American Journal of Health Research
2014; 2(6): 392-396
Published online December 17, 2014 (http://www.sciencepublishinggroup.com/j/ajhr)
doi: 10.11648/j.ajhr.20140206.22
ISSN: 2330-8788 (Print); ISSN: 2330-8796 (Online)

Assessment of endoscopic role in management of facial fractures

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To cite this article:
Mohammad Noaman Mohammad Ali, Abdel-Hay Rashad El-Assy MD, El-Hussainy El-Hussainy Shreef MD, Yasser Abd El-wahab Khalil MD, Yasser Mohmmed Al-Sheikh MD. Assessment of Endoscopic Role in Management of Facial Fractures. *American Journal of Health Research.* Vol. 2, No. 6, 2014, pp. 392-396. doi: 10.11648/j.ajhr.20140206.22

Abstract: This study evaluates the usefulness of endoscopic repair in certain types of facial fractures (orbital floor, isolated zygomatic arch and isolated anterior table frontal sinus fractures).Endoscopic application in otorhinolaryngology has expanded into many areas including facial plastic surgery and facial trauma (orbital blow-out, frontal sinus, zygomatic arch, and subcondylar fractures), therefore limiting the use of incisions for exposure. Endoscopically assisted facial bone surgery can be performed with many advantages, including: magnified direct visualization, decreased scarring, avoidance of numbness beyond the incision line, greater acceptability to the patient, decreased complication rate and short hospitalization. For assessment of the value of endoscopy in repair of certain facial fractures, we selected 12 consented patients with either orbital floor fracture, isolated zygomatic arch fracture or isolated anterior table frontal sinus fracture to be involved in our study after stabilizing the general condition. The patients were evaluated preoperatively by an ophthalmologist and all had complete CT study including coronal, axial (both bony and soft-tissue windows), sagital and 3D images. The patients were analyzed for sex, age, time of surgery, pre/postoperative symptoms; including ophthalmic symptoms, facial paraesthesia and aesthetic problems. The results of our endoscopic approach were evaluated esthetically and functionally to be classified into good, fair and poor results. We also classified the level of the surgery according to its difficulty into difficult, average and easy surgical performance.Good results were achieved in 8fractures (42%); fair in 8fractures (42%) and finally 3fractures (16%) with poor endoscopic result. The performed surgery considered easy in 9 (41%) patients, average in 6 (31%) patients and difficult in 4 (21%) patients. All patients had no significant complications. Conclusion: Endoscopic repair appears to be a safe and effective technique for repairing certain types of facial fracture.

Keywords: Endoscopic Repair, Orbital Floor Fracture, Zygomatic Arch Fracture, Frontal Sinus Fracture

1. Introduction

The use of endoscopes in otolaryngology has expanded into many areas including facial plastic surgery (brow lift and face lift) and most recently facial trauma (orbital blow-out, frontal sinus, zygomatic arch, and subcondylar mandibular fractures) (1),therefore limiting the use of incisions for exposure via the minimal-access technique (2),(3).Endoscopy as a diagnostic and surgical modality for minimal invasive oral and maxillofacial surgery has been well-documented (4), (5) and gaining support because it achieves maximally beneficial results, even in complex surgeries (6).

Facial fractures are commonly repaired through a transcutaneous incision (subciliary, coronal scalp flap, open sky and midfacial degloving)(3).Although these incisions provide excellent exposure of facial bone but carry several possible disadvantages including the increased risk of blood loss, scalp scar, permanent forehead and scalp numbness posterior to the incision, traction palsy of the frontal branch of facial nerve, temporal depression (hollowing) related to atrophy of the temporal fat pad, displacement of the lateral canthal ligament resulting in an antimongoloid slant of the palpebral fissure, Inferior descent of the lateral cheek tissues

secondary to failure to reconstruct the incision in the temporal fat pad (2), (7), (8).

Endoscopic repair of facialfractures has recently been described.

1.1. Aim of the study

This study evaluates the endoscopic role in repair of certain types of facial fracture.

