ORIGINAL RESEARCH

Endoscope Vs C-ARM Assisted Reduction of the Zygomaticomaxillary Complex Fractures

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ABSTRACT

Introduction: Amongst all bones of the facial skeleton, the zygoma and the mandible are highly accessible to the traumatic elements. Successful reductions of zygomaticomaxillary (ZMC) fracture are often difficult to evaluate clinically because of great amount of swelling. The purpose of this study is to evaluate the use of endoscope as a tool for intraoperative monitoring of ZMC fracture reduction and compare its efficacy with C-ARM guided ZMC fracture reduction. **Methodology:** Group A (experimental group) with 15 patients were treated for ZMC fracture reduction using endoscopic assisted approach. Group B (control group) comprised patients who were previously treated for ZMC fractures using C-ARM for intraoperative monitoring. The results of both techniques were evaluated using analysis of postoperative radiographs and comparison of both techniques was carried out. **Results and observations:** Endoscopic assisted approach was found to be advantageous over the use of C- ARM due to its radiation safety, ease in maintaining aseptic field, use of inconspicuous incisions and avoidance of blind dissection. However, the use of endoscope had several limitations like increased cost, increased operating time, need for trained personnel and difficult plate fixation.**Conclusion:** The use of endoscopic assisted approach has several advantages over the C-Arm guided method for reduction of zygomatic complex fractures. However, due to several limitations of the use of endoscope, routine application of the technique would require further exploration and study with a larger sample size.

KEYWORDS: Zygomaticomaxillay complex (ZMC) fracture, endoscope, C-ARM

INTRODUCTION

The exposure of the facial skeleton to injuries has alarmingly increased in India due to over population, poor road conditions and increasing number of speedy automobiles. Amongst all bones of the facial skeleton, the zygoma and the mandible are highly accessible to the traumatic elements.[1] In response to heavy forces, zygomatic bone gets separated from its neighbouring bones at or near the respective sutures. These disarticulations may lead to fractures of zygomatico-maxillary complex, zygomatic complex or fractures of orbitozygomatic region.[2]

Fractures of zygomatic complex present challenges in diagnosis and reconstruction for maxillofacial surgeons. Oedema that rapidly sets in makes clinical examination difficult, since the physical findings are masked. Successful reductions are often difficult to evaluate clinically because of great amount of swelling.[3]

Numerous techniques have been described to reduce zygoma fractures. The position of the fragment is usually confirmed by palpation; however digital exploration and crepitus are unreliable guide in some cases.[3] The assessment of the treatment of zygomatic complex fractures has also been done by visualization methods such as: computed tomography, photographs and radiographs. The gold standard for assessment of adequacy of reduction and postoperative healing of zygomatic complex is the use of CT.[4]

The photographic comparison of the face by frontal, profile, three quarter, bird's and worms eye views are to be done. These are useful for determining the malar symmetry, position of the globe (enophthalmos, papillary height), eyelid position and form, facial width and obvious scars.[5]

Conventional radiography imaging during surgery often presents difficulties in positioning the patient and delay in printing the film which increases the operative time [3]. Recently the use of C-ARM as an intraoperative imaging tool has facilitated optimal fracture site reduction, with a minimum amount of radiation exposure as compared to CT and has eliminated the need for postoperative radiographs.[1]

More recently, endoscopically assisted approach has also been used, which has facilitated fracture reduction using minimal access incisions.[6]

MATERIALS AND METHODS

Approval for the study was obtained from the ethical

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committee board of the institution. 15 patients with unilateral zygomatic complex fractures reporting to institutional hospital were included in the study for endoscopically assisted zygomatic fracture reduction. (group A or experimental group). Written and informed consent was obtained from all the participants.

15 patients who had previously undergone treatment of ZMC fracture in the same institute using C-ARM as a tool for intraoperative monitoring of fracture reduction were included in the control group (group B).[1]

Exclusion criteria includes undisplaced ZMC fractures, isolated blowout fractures of orbital floor, bilateral ZMC fractures, females in their pregnancy and patients with injury of the cervical spine. Standardized preoperative paranasal sinus (PNS) view and submentovertex (SMV) radiographs were taken (Fig.1,2).

Fig No.1: Preoperative PNS radiograph

Fig No.2: Preoperative SMV radiograph

Under standard surgical protocol naso-endotracheal intubation was carried out. The fracture site was exposed. In all patients, standard intraoral (buccal sulcus) approach was used for exposure of fracture over the zygomatic buttress area. The exposure of the fracture over the zygomatic arch in 12 patients was carried out through intraoral incision. In 3 patients an extraoral approach was used (incision in anterior margin of helical crus extending superiorly 2cm above the auricle) (Fig.3). Following the exposure of the fracture site over the zygomatic arch, the fracture line was viewed through the endoscope (Fig.4). The fracture reduction was then carried out under endoscopic assistance. The reduction was confirmed through the endoscope (Fig.5).

