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Original research

The clinical course of diplopia associated with zygomaticomaxillary complex fractures before and after surgery

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ABSTRACT

Objective: Diplopia is a common complaint following zygomaticomaxillary complex (ZMC) fractures. The present study was conducted to evaluate the prevalence of post-traumatic as well as port-operative diplopia, and the improvement of diplopia over time before and after surgery.
Methods: A retrospective case series of diplopia associated with ZMC fractures was conducted to address the research purpose. Only subjects with isolated unilateral ZMC fractures were included. Demographic variables included age and gender of the patients. The primary outcome variable of this study was the presence of diplopia during different periods before and after surgery. Descriptive statistics were conducted for all variables studied. Analytical statistics were performed to measure the significance of change in the outcome variable during different stages of treatment.
Results: In total, 231 patients were included, with a mean age of 23.78 (±5.11) years. Post-traumatic diplopia was diagnosed in 59% of patients. Only 13% of cases had pre-operative diplopia. Post-surgical diplopia was reported in 37% of cases. Post-operative follow-up diplopia showed a significant improvement over time with only 1 patient having residual diplopia 6 months after surgery.
Conclusions: Traumatic diplopia in unilateral ZMC fractures is common. However, a significant resolution of diplopia over time should be expected. Residual diplopia is an unlikely outcome.

1. Introduction

Road traffic accidents are the most common cause of maxillofacial trauma worldwide, with the exception of North America and Europe, where assaults and falls have recently become more important [1]. Excluding the nasal bones, zygomatic fractures are considered as the most common facial fractures [2,3], or by some, the second most common facial fractures following the mandible [4–7]. Several classifications of zygomatic fractures have been proposed. Older classifications include the Knight and North, Rowe and Kelley, Larsen and Thomsen, and Henderson classifications [8]. Manson et al. presented a CT-assisted classification of facial fractures, including the zygoma, based on the degree of displacement and comminution. They classified the fractures as low, middle, or high energy [9]. Zingg et al. classified the zygomatico maxillary complex (ZMC) fractures, based on the number of pillars involved and fragmentation, into types A, B, and C [10].

There are several signs and symptoms of ZMC fractures, such as flattening of the cheek, swelling, nasal bleeding, trismus, and ocular complications [11]. ZMC fractures are almost always accompanied by orbital fractures, with various degrees of comminution of the orbital floor and herniation into the maxillary sinus [12]. They are possibly the most common fractures that involve the orbit [13]. Notably, subtle ocular injuries may be overlooked by maxillofacial surgeons but have significant outcomes [14]. Therefore, careful ophthalmic evaluation in midfacial injuries is recommended.

Ocular complications in ZMC fractures may include subconjunctival hemorrhage, diplopia, enophthalmos, commotio retinae, reduced visual acuity, retinal hemorrhage, retinal detachment, corneal laceration or abrasion, traumatic mydriasis, hyphema, angle recession, canthal laceration, and ruptured globe [15–17].

Diplopia, in particular, is a common finding in midfacial trauma, especially with orbital [18,19] and zygomatic fractures [15]. Diplopia, or double vision, is usually defined as the perception of a single object as two, and can be monocular or binocular [20].

☆ AsianAOMS: Asian Association of Oral and Maxillofacial Surgeons; ASOMP: Asian Society of Oral and Maxillofacial Pathology; JSOP: Japanese Society of Oral Pathology; JSOMS: Japanese Society of Oral and Maxillofacial Surgeons; JSOM: Japanese Society of Oral Medicine; JAMI: Japanese Academy of Maxillofacial Implants.

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Monocular diplopia persists in the affected eye despite covering the other eye and is usually due to local eye disease or refractive error. By contrast, binocular diplopia disappears with covering either eye, and may indicate ocular malalignment [21]. Excluding subconjunctival hemorrhage, diplopia is probably the most common ophthalmic complication in orbito-zygomatic fractures [16,17]. The incidence of diplopia increases by the severity of orbital injury in facial trauma [22].

Another significant aspect is post-operative (iatrogenic) diplopia, which can complicate ophthalmic as well as non-ophthalmic surgeries. Neurological and orbital surgeries are major causes [23]. Common procedures that may lead to diplopia include orbital fracture repair, endoscopic sinus surgery, and orbital decompression for thyroid-related orbitopathy [24]. In addition, diplopia can be an unusual complication of dental procedures, mainly attributed to local anesthesia [25,26].

The purpose of this study was to investigate diplopia associated with unilateral middle- to high-energy ZMC fractures. The aims of the current study were to measure the prevalence of post-traumatic as well as post-operative diplopia among ZMC fracture patients, and to evaluate the improvement of diplopia over time before and after surgery.

