RESEARCH ARTICLE

Intraoperative use of C-Arm as an Aid in Reduction of Zygomatic Complex Fractures

[1]Tejraj Pundalik Kale, [2]Abhishek Balani, [3]SM Kotrashetty, [4]SD Baliga

[1]Associate Professor, Department of OMFS, KLE VK Institute of Dental Sciences, Belgaum, Karnataka, India

[2]Postgraduate Student, Department of OMFS, KLE VK Institute of Dental Sciences, Belgaum, Karnataka, India

[3]Professor and Head, Department of OMFS, KLE VK Institute of Dental Sciences, Belgaum, Karnataka, India

[4]Professor, Department of OMFS, KLE VK Institute of Dental Sciences, Belgaum, Karnataka, India

Correspondence: Tejraj Pundalik Kale, Associate Professor, Department of OMFS, KLE VK Institute of Dental Sciences, Belgaum Karnataka, India, e-mail: tejrajkale@yahoo.com

Abstract

To monitor the efficacy of C-Arm as a intraoperative tool in reduction of zygomatic complex fractures. 15 patients with isolated zygomatico-maxillary complex fracture, were selected for reduction of the same. C-Arm (image intensifier) images were taken intraoperatively. Standardization of all postoperative radiographs were done to evaluate the discrepancy in reduction. The maximum discrepancy after analysis of postoperative radiographs was within 2 mm, which was considered as acceptable limit. Thus, C-Arm is considered a useful tool for reduction of zygomatico-maxillary complex fractures with enhanced postoperative esthetics and functional results.

Keywords: C-Arm, zygomatico-maxillary complex fractures, postoperative analysis.

INTRODUCTION

Zygomatic bone being most prominent and unique in anatomical position is highly susceptible to trauma. It represents a primary buttress between mid face and the cranium.[1] In zygomatic complex (ZMC) fractures correction of esthetics and function are of prime importance. Successful reductions are often difficult to evaluate intraoperatively because of significant swelling around the periorbital, malar region[2] enhanced by communition of dependable anatomic landmarks. Immediate postoperative evaluation of fractured segments is not possible clinically due to edema, thus post-operative radiographs are needed.[2,3] CT scan is considered as the gold standard in preoperative diagnosis and for post-operative evaluation for adequate reduction.[4] In orthopedics surgery C-Arm is routinely used intraoperatively to assess adequate reduction and alignment of fracture segments, which eliminates the extra-cost incurred for postoperative CT scans. The study evaluates use of C-Arm in reduction of zygomatic complex fractures, which is easily available in hospitals with orthopedic services.[5]

MATERIALS, PATIENTS AND METHODS

In a level III trauma care center 15 patients with isolated zygomatico-maxillary complex fracture were included in the study. Written and informed consent was obtained. Patients with undisplaced fractures, bilateral fractures, pregnant and lactating mother and isolated blow out fractures were excluded from the study.

With a routine preoperative preparation Naso endotracheal intubation was carried out and multiple C-Arm views were taken preoperatively to assess the fractured site. Following this fractured site was exposed and reduction was carried out. C-Arm images were taken to confirm the reduction of fractured site. Fixation was done with titanium miniplates as per requirement and was confirmed with C-Arm images (Figs 1 and 2).

Evaluation of the reduction of fractured segments was done on standardized postoperative PNS and SMV view. Standard PNS radiograph with 80 mA exposure and 70 kV power was used.[6] Beam was perpendicular to the film through midsagittal plane at the level of maxillary sinus. For submentovertex view exposure of 10 mA and penetration power of 50 kV was used.[6] All the radiographs were taken with a Siemens 300 mA unit. Radiographic film used was Kodak 8*10 inches. All the radiographs were taken by a single operator with a standard tube film distance of 109 cm. Analysis was done for alignment of infraorbital rim, alignment at zygomatico-maxillary buttress region, approximation of fronto-zygomatic suture and contour of zygomatic arch (Figs 3 and 4).[7] Alignment of medial and