Fig No.3: Extraoral incision extending from anterior marging of helical crus superiorly upto 2cm

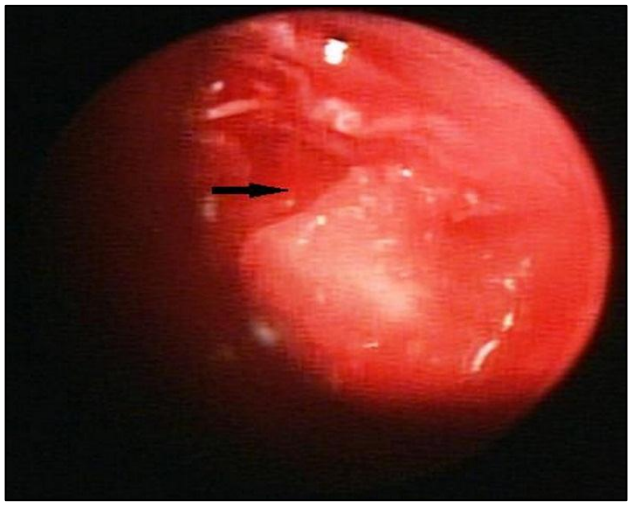

Fig No.4: Preoperative view of fracture line over zygomatic arch through endoscope

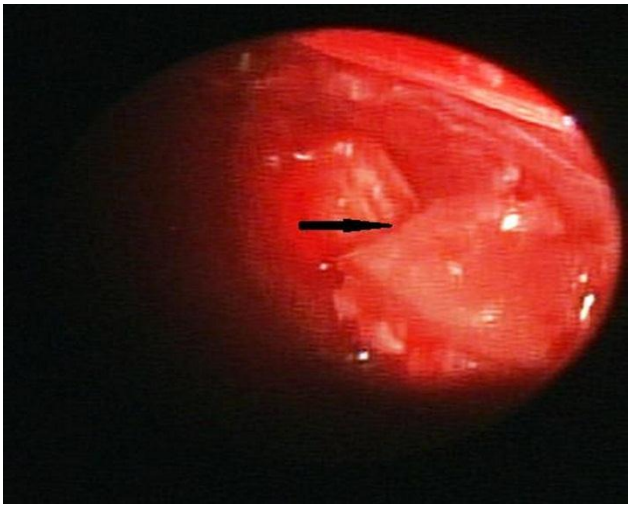

Fig No.5: Postoperative view of reduced zygomatic arch fracture through endoscope

Evaluation of the reduction of fractured segments was done on standardized postoperative PNS and SMV view.[7]

Analysis was done for size of the orbit, alignment in the regions of infraorbital rim, zygomatico-maxillary buttress, fronto-zygomatic suture and contour of zygomatic arch.[5] Millimeter ruler was used for measuring the alignment of medial and lateral portions of the infraorbital rim. Extrapolation of the outline of normal side to the fractured site was made and in cases of discontinuity, scoring was done with respect to the distance the lateral portion of the rim is above or below the medial portion and recorded. Displacement of ZMC fracture is given in relation to the alveolar process. A reverse acetate tracing of nonfractured site was made and placed over the fractured site to determine displacement value. Calliper and ruler was used to measure separation of the fronto-zygomatic suture and was recorded in millimeters. Contour of the zygomatic arch was classified as aligned, displaced laterally or displaced medially in comparison with normal (contralateral) side. A difference of > 2 mm between the treated and nonfractured side was considered significant and inadequately reduced (Fig.6, Fig.7, Fig.8, Fig. 9).

Statistical analysis to compare the two approaches based on the radiographic assessment was performed.

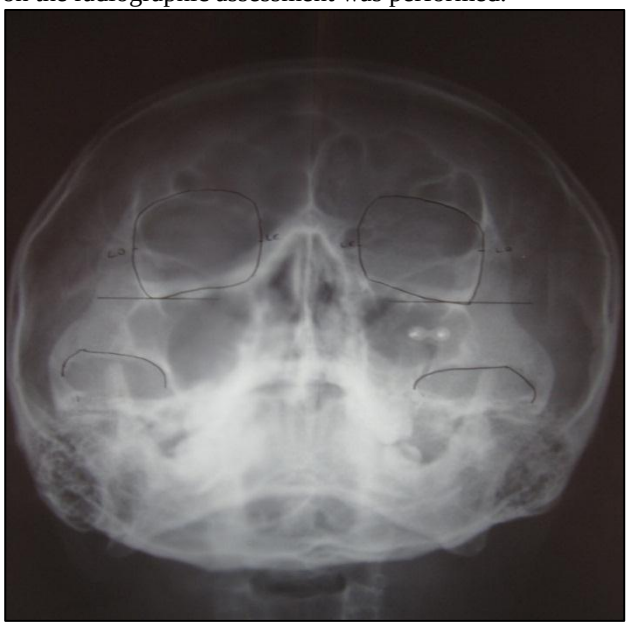

Fig No.6: Tracing on postoperative PNS radiograph

RESULTS

Both experimental and control groups presented with road traffic accidents as the primary etiologic factor for the injury (86.67% in group A and 80% in group B).

