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Research Article

Minimal Invasive Treatment of Displaced Zygomatic Bone Fracture

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Abstract

Background: Zygomatic complex fractures are a common facial injury, often requiring surgical intervention. While traditional techniques involve multiple fixation points, recent studies have explored the efficacy of single-point fixation for minimally displaced fractures. The intraoral approach offers a less invasive option with minimal scarring, reduced operative time, excellent functional outcomes, and potential cost-effectiveness. ***Objective***: To evaluate the functional recovery and cost-effectiveness of single-point fixation through an intraoral approach for minimally displaced zygomatic bone fractures, emphasizing reduced surgical time. Methods: We analyzed a prospective case series of patients with minimally displaced zygomatic bone fractures treated with single-point fixation via an intraoral approach. ***Methods***: We assessed clinical outcomes such as facial symmetry, functional recovery (e.g., mastication, mouth opening, and vision), complications, operative time, and hospital stay duration. We performed a cost analysis to compare the economic implications of single-point fixation versus traditional techniques. ***Results***: The study demonstrated successful anatomical reduction and functional recovery in all cases with minimal complications. Single-point fixation using an intraoral approach offers excellent stability, causes less visible scarring, takes less time to perform than traditional methods, leads to shorter hospital stays, and may save money by using fewer hospital resources. ***Conclusions***: Using single-point fixation through an intraoral approach is a good treatment choice for patients with slightly shifted zygomatic bone fractures, providing a less invasive method that achieves similar results to traditional techniques, takes less time in surgery, allows for great recovery, and is cost-effective.

Keywords: Cost-effectiveness, Functional outcomes, Intraoral approach, Minimally displaced fracture, Single-point fixation, Zygomatic fracture.

العلاج طفيف التوغل لكسر العظام الوجني النازح

الخلاصة

الخلفية: الكسور العقدية الوجني هي إصابة شائعة في الوجه، وغالبا ما تتطلب تدخلا جراحيا. في حين أن التقنيات التقليدية تتضمن نقاط تثبيت متعددة، فقد استكشفت الدراسات الحديثة فعالية التثبيت أحادي النقطة للكسور التي يتم إزاحها بشكل طفيف. يوفر النهج داخل الفم خيارا أقل توغلا مع الحد الأدنى من التندب، وتقليل وقت الجراحة، والنتائج الوظيفية الممتازة، والفعالية المحتملة من حيث التكلفة. **الهدف**: تقييم التعافي الوظيفي وفعالية التكلفة للتثبيت أحادي النقطة من خلال نهج داخل الفم لكسور العظام الوجنية النازحة إلى الحد الأدنى، مع التركيز على تقليل وقت الجراحة. أساليب: قمنا بتحليل سلسلة حالات محتملة من المرضى الذين يعانون من كسور العظام الوجنية التي تم إزاحها بشكل طفيف والتي عولجوا بتثبيت نقطة واحدة عبر نهج داخل الفم. **الطرائق**: قمنا بتقييم النتائج السريرية مثل تناسق الوجه، والتعافي الوظيفي (على سبيل المثال، المضغ، وفتح الفم، والرؤية)، والمضاعفات، ووقت الجراحة، ومدة الإقامة في المستشفى. أجرينا تحليلا للتكلفة لمقارنة الآثار الاقتصادية للتثبيت أحادي النقطة مقابل التقنيات التقليدية. **النتائج**: أظهرت الدراسة انخفاضا تشريحيا ناجحا وتعافيا وظيفيا في جميع الحالات بأقل قدر من المضاعفات. يوفر التثبيت أحادي النقطة باستخدام نهج داخل الفم استقرارا ممتازا، ويسبب ندوبا أقل وضوحا، ويستغرق وقتا أقل للأداء من الطرق التقليدية، ويؤدي إلى إقامة أقصر في المستشفى، وقد يوفر المال باستخدام موارد أقل في المستشفى. **الاستنتاجات**: يعد استخدام التثبيت أحادي النقطة من خلال نهج داخل الفم خيارا علاجيا جيدا للمرضى الذين يعانون من كسور العظام الوجنية المتغيرة قليلا، مما يوفر طريقة أقل توغلا تحقق نتائج مماثلة للتقنيات التقليدية، وتستغرق وقتا أقل في الجراحة، وتسمح بتعافي كبير، وفعالة من حيث التكلفة.

