Endoscopic Assisted Management of Orbital Floor and Infra-orbital Rim Fractures

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ABSTRACT

The Aim of this work is to evaluate the endoscopic approach in diagnosis and management of orbital fractures and to help us to find a protocol of the management of these difficult injuries efficiently and economically and trial to find new techniques in exposure and methods of fixation of commonly encountered orbital fractures from the perspective of plastic surgeons and to provide an overview for all practicing surgeons in training. 20 cases of orbital floor and rim fractures were managed between the period of may 2012 and may 2014 using the endoscopic assisted approach and followed up The endoscopic approach to the fracture site is a good assisted method in diagnosis and treatment of maxillofacial fractures, it is effective, with a lower complication rate. However; the endoscopic-assisted repair are generally related to fracture size, location, degree of comminution, and the surgeon's abilities

Keywords: *orbit, trauma, fracture, orbital floor, orbital rim, endoscopic managment, transantral*

INTRODUCTION

Among the multitudes of injuries seen in the trauma setting, facial injuries remain among the most common. Trauma to the maxillofacial area requires special attention. A thrall evaluation is mandatory during injuries of the face and head due to the anatomical proximity of the structures in the head and neck region. [(1)]

The evolution of the endoscopic assisted maxillofacial surgeries rooted from the experience from endoscopic sinus and skull base surgery, as well as arthroscopy of the TMJ (Tempro mandibular joint). The use of the endoscope in management of maxillofacial injuries has been prescribed for the treatment of fractures of the zygomatic complex, the mandibular condyle, the orbit and the frontal sinus. However, the classical open reduction and internal fixation of fractures using mini-plate osteosynthesis has remained unchanged. Limited incisions can be made using endoscopic assisted techniques and intraoperative control can be achieved following fracture reduction in areas of limited exposure and visibility[(2)]. However, the indications for open treatment of maxillofacial injuries have not changed due to these endoscopic approaches.

Because of the Orbital floor's inherent weakness floor fractures are common sequelae of orbital trauma [(3)]. Traditional orbital floor fracture repair involves access via the infraorbital, subciliary, or transconjunctival incision, with or without a lateral canthotomy with inferior cantholysis. [(4,5)] These approaches are relatively safe, with a few complication rate.[(6,7,8)] Possible complications associated with these incisions include visible scar formation, ectropion, entropion, lower lid retraction, prolonged lower lid edema, granuloma formation along the incision line, and iatrogenic injury to the lacrimal system and/or globe. Surgeons have developed minimally invasive techniques with endoscopy to help reduce the morbidity of orbital floor fracture repair. [(9,10,11,12)]

The Aim of this work is to evaluate the endoscopic approach in diagnosis and treatment of orbital floor and infra-orbital rim fractures in order to help establish a protocol for the efficient and economic management of these complex injuries.

PATIENTS & METHODS

20 patients with orbital floor and inferior orbital rim fractures whether isolated or in combination of facial bones fractures that presented and managed at Beni Sueif University Hospital and Kasr Al-Aini Hospital (Cairo University) during the period between May, 2012 and May, 2014.

The majority of patients were due to motor vehicles accidents. Other etiologies included: occupational hazards, street violence and fall from a height. The mean age for males was 28.82 years and that of the females was 22 years. The mean follow-up period was 15 months (range from 6 to 24 months).

All the patients underwent a full clinical assessment with complete history and general examination with the patient stable, a thrall preoperative assessment of facial skeletal structure is conducted. Local examination included facial nerve and intra oral examination were conducted as well as nasal and Ophthalmologic assessment to evaluate and document ocular status (Preoperative and postoperative examinations were performed to determine disturbance of ocular motility as evaluated with the Hess screen test). CT scan facial bone axial, coronal and sagittal cuts (0.5-1 mm) with 3D reconstruction was done for all cases preoperative, and a similar scan was performed 1 & 6 months postoperative. Pre-operative photography included frontal and lateral views as well as Intraoral Occlusal and maximal incisal opening views

The cases included in this study were ten cases of infraorbital rim fractures and ten cases of orbital floor fractures.

