option to treat the

patient alternatively, with a head frame and Kirschner wire, was chosen.

CASE REPORT

A 61-year-old man was brought to the Emergency Unit of our hospital, Ziekenhuis Oost Limburg, after a bicycle fall with impact of the face on pavement. The patient had no significant past medical history. Immediately following the accident, he had loss of consciousness with amnesia, but cognition was within normal limits during clinical examination (Glasgow Coma Scale 15/15). There was no airway obstruction. He reported pain in his neck, chest, and face.

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Initial emergency room evaluation revealed upper-lip laceration, multiple facial fractures, dental trauma, and injury of the cervical vertebrae. There were multiple bruises on the face and epistaxis and laceration of the maxillary labial mucosa on the left side, which was sutured.

Diagnostic testing included computed tomography (CT) scans of the cervical spine, brain, face, and thorax. CT identified a fracture without displacement of the lateral mass of C2, fracture of the processus spinosus of C4 and C5, and a teardrop fracture of C7. Thoracic CT suggested a fracture of the anterior border of the first rib with lung contusion. Maxillofacial CT (Fig. 1) showed a comminuted Le Fort I fracture and a fracture of the nose.

The patient was admitted to the intensive care unit where he remained for 4 days. From a neurosurgical

point of view, there was no need for surgical investigation of the cervical spine trauma. Fractures of the four cervical vertebrae were treated conservatively with a hard neck collar. The rib fracture and lung contusion were treated conservatively.

Two days after the accident, the polyfragmented Le Fort I fracture was corrected surgically under general anesthesia. With the goal to minimize force on the neck, a nasendotracheal tube was placed using an endoscope. The first surgical step was to ensure intermaxillary fixation with Ehrlich bars and wires, during which the individual mobility of many maxillary teeth became obvious. Intraoperatively, it became clear that osteosynthesis with miniplates as internal fixation would be complex. The surgeon decided to place a rigid external distractor (RED) frame in combination with a Kirschner wire (K-wire).

Figure 1 Preoperative computed tomography 3-D reconstruction (A), axial view (B), and coronal view (C) showing comminuted Le Fort I fracture.

Figure 2 Sagittal (A) and anteroposterior (B) illustration of the Kirschner wire position.

This wire was introduced according to the technique described by Kim et al in 2008,⁷ where the K-wire was used for fixation of rib cartilage grafts to the maxilla in rhinoplasty.

Without navigation and without predrilling, the K-wire was placed transcutaneously within the thick anterior portion of the palatal bone, not perforating the palatal mucosa or touching the dental roots. The insertion point was 3 mm off the midline to avoid the incisive foramen (Fig. 2).

The RED II distractor of Martin (KLS Martin, Tuttlingen, Germany) was fixed with three screws on each side to the skull and was stabilized by attaching the K-wire to the vertical rod of the RED frame (Fig. 3). Due to significant mobility of the upper jaw, the vertical dimension of the maxilla was subjectively determined.

The patient was discharged from the intensive care unit 1 day postoperatively. He remained in the hospital an additional 4 days. Postoperatively, conventional radiographs (panoramic radiograph, anterior and lateral cephalometric radiographs) showed good and stable position of the intermaxillary fixation, K-wire, and RED frame (Fig. 4), and maxillofacial CT showed appropriate fixation. The patient was followed postoperatively every week at the department of maxillofacial surgery.

After a fixation period of 6 weeks, the intermaxillary fixation wires, K-wire, and RED frame were removed. Healing was uneventful and the extraoral introduction sites healed without visible scar formation. The neck collar was also removed 6 weeks postoperatively.

One year after the accident the patient is healing well with a normal range of oral opening (38 mm) and

normal occlusion (Fig. 5). The dentist restored the enamel and dentin fractures of the teeth. No infections, sensory paralysis, or other complication developed during the treatment (Fig. 6).

DISCUSSION

As many as 30% of all maxillofacial and skull base fractures are related to sports injuries.⁵ Elhammali et al⁵ concluded that concomitant cervical spine injury is rare with these fractures.

