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A 10-year analysis of the “Amsterdam” protocol in the treatment of zygomatic complex fractures

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ABSTRACT

Despite many publications on the epidemiology, incidence and aetiology of zygomatic complex (ZC) fractures there is still a lack of information about a consensus in its treatment. The aim of the present study is to investigate retrospectively the Amsterdam protocol for surgical treatment of ZC fractures. The 10 years results and complications are presented. The study population consisted of 236 patients (170 males, 66 females, 210 ZC fractures, 26 solitary zygomatic arch fractures) with a mean age of 39.3 (SD: ±15.6) years (range 4–87 years). The mean cause of injury was traffic accident followed by violence and fall. A total of 225 plates and 943 screws were used. Twenty-eight patients presented with complications, including wound infection (9 patients) and transient paralysis of the facial nerve (one patient). Seven patients (2.8%) needed surgical retreatment of whom four patients needed secondary orbital floor reconstruction as these patients developed enophthalmos and diplopia. In conclusion this report provides important data for reaching a consensus for the treatment of these types of fractures.

1. Introduction

Maxillofacial fractures account for a substantial proportion of traumatic injuries (Calderoni et al., 2011; Katarzyna and Piotr, 2010). The incidence of maxillofacial fractures varies with geographical area, socioeconomic trends, incidence of road traffic accidents, alcohol abuse, drug abuse and by season. The pattern of maxillofacial fractures presentation varies depending on the aetiology of the injury. Common causes of maxillofacial fractures include road traffic accidents (including motorcycle, automobile, bicycle, pedestrian), assaults, falls, stumbling, sports, industrial/work related accidents and other miscellaneous causes (e.g. gunshot injuries, pathological fractures) (Calderoni et al., 2011; Naveen Shankar et al., 2011; van den Bergh et al., 2011b). An understanding of these factors may guide clinical research into the development of more effective prevention and treatment of these injuries (Calderoni et al., 2011).

Several authors have noted that the zygomatic complex and maxilla are the most common maxillofacial fracture sites (Bogusiak and Arkuszewski, 2010; van den Bergh et al., 2011b). As with other maxillofacial bone fractures the prevalence of zygomatic complex fractures is related to different conditions (Calderoni et al., 2011; Olate et al., 2010; Trivellato et al., 2011; van den Bergh et al., 2011b). Adequate reduction of the fracture is a constant challenge for surgeons due to the anatomical position of the complex. The zygomatic complex consists of 4 pillars attached by 4 suture lines. It includes the part of the orbital floor lateral to the infraorbital fissure, therefore a fracture of this complex is always accompanied by an orbital floor fracture. The aim of a treatment is reduction of the zygomatic bone, orbital floor and zygomatic arch (He et al., 2007; Hwang, 2010; Wang et al., 2008).

In the past wire fixation was a treatment modality for zygomatic complex fractures (Lund, 1971; Pozatek et al., 1973). The introduction of rigid internal fixation using miniplates has lead to greater stability and less complications. The use of miniplates is now state of the art (Olate et al., 2010). There is no consensus on the best surgical access to the orbito-zygomatic complex. The majority of authors prefer to initially use the lower lid and lateral brow approach. On the other hand, some authors use the intraoral approach as first choice, because it results in a more stable reduction with a lower complication rate (Calderoni et al., 2011).

Despite various publications on the epidemiology, incidence and aetiology of zygomatic complex fractures there remains no consensus agreement regarding treatment.

The aim of this study was to retrospectively investigate the outcomes and complications of patients surgically treated for a zygomatic complex fracture according to our treatment protocol

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over a 10-year period. We hope that our study will contribute towards the formation of a consensus view on the treatment of zygomatic complex fractures.

2. Materials and methods

2.1. Data collection

Hospital and outpatient records of patients surgically treated for zygomatic complex fractures from January 2000 to January 2010 were reviewed and analysed retrospectively. The patients were identified using the hospital database. All types of zygomatic complex fracture surgically treated by open or closed reduction were included. Patients with panfacial trauma and solitary blow-out fractures were excluded. Data collected included gender, age, cause of injury, pre and postoperative radiographical analysis, type of zygomatic complex fracture, treatment modality and complications.

2.2. Treatment protocol

Zygomatic complex fractures were diagnosed on presentation to the Outpatient Department or Emergency Ward, using a combination of clinical and radiographic examination. Radiographic analysis included submentovertex and occipitomental views or a (conebeam) CT scan. If necessary an ophthalmology opinion was obtained pre- and postoperatively to record enophthamos and/or eye-movement disturbances.