In the infraorbital rim fractures, internal fixation with plates and screws using combined endoscopic-assisted vestibular approach with subciliary approach in seven cases while the subciliary approach was used in only three cases.

In the orbital floor fractures we used combined endoscopic-assisted vestibular approach with sub-ciliary approach in seven cases and in the other three cases, we used endoscopic-assisted trans-antral approach combined with sub-ciliary approach.

The Technique:

The endoscopic-assisted transantral: approach was used in 3 cases with orbital floor fractures through transmaxillary fashion or through comminuted anterior maxillary wall fracture. With the patient under general anesthesia via oral endotracheal intubation, access to the lateral antral wall is achieved via modified Caldwell-Luc incision.

The approach involves an upper buccal sulcus incision and subperiosteal dissection to expose the maxilla and inferior orbital nerve.

The lateral antrostomy is made just below the nerve and above the canine tooth root is performed next with the positioning of two portals, each 6 to 7 mm in diameter, with the posterior osteotomy at the buttress area. The antrum acts as a natural optical cavity.

A 30-degree endoscope, with a xenon light source, 4 mm in diameter was used; however a 0 to 45 (or 70) degree scope can also be used (Figure 2).

The endoscope is inserted through one antrostomy (the vision portal), while instruments are manipulated through the working portal. The fracture site is visualized, and inspected. Each shelf is carefully dissected, and prolapsed orbital fat is repositioned cranially into the orbit (Figure 1).

Margins of the fracture were identified and sharp bony fragments were removed or con-formed. The endoscope was utilized in the reduction of floor fractures and in reduction of any prolapsed tissue back into the orbital cavity.

The endoscopic-assisted vestibular approach was used in 7 cases with infraorbital rim fractures and 7 cases with orbital floor fractures.

The orbital floor and the infraorbital rim were good visualized via the endoscopic-assissted transoral approach. The endoscope was used to assist in exploration of the orbital floor and to reduce herniated orbital tissue, as well as to identify the posterior shelf for implant placement.

The incision is similar to the one used for the standard intraoral approach for open reduction and internal fixation (ORIF) of the maxillary fractures. Next, the subperiosteal dissection will create an optical cavity. The 0-, 30-, or 45-degree, 4-mm diameter scope, xenon light-source.

The endoscope visualization of the fracture of infraorbital rim and floor are ideal.

Once optimal fixation is achieved and reduction established with the endoscope, the wound is closed and the appropriate documenta-tion is recorded.

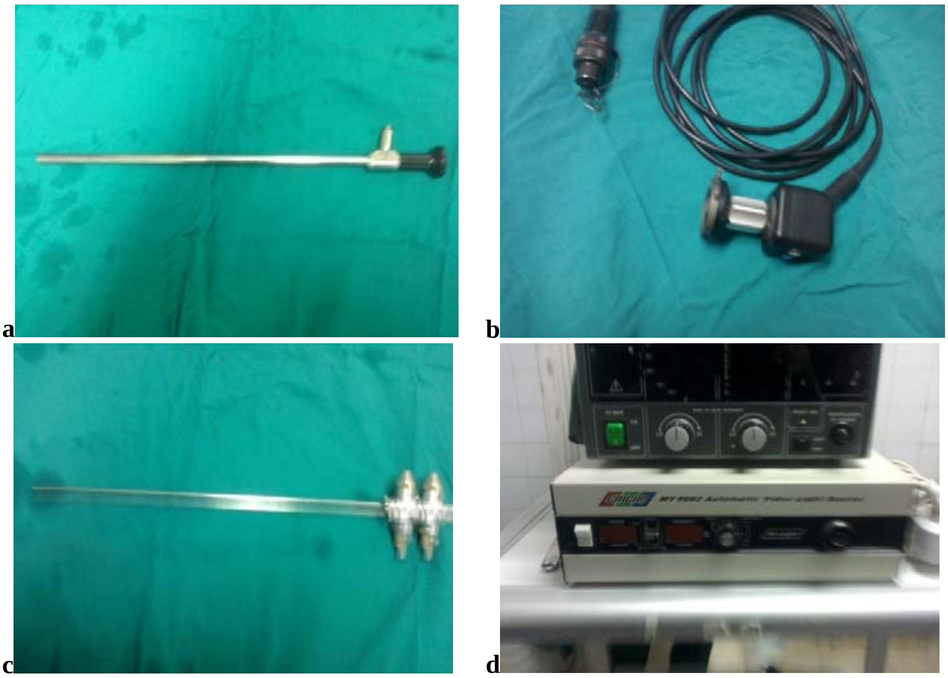
In comminuted or displaced fractures of the orbital floor and infraorbital rim, open reduction and placement of conchal cartilage or titanium mesh were used to reconstruct the orbital floor and infraorbital rim.