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INTRODUCTION

The lateral prominence and convexity of the zygomatic bone make it the most important bone for providing the aesthetic facial look and setting up the facial width, but at the same time, this prominence and convexity make this bone more vulnerable to injury and result in cosmetic deformity as well as functional deficits such as altered vision, restricted mouth opening, and paraesthesia [1]. Zygomatic complex fractures are the second most common fractures after nasal fractures among facial injuries. These fractures primarily affect men in their third decade of life [2]. The etiology of zygomatic complex fractures includes road traffic accidents, assaults, falls, and sport and missile injuries [3]. For these reasons, the proper diagnosis and treatment of these fractures are important for the functional and cosmetic outcome of facial trauma patients. Accurate restitution of the form and function of the ZMC is challenging because of its

multipoint articulation within the craniofacial skeleton (the zygoma articulates with the frontal, sphenoid, temporal, and maxillary bones) and the difficulty involved in intraoperative assessment of reduction at all articulations [4]. Most treatments for zygomatic complex fractures involve open reduction and internal fixation through multiple incisions [5]. Several approaches are used, namely lateral eyebrow, subciliary, temporal, or intraoral incisions for one-, two- or three-point fixation of zygomatic complex fractures. It stays unclear whether successful and predictable outcomes can be achieved with more fixation points on ZMC fractures and if the number of fixation points affects the quality of the anatomical reduction, stability through time, and the potential complications [6]. Surgeons have used between 1 and 4 fixation points for ZMC fractures, but there is no agreement on the best method; therefore, this article focuses on achieving good cosmetic results with single-point fixation through the mouth to avoid visible scars, while also ensuring stability, reducing surgery time, and lowering costs by minimizing hospital stays, anesthesia use, and hardware expenses with a single bone plate. This study aims to evaluate the effectiveness of using single-point fixation through an intraoral approach in the treatment of minimally displaced zygomatic bone fracture.

METHODS

Study design and setting

This prospective case-control study was conducted in the Maxillofacial Centre at AL-Shaheed Gazzi Al-Hariri Hospital, Medical City/Baghdad, from 2020 to 2024, on nine patients, seven of whom were male and two were female, with an age range of 18 to 30 years and a mean age of 23.7 years. All patients attended the consultatory clinic and emergency department in the maxillofacial center.

Inclusion criteria

Patients with fractures resulting from low- to middle-energy impacts are the focus. Individuals suffering from zygoma fractures exhibit horizontal displacement and minimal vertical displacement (less than 3 mm).

Exclusion criteria

Fractures caused by high-energy impacts. Fractured zygoma with more than 3mm. vertical displacement. Compound fractures. Medically compromised patient. Patients are present with diplopia and/or enophthalmos.

Surgical intervention

Indications of surgery included a minimally displaced zygomatic bone (low to middle energy) that causes aesthetic (flattening on the malar region) and functional (limitation of mouth opening) problems. Additionally, the general assessment and evaluation followed a systematic approach: 1) Personal information of patients, which includes name, age, sex, and occupation. Chief complaint of patient, duration and nature of trauma. Medical history and surgical history; 2) Clinical examination extra orally including symmetry and general face character (lacerations, tenderness, flattening at the malar region, a step-off, ecchymosis, edema, enophthalmos, and diplopia) and intra orally included (oral hygiene, buccal vestibular ecchymosis, and range of mandibular motion); 3) Pre- and postoperative radiographic assessment for evaluating and measuring displacement of the fractured zygoma by using a computerized tomography scan or cone beam computerized tomography (Figures 1 and 2); 4) photographs (pre- and postoperative); and 5) postoperative follow-up period.

Figure 1: 3D view of preoperative Computerized. Tomomgraphy scan demonstrate right side zygomatic bone fracture

Figure 2: Postoperative radiograph.

Surgical procedure

During the surgical procedure, general anesthesia is administered to the patient via a nasotracheal tube. A transoral vestibular incision was made. reduction of the fracture site to obtain good anatomical alignment. Palpation of the infra- and lateral orbital rims to confirm adequate reduction; force duction test to exclude ocular muscle entrapment. Then finally fixation by single bone plate (1.5mm bone plate with a minimum of 4 screws) and suturing (Figure 3).

Figure 3: Intraoperative single miniplate with 4 screws across zygomaticomaxillary buttresses.

Post-operative care and follow-up

Pharmacotherapy, including antibiotics, was given to the patient and continued for 5 days, with anti-inflammatory agents for 2 days, and analgesics as needed. The patient was instructed to not sleep on the treated side of the trauma to prevent direct pressure on the fractured zygoma until primary healing occurs. This will take several 2-3 weeks and require a soft diet and good oral hygiene by brushing teeth and using chlorhexidine for mouth rinse. Additionally, the patient was asked to come for a follow-up and suture removal after seven days.