2. Patients and methods

2.1. Study design and population

A retrospective case series was conducted to address the research purpose. The study was approved by the research center of the Riyadh Colleges of Dentistry and Pharmacy. The study population was composed of all patients admitted at King Saud Medical City, Saudi Arabia, for management of ZMC fractures in the last ten years (2007–2017).

2.2. Inclusion and exclusion criteria

Patients with isolated unilateral middle- or high-energy ZMC fractures were included in this study.

The following patients were excluded as study subjects: low-energy non-displaced ZMC fractures; bilateral ZMC fractures; young children (<15 years old); isolated zygomatic arch fractures; pure orbital fractures; old midfacial trauma or surgery; ophthalmic disorders or surgeries prior to the trauma; ZMC fractures associated with other facial or non-facial fractures; ZMC fractures associated with other acute injuries necessitating immediate operation and/or intensive care unit admission; ZMC fractures associated with head injuries necessitating neurosurgical admission or intervention, and cases associated with acute ocular injuries necessitating urgent surgical intervention such as ruptured globe, traumatic optic neuropathy, retrobulbar hemorrhage, muscle incarceration, and traumatic hyphema.

2.3. Study variables

The primary outcome variable of this study was the presence of diplopia during different stages before and after surgery, with two possible values: “yes” or “no”. The diagnosis of diplopia was based on the positive finding of troublesome double vision during examination as documented in the patients’ records. The original recording of diplopia was made by the treating maxillofacial surgeon based on a “broad H” test, where examiner asked the patient to follow an object held around 30 cm ahead and moved along a pattern of “H” without moving the head. The examiner asked the patient to report double vision in any of the nine gaze positions. Patients with positive diplopia were seen by an ophthalmologist, who in turns confirmed the diagnosis of diplopia utilizing prisms and/or visual field tests. Patients with diplopia in primary gaze, within 30° of primary gaze, or in downward gaze were recorded as “yes”. Patients with no diplopia, or with diplopia in extreme gaze, were recorded as “no”.

Demographic variables included age and gender of the patients. The side of the fracture was recorded. In addition, the classification of the fracture, based on Manson et al. [9], was included. The classification is described in the data collection section of this manuscript.

2.4. Data collection

Clinical data in the retrieved files were reviewed, along with the CT scan records, ophthalmic consultations, and neurological findings. CT scans were already taken in all patients as found in the patients’ electronic files. All of the CT scan records were re-evaluated by one of the researchers to confirm the diagnosis of a unilateral middle- or high-energy ZMC fracture per subject. The ZMC fracture was considered as middle-energy if there was separation of all four articulations with mild to moderate displacement. Fractures that showed comminution in lateral orbit or lateral displacement with segmentation of the zygomatic arch were classified as high-energy. The subjects were distributed into two groups, middle-energy group and high-energy group. The patient’s age and gender, along with the side of the ZMC fracture were also documented.

The admission note for each patient was checked for the presence of post-traumatic diplopia (PTD) at the time of initial presentation. The presence of pre-operative diplopia (POD) at the end of the preoperative observation period, immediately before surgery, was documented. The operation notes of each case were reviewed to document whether orbital exploration (OE) was performed. The post-operative notes were checked to record the presence of immediate post-surgical diplopia (PSD) after full recovery.

The follow-up notes were reviewed to document the presence of post-operative follow-up diplopia (PFD) in the weekly recall visits for 3 weeks and in the 3rd postoperative month recall. The PFD was documented as 1st week PFD, 2nd week PFD, 3rd week PFD, and 3rd month PFD. Patients with persistent diplopia after 6 months of surgery were documented as having residual diplopia (RD).

2.5. Data analyses

The data were analyzed using IBM® SPSS® Statistics version 22. Descriptive statistics were conducted for all variables studied. Analytical statistics were performed to measure the significance of change in the outcome variable during different stages of treatment. A p-value of <.05 was used to report the significance of all results, unless otherwise stated.

3. Results

Overall, 231 patients were included in our study. All patients were admitted and surgically treated for isolated unilateral middle- to high-energy ZMC fractures. Surgeries were performed by oral and maxillofacial surgeons within 10 days of the trauma.

The surgical approaches for each case varied, including intraoral incision (to expose and fix the zygomatico-maxillary suture); lateral eye brow incision (to expose and fix the frontozygomatic suture); Gillies approach (to elevate a depressed zygomatic arch, if any); subtarsal stepped incision (if OE was performed) for infraorbital rim fixation, with orbital reconstruction using a titanium mesh ± autogenous bone as necessary; and coronal flap. Every middle-energy fracture was managed by open reduction and internal fixation with 2- to 3-point fixation, while high-energy fractures included 4-point fixations.

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