Subciliary approach were used in 20 cases with orbital floor fracture (10 cases) and infraorbital rim fractures (10 cases)

A temporary tarsorrhaphy after application of bland eye ointment was done first which was simply removed at the completion of the operation.

The infra orbital nerve was explored and decompressed in all fractures. Subciliary incision was closed by 6/0 prolene suture. Vestibular incision was closed 3/0 vicryl suture and Lateral eye brow was closed by 6/0 prolene suture.

After bony reduction and fixation has been completed, the reestablishment of soft-tissue relationships and suspension is vital.



a b c d

Fig. (1): Endoscopic Equipment's, a. endoscope, b. camera, c. suction irrigation d. video system

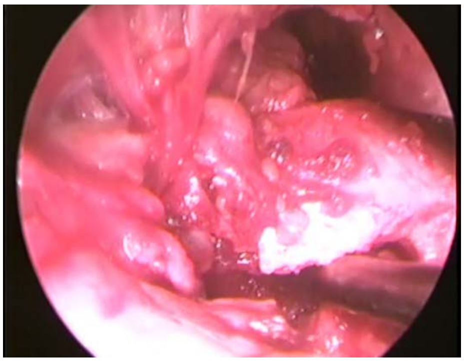


Fig. (2): Endoscopic-assissted transantral approach for reduction of orbital floor.

RESULTS

In this study 20 cases of orbital fractures were managed. All cases as one group for assessment of their Orbital Fractures (20 cases),

In rim fractures subciliary incision smaller than incision which usually been used in ORIF of the same fracture site were needed. So the complications usually associated with extensive incisions in subciliary approach may be decreased. Poor visualization in the conventional approach for operation of infraorbital rim may be avoided through the use of the endoscope. In performing aesthetic surgery for infraorbital rim with smaller scar and less morbidity, this technique may prove to be ideal. Also, in cases with orbital wall fractures poor visualization in the conventional approach for operation of orbital floor may be avoided by use of the endoscope.

Transantral orbital floor exploration also allows precise determination of orbital floor fracture size, location, and the presence of entrapped periorbital tissue. The information obtained using endoscopic techniques may be used to select patients who otherwise would not gain from lid approaches to the orbital floor and may possibly eliminate non therapeutic exploration. Transantral endoscopic orbital floor exploration aids with the reduction of complex orbital floor fractures and allows precise identification of the posterior shelf for implant placement. And we was needed to limited subciliary incision smaller than incision which traditionally been used in reconstruction of the same fracture site. So the complications usually associated with extensive incisions in subciliary approach may be decreased. Poor visualization in the conventional approach for operation of orbital floor may be avoided by use of the endoscope.

The results were evaluated and classified to Excellent, Good, Poor results according to the following parameters.