RESULTS

This study was conducted on nine patients—seven males and two females with a mean age of 23.7 (18 to 30 years) presenting with traumatic horizontal displacement zygomatic bone fractures; the efficacy of single-point fixation through an intraoral approach was assessed. The primary outcomes focused on patient demographics, postoperative stability, aesthetic results, functional recovery, and complication rates that are associated with operative time and hardware usage. The study primarily involved male subjects, which may indicate a sex predisposition to such fractures or reflect the demographics of trauma cases seen in the study setting. This observation could prompt further investigation into sex-specific risk factors or anatomical considerations in zygomatic fractures; also, there is a specific age group predilection that involves a young age group for both male and female patients (Figure 4).

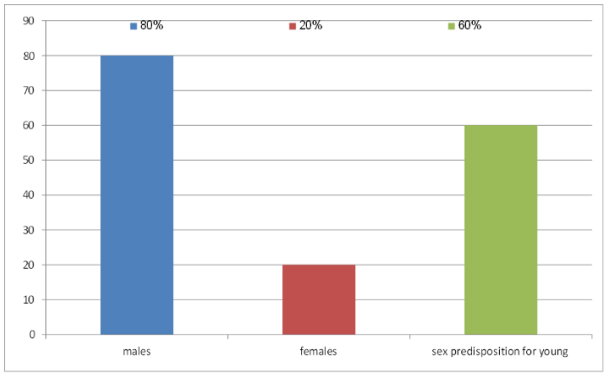

Figure 4: Sex-specific risk factors or anatomical considerations in zygomatic fractures.

Both male and female patients reported high satisfaction with the cosmetic results. The intraoral approach avoided external scarring, which was particularly appreciated by the patients. Clinical assessments confirmed the symmetrical facial contours and minimal postoperative swelling and bruising (Figure 5).

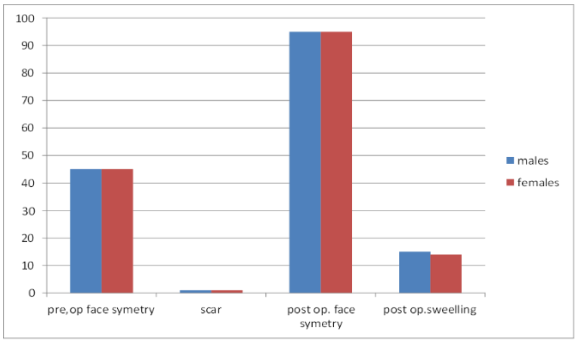

Figure 5: Results of the clinical assessment according to sex differences.

None of the patients are present with enophthalmos. None of the patients experienced significant functional deficits at the final follow-up or abnormal ocular movement. None of the patients demonstrates post-operative periorbital edema that interferes with vision. All nine patients demonstrated stable fixation at the follow-up appointments by clinical examination and radiological finding. Radiographic evaluations (cone beam computerized tomography) showed satisfactory alignment of the zygomatic bone in all cases, with no signs of displacement. Reduced anesthesia exposure, which reduces the risk of anesthesia-related complications such as respiratory depression, hypotension, and postoperative nausea and vomiting. Faster recovery, which makes the patients typically experience quicker initial recovery and a shorter hospital stay. Reducing overall healthcare costs and improving patient throughput. No intraoperative complication such as bleeding or vital structure damage, since the approach is intra-oral with minimal dissection. No postoperative complication. The patients were followed up for an average of six months. Throughout the follow-up period, no complications or issues with hardware were noticed (Table 1).

DISCUSSION

The current study was conducted on nine patients—seven males and two females with a mean age of 23.7. Young adult males are more exposed to trauma than females; this is consistent with many studies. The results of Kanala *et al*. study show men aged 20-40 years were the most common victims of facial trauma [8]. Generally, males are more frequently exposed to trauma than females across various age groups due to multiple factors and reasons (higher risk activity levels, more engagement in physical play and sports, and greater propensity for risk-taking behaviors, motor vehicle accidents, physical altercations, and certain occupational hazards), and due to the same reasons, young adult patients are exposed to trauma

more frequently than another age group, which goes with the Juncar *et al*. study, which stated that the incidence of maxillofacial fracture was high among patients in the 20–29 age group and male patients were more affected [9]. Both male and female patients reported high satisfaction with the cosmetic results.