Analysis of postoperative PNS radiographs showed difference in the orbital size between right and left sides <2mm in all patients (**Table 1**). Both groups showed perfect alignment of infraorbital rim in 10 (66.67%) patients (**Table 1**).

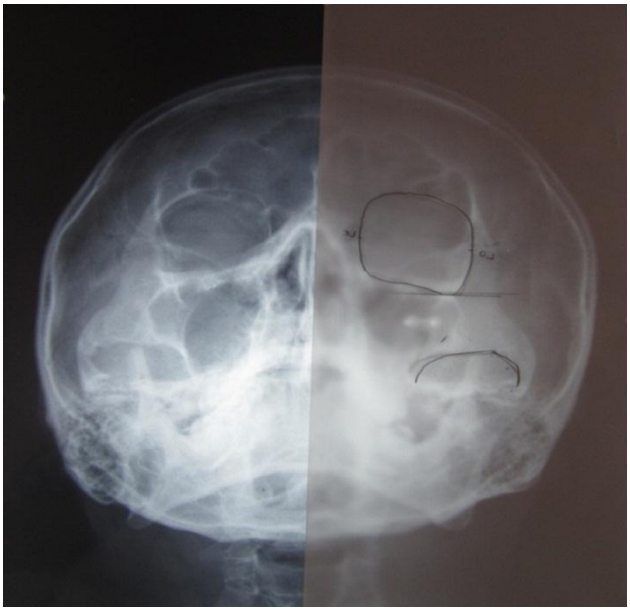

Fig No.7: After rotating tracing on PNS radiograph to opposite side

Fig No.8: Tracing on post operative SMV radiograph

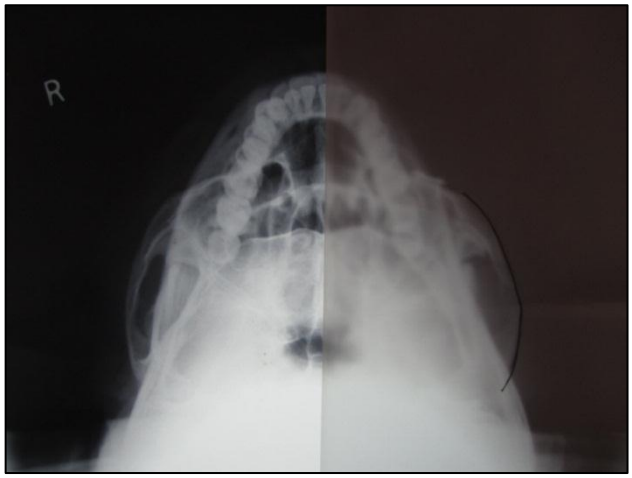

Fig No.9: 9.After rotating the tracing on SMV radiograph over the opposite side

In group A, five patients, while in group B, four patients showed perfect alignment of buttress. The difference was not statistically significant. All patients in both groups

showed reduction and alignment of zygomatico-maxillary buttress with a difference of <2mm, hence were considered to be adequately reduced (**Table 1**).

12 patients in Group A (80%) and 11 patients in Group B (73.33%) showed perfect approximation of fronto-zygomatic suture. This difference was not statistically significant. All patients in both groups showed approximation of fronto-zygomatic suture within 2mm difference, hence were considered adequately reduced (**Table 2**).

On analysis of postoperative SMV radiograph 13 patients in Group A and 12 patients in Group B showed perfect alignment of zygomatic arch. The difference was found to be statistically insignificant (**Table 2**).