Availability and Assistance of endoscopy in the diagnosis and fracture exposure, reduction, and fixation, Size of subciliary incision and scarring, improved Visualization orbital floor, as well as operative and anaethesia times, Documentation and recording of the diagnosis and treatment of the fracture. Risk to neuromuscular structures. Stability of fixation, Improved teaching opportunities and learning curve for the endoscopic techniques, Satisfactory facial form, and symmetry, Post operative and follow up imaging (CT scan with 3D), Ophthalmic examination including enophthalmos and diplopia. Financial and cost for the use of the endoscope and finally Presence of complications and Patients' satisfaction.

With application of the evaluation system that previously described to the cases we find:

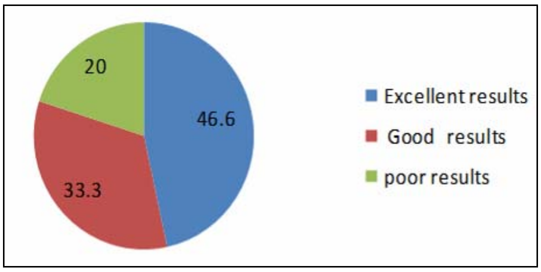


Fig. (3): Pie chart Evaluation of the results in cases treated with endoscopic-assissted technique.

Early complication included Wound Infection (Mandibular vestibular incision) in 2 cases. Mild diplopia in 2 cases and Neuropraxia of the infra-orbital nerve in 2 cases. At the 6 month follow up, disturbed sensation of the infra-orbital nerve was observed in 1 case, as well as a palpable and persistent discomfort from bone plates was observed in 1 case. And one case Presented by blindness of one eye due to already ruptured globe preoperative. Generally the postoperative results were satisfactory with a few complications. The extra time needed for the endoscopic procedures was less than 1 hour. Endoscopically assisted maxillofacial procedures can be performed with adequate visualization and direct manipulation of all facial bones. The most accepted endoscopic approach to the orbit is the transantral approach via an upper sulcus incision.[13] with Complications usually associated with extensive incisions in the surgical approaches may be decreased or avoided.