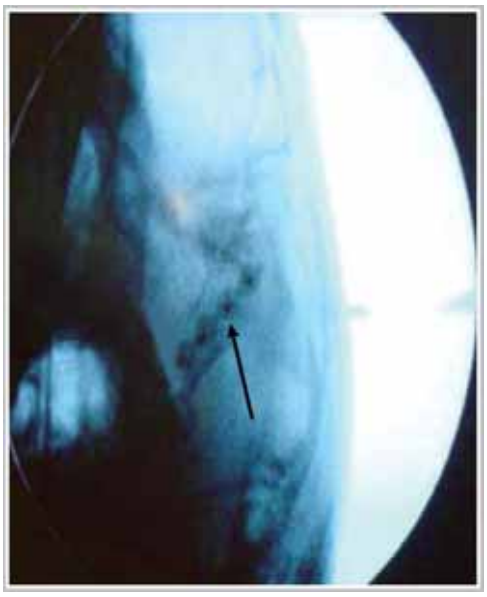

Fig. 1: Postoperative C-Arm view (buttress fixation)

Fig. 3: Postoperative PNS analysis

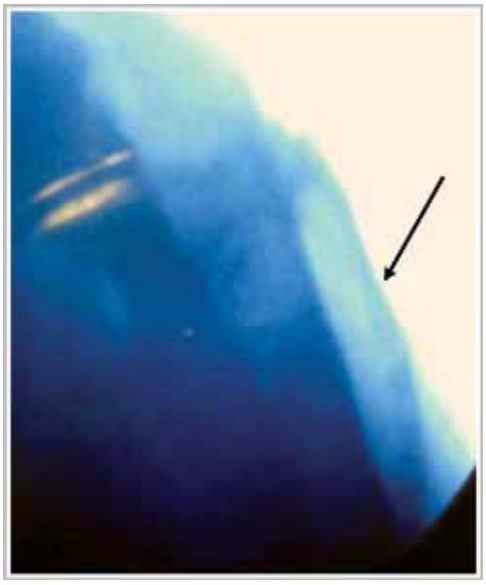

Fig. 2: Postoperative C-Arm view (arch elevation)

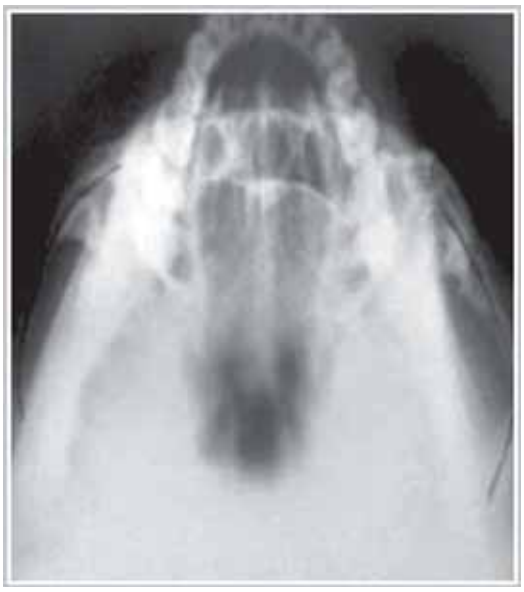

Fig. 4: Postoperative SMV analysis

lateral portions of the infraorbital rim was measured with a millimeter ruler. In case of discontinuity, the lateral portion of the rim was scored certain distance above or below the medial portion, by extrapolating the outline of normal side tracing to the fractured site, change was recorded. Amount of displacement of zygomatico-maxillary complex is showed in relation to the alveolar process. An acetate tracing of nonfractured site was reversed and placed over the fractured site to assist the determination of this value. The difference in position was recorded. Separation of the fronto-zygomatic suture was measured in millimeters with a caliper and ruler. Contour of the zygomatic arch was compared with contralateral side and was classified as aligned, displaced laterally or displaced medially.

A difference of > 2 mm between the treated and non-fractured side was considered significant and inadequately reduced.[7]

RESULTS

Of the 15 patients 5 patients had radiographic evidence of infraorbital rim fracture, 4 were undisplaced and clinically