2. Patients and Methods

This was a clinical trial prospective cohort study of patients treated in plastic surgery department and ENT department, Menoufia university hospital, Egypt, over a 25-month period, April 2012 to May 2014. The study was approved by the ethical committee of the hospital. Twelve patients met the inclusion criteria for the study and consented to undergo endoscopic surgical repair. The patient's consent includes the acceptance for study conduct as well as the acceptance of using endoscope to be involved in our study. CT scan with axial, coronal, and sagittal views (soft and bony windows) was obtained in each patient at the time of presentation as well as 3D reconstruction of the facial skeleton.Every patient with an orbital fracture or ophthalmic problem was evaluated preoperatively by an ophthalmologist. The ophthalmic examination includes: visual acuity; color vision; extraocular muscles examination; pupil examination and optic nerve assessment.

The inclusion criteria include: fractures of the orbital floor, isolated depressed anterior table frontal sinus fractures and isolated fractures of the zygomatic arch. The exclusion criteria include: serious problems like any neurosurgical or ophthalmic lesions, isolated mandibular fractures, linear fractures (no surgical indication) of the anterior table frontal sinus or those associated with upper orbital margin fractures, zygomatic complex fractures rather than isolated fractures of the zygomatic arch, and orbital fractures of the medial wall, lateral wall or roof of the orbit, or concomitant fracture of the inferior orbital rim.

The endoscopic system used in fracture repair is consists of a standard 4-mm, 0 degree and 30 degrees telescope (Karl Storz GmBH &Co, Germany).

Regarding the orbital floor fracture, the endoscope was used to control the reduction of the orbital floor fracture and the prolapsed orbital tissue into the orbital cavity. If the fracture is a simple trap door fracture, replacement of the bone in an anatomic location with overlap of the edges is attempted.The reduced bone fragment is held in place by interfragmentary resistance. If the defect is large and the reduced fragment is unstable, a piece of titanium mesh can be used to fill the defect. If the implant is stable, a forced duction test is then performed to insure free movement without entrapment and displacement of the implant. The gingivobuccal incision is closed and no further packing is required.

For isolated fractures of the zygomatic arch, a preauricular incision at the margin of tragus, extending superiorly to the anterior margin of the helical crus, is made. A periosteal elevator is used to dissect beneath the superficial layer of the deep temporal fascia to create an adequate optical cavity, and then a 4-mm diameter, 30 degree angle endoscope (Karl Storz, Germany) is inserted. The fracture is repositioned with a periosteal elevator.

For isolated anterior table frontal sinus fractures, scalp mini-incisions are needed for this procedure. Using endoscope, a directed subperiosteal dissection was performed down to the level of the fracture. A 4.0-mm, 30-degree endoscope is inserted through the scalp incision to visualize the optical cavity. Under direct visualization, the periosteumis was then carefully elevated over the defect. The supraorbital and supratrochlear neurovascular pedicles may be visible at the orbital rim. Caution should be used to avoid excessive traction, which can result in postoperative paresthesias.The fracture was repositioned using small elevators and to reduce depressed segments. If the repositioned fracture appeared stable no fixation was necessary.With unstable repositioning an internal fixation with plates (miniplate 2.0 mm and microplates 1.5 mm) and screws were needed.After completing, the frontal bone was irrigated and checked with the endoscope, the wounds or incision sites were sutured in layers (Monocryl 4×0 and Vicryl rapid 3×0). No drains were used and a pressure dressing is applied.

2.1. Post-Operative

To prevent infection associated with fracture and surgery, patients were given third-generation cephalosporins for 5 days postoperatively.

Postoperative examination was performed clinically and radiographically (CT scan). CT scans were obtained 2 months postoperatively in patients with reduction only, whereas those underwent fixation (plates or mesh) the scanning was done 3 weeks postoperatively.

2.2. Outcome Analysis

There were a group of variables that had been studied for their relation to the outcome. These variables include: age, gender, symptoms at presentation, time elapsed between onset of the trauma to the surgical treatment and the postoperative hospital stay time.

We also classified the level of the surgery according to its difficulty into difficult, average and easy surgical performance.

The results of our endoscopic approach were evaluated esthetically and functionally to be classified into good, fair and poor results. The good results includes: return to the premorbid condition (regarding appearance and function) and absence of complications. The fair results includes: failure to return the patient completely to the premorbid condition with fair satisfaction (as regarding the appearance), minor complication not affecting the function significantly and/or minimal acceptable reduced sensibility. The poor results includes: persistence of the premorbid esthetical condition or

complications that affect the function significantly.