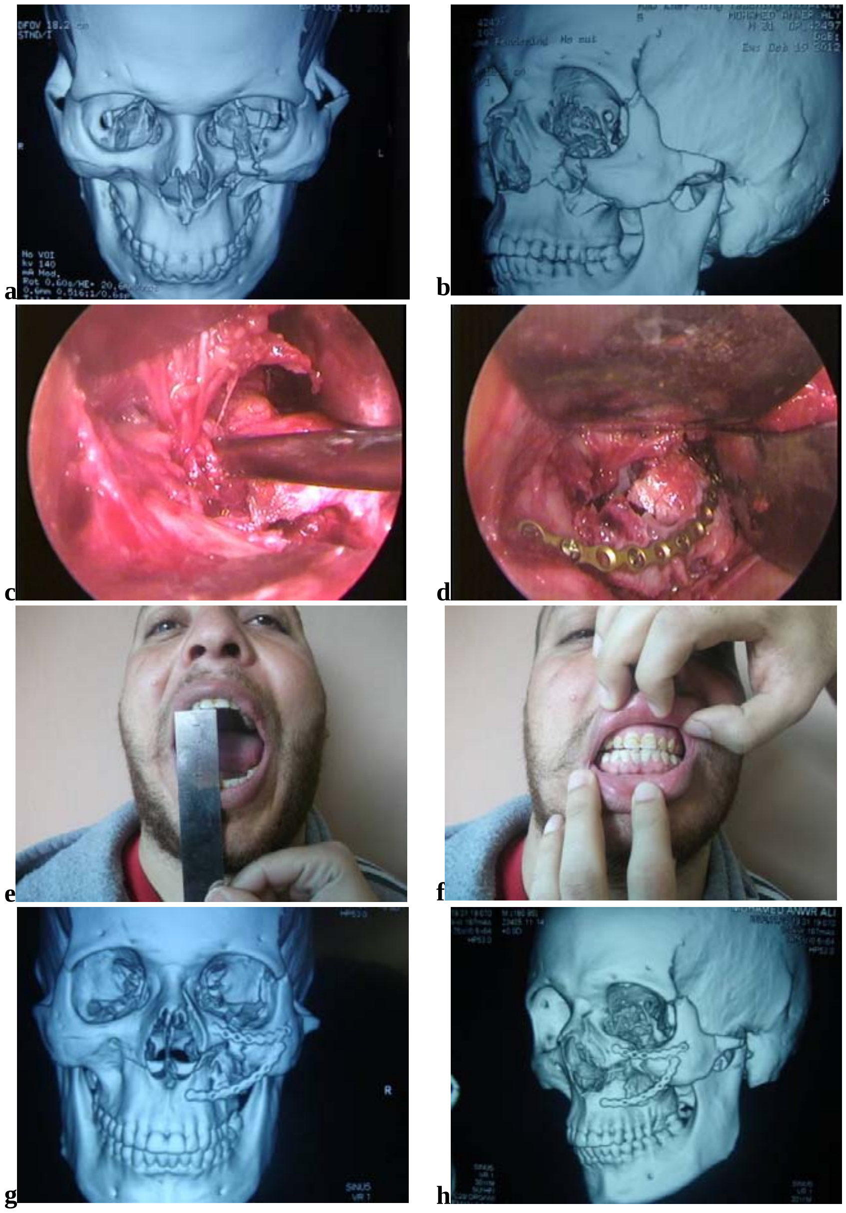


Fig. (4): (a & b) 35 years old male patient with Lt zygomatico-maxillary, Lt zygomatic arch, Lt infraorbital rim and Lt orbital floor fractures. Preoperative 3D CTof the patient show Lt zygomatico-maxillary, Lt zygomatic arch, Lt infraorbital rim and Lt orbital floor fractures. (c & d) Intraoperative endoscopic pictures showing,. infraorbital rim fracture and infraorbital nerve appear, patients underwent reconstruction of maxillary wall with bone graft and plates. (e & f) 6 Months post operative photography of the patient showing occlusion and mouth opening. (g & h) 6 Months post operative 3D CT reconstruction.