A review by Haug et al in 1990 reported that the most frequently concomitant injuries associated with maxillary fractures were lacerations and abrasions.³ The authors reported that 51% of patients with maxillary fractures sustained neurological injuries. In a recent report, Mulligan and Mahabir described the prevalence of cervical spine injury and head injury with isolated and multiple craniomaxillary fractures.⁴ They concluded that in isolated craniomaxillary fractures, cervical spine injuries ranged from 4.9 to 8.0%, and two or more facial fractures increased the prevalence of cervical spine injury from 7.0 to 10.8%. Elahi et al published a review in 2008,² concluding that 3.69% of all patients with craniomaxillofacial fractures showed a concomitant cervical spine injury. The majority of injuries to the cervical spine were seen in association with motor vehicle accidents; alcohol use was implicated in 57% of these injuries. In the present case, the patient was riding a bicycle in sober condition and suffered a maxillofacial injury in combination with a cervical spine injury.

In the review by Elahi et al,² cervical spinal injuries most commonly occurred at C1 to C2 and C6

Figure 3 Perioperative images (A to D) of the Kirschner wire and rigid external distractor frame in place.

Figure 4 Panoramic radiograph (A) and lateral cephalometric radiograph (B) 6 days postoperative.

to C7, which we saw in our patient, following in frequency by injuries to C4 and C5. If neurosurgical intervention is not required, cervical fixation devices (i.e., hard or soft collars) should be maintained during surgery to repair concomitant facial fractures.

To treat Le Fort I fractures with open reduction, it is important to progress from stable bone to stable bone. For a comminuted maxillary fracture, this would mean using bone graft reconstruction. Although some authors^{6,8} state that the use of head frames in fractures of the midface is rare in modern practice, cumbersome, and disliked by the patient, it can be a helpful method to compensate for bone loss, to stabilize unstable fractures, and to rehabilitate occlusion and vertical height. Other advantages of head frame use compared with conventional osteotomy are the reduced operative time, less blood loss, and minimal manipulation with reduced surgical access when the cervical collar must be maintained intraoperatively.⁹

In this case, we chose to use a head frame in combination with a K-wire to obtain good maxillary

Figure 5 Clinical photographs of the patient 1 year after treatment with normal range of opening (A) and normal occlusion (B).

Figure 6 Clinical photograph of the patient before (A) and 1 year after (B) treatment. A cone beam computed tomography 1 year after treatment to document bone healing in axial view (C), coronal view (D), and sagittal view (E).

stabilization of the comminuted fracture. The K-wire was placed according to the technique described by Kim et al in 2008.⁷ Although the K-wire fixation technique is extremely stable, K-wire insertion is challenging. Perforation of the palatal mucosa or nasal floor, dental injury, and injury of the foramen incisivum can occur when the K-wire is not accurately placed. Instability can be caused when the wire does not adequately penetrate the tissue. On the other hand, it is important to place the K-wire just within the thick anterior portion of the palate and to stop penetration before the thin posterior part. A surgical navigation system could be helpful for the surgeon to obtain these goals. For a surgeon experienced with intraoperative navigation systems, the setup time will add only 15 minutes to total operative time.⁷ To obtain a stable maxilla, the K-wire was attached to the vertical rod of the halo frame. Besides the technical difficulty, another limitation of this closed reduction technique, which would certainly be a problem if there was a concomitant mandibular fracture, is the possibility to create a rotation of the segment around the K-wire axis. Standard treatment with open reduction and internal fixation gives greater stability and minimizes this risk of rotation. Due to the significant degree of mobility, the vertical dimension of the maxilla could only be determined subjectively in our patient. Progressive vertical extrusion to correct the lip-to-incisor ratio after the trauma was not necessary, but could have been possible, which could never have been achieved with miniplates for osteosynthesis. However, open reduction and internal fixation would contribute in the rehabilitation of the maxillary height.

The consolidation period and intermaxillary fixation time in this case was 6 weeks, with no apparent relapse observed.

CONCLUSION

Traumatic dental, maxillofacial, and cervical injuries are not uncommon in bicyclist.¹ The treatment of choice of

a traumatic, comminuted maxillary fracture is internal fixation with miniplates for osteosynthesis and bone graft reconstruction, but this can sometimes be difficult and complex. In this case of a comminuted Le Fort I fracture with additional complicating injuries, we used a Kirschner wire with a head frame as an alternative treatment. Besides the few limitations of this minimally invasive technique, we obtained good results in this case.

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