Sr. no	Orbital size (in mm.)			Alignment of infra orbital rim			Contour of zygomatico-maxillary buttress		
	Right	Left	Diff	Cont.	Non cont (mm)		Aligned	Rotated	
					Superiorly	inferiorly		Superiorly	Inferiorly
1	40	40	0	Y	-	-	Y	-	-
2.	43	42	1	Y	-	-	Y	-	-
3.	41	40	1	N	-	1.5mm	N	1mm	-
4.	39	39	0	Y	-	-	Y	-	-
5.	43	43	0	Y	-	-	Y	-	-
6.	38	38	0	Y	-	-	Y	-	-
7.	40	42	2	Y	-	-	N	-	1.5 mm
8.	40	40	0	Y	-	-	N	-	1.5 mm
9.	42	42	0	Y	-	-	N	0.5 mm	-
10	41	42	1	Y	-	-	N	1mm	-
11	41	41	0	N	0.5mm	-	N	-	0.5 mm
12	40	42	2	N	1mm	-	N	-	1mm
13	40	41	1	Y	-	-	N	-	2mm
14	42	42	0	N	0.5mm	-	N	0.5mm	-
15	40	40	0	N	-	1mm	N	1mm	-

Table 1: analysis of postoperative PNS radiographs with respect to orbital size, alignment of infraorbital rim and contour of zygomatico-maxillary buttress.

Sr. No.	Approximation of fronto zygomatic suture		Contour of zygomatic arch		
	Y	N	Aligned	Bowed Laterally	Bowed Medially
1	Y	-	Y	-	-
2	Y	-	Y	-	-
3.	-	N, 0.5mm	Y	-	-
4.	Y	-	N	-	Y
5.	Y	-	Y	-	-
6.	Y	-	Y	-	-
7.	Y	-	Y	-	-
8.	Y	-	Y	-	-
9.	Y	-	N	-	Y
10.	Y	-	Y	-	-
11.	-	N, 1mm	Y	-	-
12.	-	N, 1mm	Y	-	-
13.	Y	-	Y	-	-
14.	Y	-	Y	-	-
15.	Y	-	Y	-	-

Table 2: analysis of postoperative PNS radiographs with respect to approximation of fronto-zygomatic suture and analysis of postoperative SMV radiograph with respect to contour of zygomatic arch

DISCUSSION

The aesthetic concern for preservation of an undisturbed facial appearance and function has led to adoption of less conspicuous incisions and decreasingly aggressive exposure. Hence, endoscopic assisted techniques of facial trauma repair are becoming increasingly popular.

Difficulty in intraoperative monitoring of reduction of fractures due to swelling highlight the necessity of an effective tool for intraoperative monitoring of the reduction of zygomatic fractures, so that the need for a secondary surgery is eliminated and more predictable and functionally acceptable results are obtained.[3,8] The aim of our study was the evaluation of the efficacy of endoscope as a tool for intraoperative monitoring of zygomatic complex fractures. Also, we carried out a comparative analysis of endoscopic assisted versus C-ARM guided approach for monitoring zygomatic fracture reduction.

Various studies in the literature have pointed out that flattening over the malar prominence is the commonest clinical presentation of zygomatic fractures [9,10]. However, majority patients in group A of our study presented with pain and tenderness and ecchymosis in zygomatic buttress region, while patients in group B mainly presented with subconjunctival hemorrhage as predominant feature.

Authors have made use of intraoral as well as extraoral incisions for approaching the zygomatic arch via the endoscopic assisted approach.[11,12] Krimmel el al[12] are of the opinion that though the zygomatic arch can be approached through the buccal sulcular incision, an additional incision extending 1.5 cm above the auricle is necessary to approach the proximal stump of the zygomatic arch. In our study, we incorporated the use of both intraoral as well as extraoral incisions (intraoral incisions in 12 patients and extraoral in 3 patients). In our opinion also, the extraoral incision is superior in comparison to intraoral incision due to its ease of access for approaching the proximal part of the zygomatic arch.

Both the techniques (endoscopic and C-ARM) in our study showed comparable efficacy for intraoperative monitoring of zygomatic complex fracture reduction.

Limitations to the use of C-ARM in intraoperative monitoring of fractures include the need for accurate patient positioning for a quality image acquisition, emission of ionizing radiation which makes the use of protective shielding devices mandatory and difficulty in maintaining an aseptic surgical field.[3,13] The use of endoscope helps to circumvent these limitations. Minimally invasive incision for reduction of arch fractures and avoidance of blind dissection were advantages of endoscopic assisted approach over C-ARM highlighted in our study. These were in accordance with previous studies.[14,15]

Several limitations of the endoscopic assisted approach, which have also been mentioned in previous studies[11,12,15] include increased cost of the equipment, need for trained

personnel, representation of three dimensional structures into a planar video, which affects the dimensional perception of the traditional operation, complicated plate fixation through percutaneous trocar, requiring an additional stab incision over the fracture site and increased initial operating time.

CONCLUSION

The use of endoscopic assisted approach has several advantages over the C-Arm guided method for reduction of zygomatic complex fractures. However, due to several limitations of the use of endoscope, routine application of the technique would require further exploration and study with a larger sample size.

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