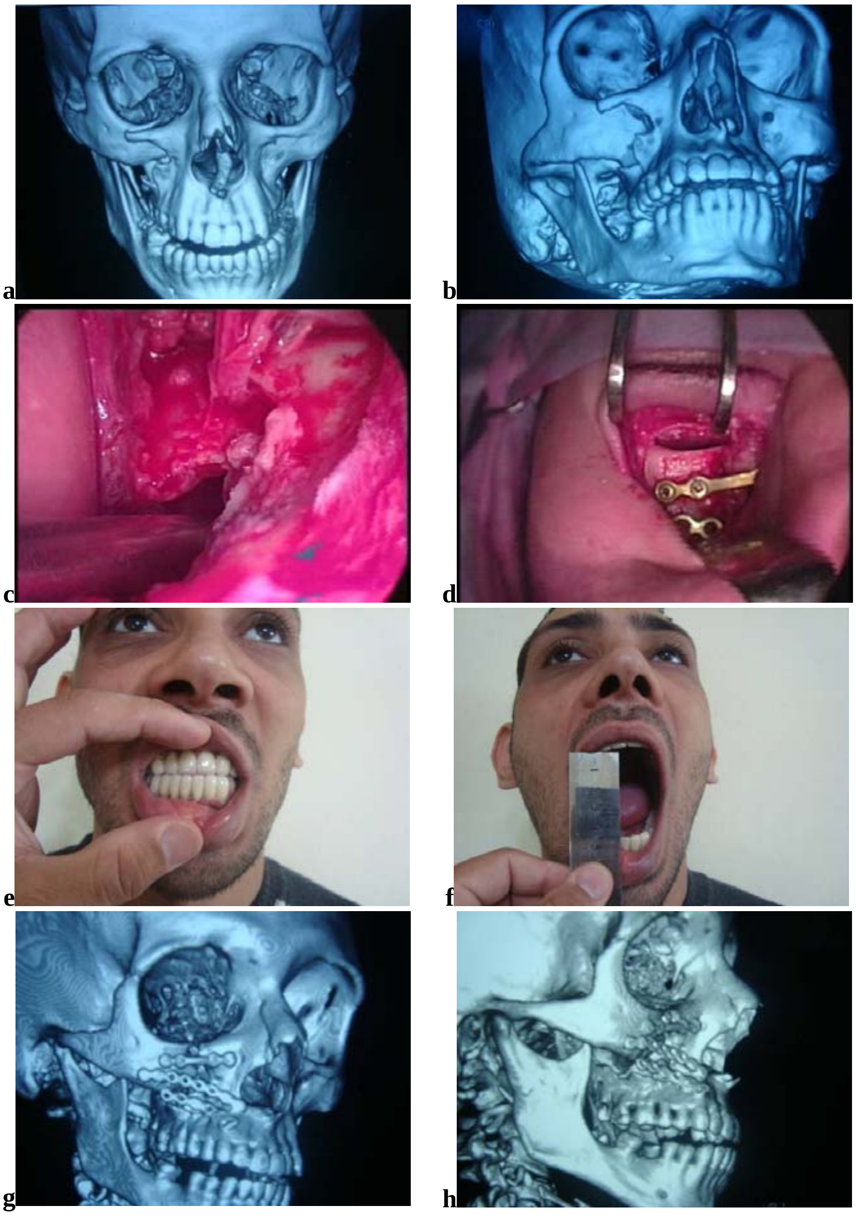


Fig. (5): (a& b) 32 years old male patient with Rt zygomatico-maxillary, Rt infraorbital rim and Rt orbital floor fractures. Preoperative CT with 3D of the patient show Rt zygomatico-maxillary, Rt infraorbital rim and Rt orbital floor (c & d) intraoperative infraorbital rim fracture, infraorbital nerve and vessels appear, fixation of infraorbital rim with plates, (e & f) 18 Months post operative photography of the patient showing occlusion and moth opening. (g & h) 6 Months post operative 3D CT reconstruction.

DISCUSSION

Orbital floor fractures are caused by a variety of traumas, including fights, sports injuries, and MVA and might result in the herniation of orbital contents into paranasal sinuses and its subsequent complications [(14)]. Early diagnosis using multiple methods and treatment of orbit fractures are important to achieve esthetics and preserve the function of the eye [(15)].

Indications for orbital floor fracture repair include entrapment, enophthalmos, or a large floor defect (>50%). The indications for endoscopic orbital floor fracture repair are similar, but should only be attempted by surgeons experienced in the techniques[(16)].

Through traditional approaches to the orbit, such as the subciliary incision or the conjunctival incision plus or minus lateral canthotomy, the fracture lines except of the posterior edge is well visualized before reduction of the prolapsed orbital contents. In addition, complications such as external scarring, ectropion, entropion, eyelid edema, and granuloma formation have been known to be associated with these open lid techniques also, exploring the status of the posterior edge and the orbital contents in detail is difficult[(17)].

Due to of the lower complication rates associated with smaller exposures and incisions, minimally invasive surgical techniques have been widely accepted. Indications for endoscopic repair are generally related to fracture location, size, degree of communication, and the surgeon's abilities. [(18)]

In a study by Sandler et al. [(19)] in 1999, in 7 patients, 6 orbital floor fractures were diagnosed with use of an endoscope, which was consistent with the results of CT scan images in the coronal section; the inability to diagnose one fracture case was attributed to the absence of disruption of the mucosa on the sinus roof.