3. Results

In our study, 12 patients (10 males and 2 females) were managed with the described technique. The mean age was 26.6 years with a range of 18 to 38 years. The cause of trauma was assaults in 5 patients (41.67%), motor vehicle accidents in 6 patients (50%) and falling from height in 1 patient (8.33%).

The patients were diagnosed as having facial fractures and after applying the exclusion criteria of certain fractures, the total number of every isolated fracture was nineteen fractures that had been dealt with as a separate entity to be also studied away from others. So, the studied fractures were (19) selected within (12) cases and of course many patients (6) were diagnosed with combined fractures and others (6) with single fracture.

The patients were managed after a period of time ranged from 3 to 40 days from the initial trauma (mean 11.3 days); and with stabilized general condition.

Intraoperatively, 12 fractures (63.16%) from all 19 fractures had a titanium plate and screws or titanium mesh to support the reduced fractured bone (implant) and 7 fractures (36.84%) had a reduction only without need for implant.

The surgery performed was either endoscopic assisted surgery (12 fractures; 63.16%) or endoscopic approach (7 fractures; 36.84%). Regarding the difficulty of the performed endoscopic assisted surgery, we found that the operation was easy in 6 fractures (50%), of average difficulty in also 3 fractures (25%) and difficult in 3 fractures (25%). Regarding the difficulty of the performed endoscopic approach surgery, we found that the management was easy in 3 fractures (42.86%) of average difficulty in 3 fractures (42.86%) and difficult in 1 fracture (14.28%).

The patients spent 1 to 7 days as a postoperative hospital stay time (mean 3.66 days). Follow up assessment of the recovery which was based on clinical and radiological examination provided the following results: 8 fractures (42.16%) showed good recovery and 8 cases (42.16%) showed fair recovery; and the other 3 cases (15.77%) showed poor outcome, one of them (endoscopic approach for frontal sinus fracture) will need revision surgery and the other two zygomatic fractures already treated via the traditional open technique after failure of endoscopic exploration of the fracture sites.

4. Discussion

Endoscopic applications in otolaryngology continue to expand, most recently in the area of maxillofacial trauma (1). It wasreported that (7) in craniomaxillofacial surgery, endoscopy had been used since 1994, in many facial bone fractures, by many authors.

In current study of 12 patients represented 19 fractures with the previously determined inclusion criteria, we found that (83.3%) of the patients were males, as suspected from the etiology of facial trauma according to literatures, in addition to the age of the cohort with a range of 18 to 38 years old and the mean age was 26.6 years old. The trauma was mainly due to assaults or motor vehicle accidents and a minor contribution of falling from height in 1 patient (8.33%). This finding agrees with most reports, with sometimes more prevalence of motor vehicle accidents than other causes.

All patients spent a time for preoperative assessment and preparation, and in some there was a delay of presentation in our hospital up to 4 weeks, so the range of this time was 3 to 40 days with a mean of 11.3 days. We classified this period into 4 stages: up to 7 days, 8-14 days, 15-21 days and more than 21 days in order to study the relation between this time delay and both the difficulty and the result of the endoscopic surgery.

The all 8 orbital cases underwent reduction and implantation, whereas the all 5 zygomatic cases underwent reduction only without a need for implantation (fixation). Among the 6 frontal fractures, 4 (66.6%) of them had implant in the form of titanium plate and screws, and the other 2 cases (33.3%) were not in need of fixation as appeared intraoperatively.

The patients spent 1 to 7 days as a postoperative hospital stay time (mean 3.66 days). This period seemed to be an advantage over the traditional open method that ranged from one to two weeks (9), (10). This advntage was reported in many studies of endoscopic repair (11), (12).

To assess the endoscopic surgery from the point of the performance, we classified it into three levels; easy, average and difficult surgery. In our study, we found that the performed surgeries were easy in 47.4% (9 cases), average in 31.6% (6 cases) and finally difficult in 21% (4 cases).

Regarding the orbital fracture group (8 cases), the good results were observed in 50% of the cases. The remaining 4 cases were of fair results and belong to the endoscopic assisted group.

Regarding the zygomatic fracture group (5 cases), it was noted that in two patients (40%), the results were poor and in another two cases (40%), the results were fair. The result was “good” in only one patient (20%).