Patients were treated according to the department's protocol demonstrated in Fig. 1. The fracture reduction was performed using a hook and if necessary the fractured bones were fixed. The preferred site of fixation was the lateral orbital rim. Where the reduction was unstable a second miniplate was placed at the zygomatico-alveolar crest. If necessary a third miniplate was placed at the infraorbital margin. KLS Martin 2.0 mm and/or 1.5 mm plates were used.

As a training unit the departmental policy was to adhere to the treatment protocol, however the surgeon had the option to deviate from the protocol if necessary.

During the surgical procedure a forced duction test was performed twice, before and after reduction of the zygomatic complex. If ocular movements were restricted and entrapment of the rectus inferior muscle was suspected, the orbital floor was explored. Another reason for exploration was the detection of a comminuted orbital floor fracture on the CT images. Where necessary the orbital floor was reconstructed using Medpor, titanium or autologous bone. The reconstructive material was chosen by the operating surgeon.

Postoperatively all patients received standard analgesics (diclofenac 50 mg three times daily or paracetamol with codeine 1000/20 mg four times daily). Patients received prophylactic antibiotics for one week if either the zygomatico-alveolar crest or the infraorbital margin was used for fixation (either clindamycin 600 mg three times daily or amoxicillin-clavulanate 625 mg three times daily). Patients also received prophylactic antibiotics after orbital floor reconstruction.

Postoperatively conventional radiographs (submentovertex and occipitomental views) were performed to assess the reduction, for teaching and medicolegal reasons. If the reduction was performed suboptimally and there were clinical signs of a malpositioned zygomatic complex, the patient was retreated.

All patients were followed up weekly for the first 3 weeks postoperatively, then at 3 and 6 months as per the department's protocol.

Osteosynthesis material was only removed in cases of persistent infection that did not respond to oral antibiotics (after 2–3 months postoperatively). Osteosynthesis material was also removed for age related reasons. The material was removed 6–12 months after surgery for patients younger than 18 years old to prevent any possible growth restriction of the zygomatic complex due to the presence of the osteosynthesis material.

2.3. Statistics

Data was analysed using the Statistical Package for Social Sciences (SPSS) version 15.0. For parametric data Student *t*-test and for non-parametric data chi square tests were performed.

3. Results

The study population consisted of 170 males and 66 females with a mean age of 39.3 (SD: ±15.6) years (range 4–87 years). In 210 patients the zygomatic complex was fractured, whereas 26 patients presented with a solitary zygomatic arch fracture. Fig. 2 demonstrates the cause of the fractures. The fractures were mainly the result of vehicle accidents, followed by violence. The left side was more affected (145 patients) than the right side (91 patients). There were no significant differences between males and females. The clinical signs and symptoms are shown in Table 1. Most patients presented with paraesthesia in the infraorbital nerve distribution (47.0%), followed by malar depression (37.3%) and haematomas/ecchymosis (36.0%).

3.1. Radiographical analysis

The type of pre and postoperative analysis was divided into conventional radiographs, consisting of submentovertex and occipitomental views or a (conebeam) CT scan. In total 413 preoperative radiographic analyses were performed. Postoperatively 361 radiographs were taken.

3.2. Treatment modalities and operation duration

All 26 patients with solitary zygomatic arch fractures were treated by reduction via the Gillies approach which was consistent with the department's protocol. The mean operation time was 31.0 (SD: ±8.9) min. Postoperative radiographs consisted of submentovertex and occipitomental views. No CT scans were performed.

Of the 210 patients with zygomatic complex fractures 33 patients were treated with reduction without fixation. The remaining 177 patients underwent reduction and fixation using 225 plates (22 × 1.5 mm Martin-plates and 203 × 2.0 mm Martin-plates) and 943 screws. The distribution and localisation of the plates is demonstrated in Fig. 3 and Fig. 4. The mean operation time for all zygomatic complex fractures was 65.9 (SD: 3.7) min.

In 141 patients only one plate was placed. One hundred and thirty seven plates were placed on the lateral orbital rim. The plate was positioned on the zygomatico-alveolar crest in 2 patients. The surgeons felt that the zygomatic complex was most displaced at the zygomatico-alveolar crest in these patients as this approach gives better control of the reduction at this location. The infraorbital margin was used for fixation in 2 other patients. In both patients it was clear preoperatively that an orbital floor reconstruction was necessary.

Two plates were required in 29 patients. In 26 patients the first plate was placed on the lateral orbital rim and in 3 patients on the zygomatico-alveolar crest. The second plate was fixed on the zygomatico-alveolar crest in 15 patients and on the infraorbital margin in 14 patients.

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