In the study conducted by **Shirania et al** [(20)] the sensitivity of endoscope in the diagnosis of orbital floor fractures was 70% compared to the gold standard. However, the sensitivity was 85% in 3-mm CT scan images. The low sensitivity of the endoscope technique in that study might have resulted in the slow learning curve, especially in the first few patients. The final results show the importance of using fine 1-mm CT scan sections for the diagnosis of orbital floor fractures, especially in cases in which fractures are not limited to orbital floor and other areas are also involved; proving CT scan mandatory in diagnosis [(21)]. In addition, evaluation of CT scan images in coronal sections showed that frequency of fractures of internal wall of the orbit along with the orbital floor fracture was 25%; the frequency of such fractures has been reported to be 20% invalid reports and references [(22)]. In the endoscope group of the same study, only four patients needed to have implants placed after reduction of fractured segments based on the amount of the remaining defect; a cutaneous incision was made on the eyelid for implant placement. However, in the conventional technique group, visualization of the orbital floor was only possible with palpebral incisions because an endoscope had not been used and in 35% of the cases exploration of the orbital floor was carried out without implant placement, which can be considered non-therapeutic exploration.

In a study by Ellis et al. [(23)] on 235 patients with fractures of orbital floor, exploration of the orbital floor was carried out without justification in 65% of the patients. In addition, in a similar study by Covington et al. [(24)] in 1994 on 180 patients with fractures of the zygoma, who underwent treatment, exploration of the orbital floor was carried out in 37% of the patients without any therapeutic aims. Direct visualization of the orbital floor using an endoscope after reduction of fractured segments and making sure of the absence of involvement of periorbital tissues provides the surgeon with thorough information about the size and position of remaining defects and the need or lack of need for reconstruction of the orbital floor. In addition, the majority of orbital floor fractures are minute or linear without significant displacement of fractured fragments [(25)].

It was observed in this current study that the use of endoscopic assisted technique generally improved and assisted in the diagnosis and fracture exposure. Subsequently aiding in the size of subciliary incision with improvement of visualization of the orbital floor and resultant unnecessary postoperative scaring and complications. Also reducing of the risk of injury to the neuromascular structures achieving better results and aiding reduction and fixation stability.

Usually, exploration of the orbital floor is carried out through cutaneous incisions on the lower eyelid. However, ectropion and lid retraction are common complications. Further supported by **Shirania et al** [20], were comparison of the two groups showed an increased complication rate in the conventional group, including edema and scar of the lower eyelid, given the non-therapeutic exploration in this group, i.e., in the endoscope-treated group the complications were only confined to cases in which there was a definitive need for reconstruction of the orbital floor (20%). In the other group, this rate was 55%, significantly different from the other group. The incidence rates of ectropion in the endoscope and routine technique groups were 5% and 10%, respectively, with no significant differences in the rate of incidences between both groups. A recovery rate of 60% was also observed for sensory disturbances in endoscope-treated group versus 55.6% in conventional technique group, with no statistically significant differences between the two groups. Manson et al. [26] reported an incidence rate of 6-37% for temporary ectropion after palpebral incisions to gain access to the orbital floor. The rate has been reported to be 6-9% in the case of permanent ectropion, which needs surgical intervention for correction. [27]

In a study by Jungell and Lindqvist [27] in 1987 on 68 patients with fractures of the zygoma, 56 patients had sensory disturbances of the infraorbital nerve. After treatment of the fracture, a recovery rate of 58% was observed. In addition, Westermark et al.[28] in 1992 reported a disturbance rate of 80% for infraorbital nerve subsequent to trauma, with 22- 50% of the cases remaining disturbed even after treatment of the fracture.