Regarding the frontal fracture group (6 cases), it is noted that the results were good in 50% of patients (3 cases). The fair outcome was observed in two cases (33.33%) and failed in one case (33.33%).

When we compare the difficulty of the performed endoscopic surgery among the three groups, we will observe that difficulty was significant in the zygomatic group (60%) without any easily performed surgery unlike the orbital group, where all surgeries were easily performed (100%). In the frontal group, the majority of surgeries were of average difficulty (66%), table (1).

On studying the effect of the time that elapsed between the onset of trauma and the surgical interference (Delay Time) and whether this factor had an effect on the difficulty of the endoscopic surgery and the result of the endoscopic usage, table (2). It is noted that the degree of difficulty is directly related to the time delay, on the other hand, it is noted that

the delay time is inversely related to the degree of postoperative results. We think that relation is logic as it is related to the effect of the fibrous tissue formed with time, which in turn make the dissection more difficult and worsen the result of any surgery.

There are other two factors; the endoscopic method (EAT, EAP) and type of repair (reduction+/- implantation), which studied for their relation to the difficulty or results of the endoscopic surgery. The endoscopic method has no statistical significant relation to the difficulty or to the result of the endoscopic surgery, table (3), while the type of repair is significantly related to the results of the endoscopic surgery, table (4). This means that implantation and fixation gives better results, because of the better alignment and improved healing and stability.

Table (1). *Distribution of difficulty of endoscopic surgery and results among the three anatomic fracture locations.*

EndoscopicMethod	Surgical Difficulty				Result			
	Easy	Average	Difficult	total	Good	Fair	Poor	total
EAT	6 (50%)	3 (25%)	3 (25%)	12 (100%)	3 (25%)	7 (58%)	2 (17%)	12 (100%)
EAP	3 (43%)	3 (43%)	1 (14%)	7 (100%)	5 (72%)	1 (14%)	1 (14%)	7 (100%)
total	9 (47%)	6 (31%)	4 (21%)	19 (100%)	8 (42%)	8 (42%)	3 (16%)	19 (100%)

Table (2). *The statistical correlation between the delay time and both difficulty and results.*

	Difficulty		Result	
Delay days	(r)	0.516	(r)	-0.605
	P value	.024	P value	0.006

Table (3).*The results of endoscopic application in relation to the endoscopic method.*

Variable		Result				Statistics	
		Good	Fair	Poor	Total	X^2	P value
End. method	Endoscopic approach.	5	1	1	7		
	Endoscopic assisted technique.	3	7	2	12	4.32	0.36
	Total	8	8	3	19		

Table (4). *The difficulty of surgery in relation to the endoscopic method.*

variable		Difficulty of surgery				Statistics	
		Easy	Average	Difficult	Total	X^2	P value
End. method	Endoscopic approach.	3	3	1	7		
	Endoscopic assisted technique.	6	3	3	12	0.74	0.692
	Total	9	6	4	19		

In our study, we found that endoscope provides excellent visualization of the medial and inferior walls of the orbit, which enables safe removal of bony fragments and clear anatomic reduction of fractures, as also reported by authors(9).

A significantly accepted outcome, regarding enophthalmos and diplopia improvement, was found in the orbital fracture group, therefore the endoscopically controlled repair of orbital floor fractures seems to be a more accurate and successful treatment. These results agree with that reported by authors (13).

We agree with authors (8) in the significant value of endoscope regarding the careful exposure of all fractures and the accurate reduction of these fractures in a three-dimensional fashion.

Some of the advantages of endoscopic repair were evident in our study. There were no postoperative complications associated with transorbital incisions, such as ectropion or unsightly facial scars that observed and reported in the external approach. The endoscope enables clear identification of the bony shelves so that the implant can be placed safely and with adequate support.

5. Conclusion and Recommendations

The application of endoscopy in managing certain types of facial fractures yields many advantages that will make the endoscope a valuable and dependable tool improving our results and lessening the traditional hazards of the other conventional non-endoscopic approaches.

We recommend the usage of the endoscopic approach in certain facial fractures especially in orbital floor fracture and isolated anterior frontal table fracture. In zygomatic fracture, the endoscope can be used as a helping tool especially for early intervention.

We recommend further investigations, including long-term follow-up and a larger series of patients, with further research as well as development of instrumentation specific for Maxillofacial Surgery which needs to be encouraged.

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