Table 1: Results of patients' follow-up for six months

Demographics	n-9 (7 male, 2 female)	Mean age 23.7 years, range 18-30 years. Predominantly young males.
Fracture Type	Traumatic horizontal displacement	Zygomatic bone
Surgical Approach	Intraoral, single-point fixation	
Patient Satisfaction (Cosmetic)	High	Both male and female patients
External Scarring	Absent	Intraoral approach
Facial Contours	Symmetrical	Confirmed by clinical assessment
Post-operative Swelling/Bruising	Minimal	
Enophthalmos	Absent	
Functional Deficits	None	Normal ocular movement
Periorbital Oedema (Vision)	None	Did not interfere with vision
Stable Fixation	Demonstrated	Clinical examination and radiological findings
Zygomatic Bone Alignment	Satisfactory, No Displacement	Cone Beam Computerized Tomography
Anesthesia Exposure	Reduced	Reduced risk of complications (respiratory depression, hypotension, postoperative nausea/vomiting)
Recovery	Faster	Shorter hospital stay, improved patient throughput
Intraoperative Complications	None	No bleeding or vital structure damage
Postoperative Complications	None	
Hardware Issues	None	

Since the intraoral approach avoided external scarring, which was particularly appreciated by the patients, whereas two- or three-point fixation has an external scar at the lateral canthal or infraorbital rim area, which is not desired by the patient, and this agrees with the Kim *et al*. retrospective study, which resulted in none of the patients (1-point fixation in the ZM area) complaining of external scarring [10]. Also, clinical assessments confirmed the symmetry of the facial contours and minimal postoperative swelling and bruising without ectropion that may be associated with subciliary or subtarsal incisions, which are used for the extraoral approach [11]. Functional outcomes, including mouth opening and chewing ability, were assessed and found to be near normal within a few weeks; none of the patients experienced significant functional deficits at the final follow-up, and this is consistent with two or three-point fixations, which have the same results at this point. None of the patients demonstrate postoperative periorbital edema, while infraorbital approaches cause more edema, and this agrees with Aleem *et al*. [11]. All nine patients demonstrated stable fixation with no signs of displacement or hardware failure, whereas Davidson *et al.* stated that one point fixation produced unstable fixation in there vitro studies and they proposed that 2-point fixation using a Miniplates alone conferred a degree of stability comparable with most methods of 3- point fixation regardless of the site at which the Miniplates were applied [13], this may due to that the Davidson *et al*. study doesn't met the inclusion criteria of our study that we mention specification of the patients, whereas Kim *et al*. study show that all 34 patients achieved satisfactory bony stability and symmetric malar appearances with single point fixation [14]. In single-point fixation, there is no or a decrease in the need for another surgery session to remove hardware devices, whereas patients with two- or three-point fixation may need to remove hardware devices, especially lateral or infraorbital rim. Miniplates which is more prominent and became painful with time than intra oral miniplate at zygomaticomaxillary buttress, this agree with Raghoebar *et al*. study which states that no one of the patients with one point fixation experienced pain [6], and also agree with Balakrishnan *et al*. which state that this approach provided best result with minimal complications such as pain, palpability of implants [15] compared with two or three points fixation [16] and this has advantage of reduced anaesthesia exposure and reduces the risk of anaesthesia-related complications such as respiratory depression, hypotension, and postoperative nausea and vomiting; this is in tune with the results reported by Cheng *et al*. study which stats that complications increased significantly with prolonged operative duration [17] , Short operative time also lower the risk of surgical complications associated with a lower risk of intraoperative complications such as excessive bleeding and post-operative complication such as infection, and also faster recovery which make the patients typically experience quicker initial recovery and shorter hospital stays, reducing overall healthcare costs and improving patient throughput, whereas two or three point fixation need more time for more dissection to reach zygomaticofrontal suture, zygomaticotemporal suture, infraorbital rim, this is consistent with Hang Cheng *et al*. study which state that prolonged operative time can increase the risk of surgical site infection which has an effect on patient outcomes and health care economics, hospitals should focus efforts to reduce operative time [17]. No intra operative complication such as bleeding or vital structure damage since it is intra oral approach with minimal dissection whereas two or three point fixation may have intraoperative bleeding or vital structure damage due to more need for dissection to approach the infraorbital rim, zygomatico-frontal suture and zygomaticotemporal suture, also there is no major Post-operative complications, (infection, malunion, or

non-union) were reported in this study, but Shokri *et al*. find 7 of 162 patients in his retrospective study that analysed from 211 patients presents with intraoral plate exposure [18], plate exposure may be due to the patients fail to follow the instructions for maintain good oral hygiene or the patients could be medically compromised or soft tissue deficiency due to trauma, also there is no extra oral scar formation since it is intraoral approach whereas extra oral approach for ZFS leave a scar which was aesthetically unacceptable, this is consistent with Abhinandan Patel which state that multiple fixation is associated with more postoperative complications, such as infection and nerve palsy [19].

Study limitations

The limitation in this study is related to small sample size and difficulty in intraoperative assessment of the reduction sites.

Conclusion

Single-point fixation through an oral approach for minimally displaced fracture of the zygomatic bone is an effective treatment method; it demonstrates stable fixation, with good aesthetic outcomes, short operative time, reduced surgical risks, no postoperative complications, and a decrease in the need for another surgical session to remove hardware.

Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

Additional data is available from the corresponding author upon reasonable request.

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