When used by otolaryngologists in endoscopic sinus surgery, high-resolution endoscopes provide clear visualization and access to the orbital walls, reduce entrapped orbital tissue, and help identify the posterior shelf for implant placement. They clearly show the posterior border of the orbital floor fractures and infraorbital nerve accurately. In the current study an open lid incision was inevitable when implant placement was necessary. Endoscopy provided the possibility of dual manipulation and examination by two surgeons for the orbital floor when combined with a traditional approach from the eyelid. Also, dual vision from orbit and sinus can be achieved through temporally removing the inferior orbital rim, and is another choice. However, it does require a longer skin incision and wide dissection around the orbital rim and infraorbital nerve in order to perform osteotomy and plate fixation[29].

Eyelid skin incision may be avoided in transantral endoscopic orbital floor exploration in reconstruction of small orbital floor defects. There has been another report on using a larger maxillary antrostomy for endoscopic reconstruction of the orbital floor. However, accurate reduction and reconstruction without adequate information and manipulation from the orbital approach tends to be difficult, even among experienced surgeons. Typically, an incision in the eyelid skin or conjunctiva is necessary when reconstructing the orbital wall. In the infraorbital rim fractures combined endoscopic-assissted vestibular approach with subciliary approach conducted avoided the poor visualization in the conventional approach for operation of orbital floor, proving this technique to be ideal for orbital floor reconstruction with smaller scar and less morbidity[30].

Furthermore transantral orbital floor exploration allows for accurate identification of orbital floor fracture size, location, and the presence of entrapped periorbital tissue. The information gathered through endoscopic techniques may be used to select patients who would not benefit from lid approaches to the orbital floor and may possibly eliminate nontherapeutic exploration. Thus reducing the risk of complication transantral endoscopic orbital floor exploration assists in the reduction of complex orbital floor fractures and helps in precise visualization of the posterior shelf for implant placement. In addition, transantral endoscopic procedures can totally reduce entrapped periorbital tissue caught in a trapdoor type of fracture. This technique may prove to be ideal for orbital floor reconstruction with smaller scar and less morbidity. Also using the transantral orbital floor technique protects the lower eyelid–supporting structures against injury, however one of the inevitable side effects of maxillary antrostomy is post surgical numbness of the alveolus. Application of this technique in children is not possible, due to their having small antrum and tooth buds in the anterior wall of the maxilla,.

Also in the current study the postoperative course was satisfactory with a few postoperative complications. The added time required for the endoscopic procedures was less than 1 hour with improvement in the learning curve. Endoscopically assisted facial bone surgery may be carried out with good visualization and direct manipulation of all facial bones. Complications usually associated with extensive incisions in the surgical approaches may be decreased or avoided. Poor visualization in the conventional approach for operation of orbit, may be avoided by use of the endoscope. This technique may prove ideal for aesthetic surgery for the facial skeleton resulting in smaller scar and less morbidity.

CONCLUSION

The study of different approaches, modalities & methods of management orbital fractures helped us to define a protocol for the management of these difficult injuries efficiently and economically and also the best techniques in exposure and methods of fixation.

The endoscopic approach to the fracture site is a good assisted method in diagnosis and treatment of maxillofacial fractures, it is effective, with a lower complication rate. The endoscopic-assisted repair are generally related to fracture size, location, degree of comminution, and the surgeon's abilities.

Endoscopically assisted facial bone surgery can be performed with sufficient visualization and direct manipulation of all facial bones. In addition to reduction or avoidance of unnecessary complications typically associated with extensive incisions in the conventional technique. Inadequate field visualization in the conventional approach may be avoided through the use of the endoscope. This technique has shown to be ideal for aesthetic surgery for facial skeleton with smaller scar, good visualization and less morbidity.[16]

However; a current lack of dedicated instrumentation, a narrow field of view, a moderate learning curve for the techniques, a limited reduced ability for bimanual instrumentation without an assistant.

Never the less excellent results associated with use of endoscopic technique in diagnosis and management of orbit, fractures. The postoperative results were satisfactory with only a few complications. And the time required for the endoscopic procedures was less than 1 hour.

Also the potential of reduced hospital stays duration, and improved teaching opportunities (since the procedure can be displayed on a monitor) add to the benefits.

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