Table 1: Postoperative PNS analysis

S. no.	Patient details	Alignment of infraorbital rim			Contour of zygomatico-maxillary buttress		
		Cont.	Non cont. (mm)		Aligned	Rotated	
			(Superiorly)	(Inferiorly)		Superiorly	Inferiorly
1	30 yr/M	Yes	–	–	–	1 mm	–
2	45 yr/M	Yes	–	–	–	0.5 mm	–
3	44 yr/M	No	–	1.5 mm	–	–	1 mm
4	36 yr/M	Yes	–	–	Aligned	–	–
5	28 yr/M	No	–	0.5 mm	Aligned	–	–
6	31 yr/M	No	–	1 mm	–	–	1 mm
7	25 yr/M	No	–	0.5 mm	–	–	1 mm
8	23 yr/M	Yes	–	–	–	–	0.5 mm
9	37 yr/M	Yes	–	–	–	–	0.5 mm
10	33 yr/F	Yes	–	–	–	–	1 mm
11	28 yr/M	Yes	–	–	–	–	1 mm
12	24 yr/M	No	–	0.5 mm	Aligned	–	–
13	31 yr/M	Yes	–	–	–	0.5 mm	–
14	33 yr/F	Yes	–	–	Aligned	–	–
15.	29 yr/F	Yes	–	–	–	–	1 mm

Table 2: Postoperative PNS and SMV analysis

Patient no.	Patient details	Approx. of F-Z suture		Contour of zygomatic arch		
				Aligned	Bowed laterally	Bowed medially
1	30 yr/M	–	No (1 mm)	Aligned	–	Bowed medially
2	45 yr/M	Yes		–	–	–
3	44 yr/M	Yes		–	Bowed laterally	–
4	36 yr/M	Yes	–	Aligned	–	–
5	28 yr/M	–	No (1 mm)	Aligned	–	–
6	31 yr/M	Yes	–	Aligned	–	–
7	25 yr/M	Yes	–	Aligned	–	–
8	23 yr/M	–	No (0.5 mm)	Aligned	–	–
9	37 yr/M	Yes	–	Aligned	–	–
10	33 yr/F	Yes	–	–	–	Bowed medially
11	28 yr/M	–	No (0.5 mm)	Aligned	–	–
12	24 yr/M	Yes	–	Aligned	–	–
13	31 yr/M	Yes	–	Aligned	–	–
14	33 yr/F	Yes	–	Aligned	–	–
15	29 yr/F	Yes	–	Aligned	–	–

asymptomatic. Diplopia was noted in 1 patient, who underwent surgical exploration to release the entrapped inferior rectus and infraorbital fixation was done with miniplates (Table 1).

Four postoperative PNS radiographs with (26%) fracture at buttress revealed good alignment and fixation. Mild inferior displacement was evident in 8 postoperative PNS views (< 2 mm) and in 4 cases (26%) the buttress was displaced superiorly < 2 mm (Table 1). Tracings and superimposition showed good alignment at fronto-zygomatic region in 11 cases (73%), and separation of 2 mm was evident in 4 cases (Table 2).

SMV for zygomatic arch contour revealed accurate superimposition of all the 12 sides (80%) and were comparable with the nonfractured sides. Two postoperative SMV radiographs revealed medial displacement (< 2 mm) of the arch and lateral displacement in one case (< 2 mm) (Table 2).

All postoperative radiographs were taken in standardized way. Only data which showed discrepancy of more than 2 mm were considered significant or as inadequately treated. Postoperative superimposition and analysis of PNS view revealed a maximum discrepancy of 2 mm, which was evident in four cases of fronto-zygomatic fractures and eight cases of zygomatic buttress fractures. Analysis of SMV view showed mild discrepancy in arch contour in three cases. An overall discrepancy of less than 2 mm was evident in analysis of all the four regions on postoperative radiographic analysis (Tables 1 and 2).

DISCUSSION

The zygomatico-maxillary complex is an essential component of facial esthetic units and is subjected to trauma more often than any other bone of the face except the nose.[7] The four most important considerations in treating zygomatic complex fractures are adequate reduction, rigid fixation, orbital reconstruction when necessary and careful handling of periorbital soft tissues. Intraoperative reduction at times may be inadequate, which is evident on post-operative radiographs or after facial swelling has subsided and facial asymmetry becomes obvious.

The C-Arm (image intensifier) used to check for reduction and alignment of fracture segments, aided with SMV projection provides excellent intraoperative control for reduction of zygomatico complex fractures to achieve acceptable facial width. Image intensifiers exposes the patient and surgical team to radiation (C-Arm), however this radiation dose is 60 to 80% less as compared to spiral CT.[8] Unfamiliarity with the maxillofacial imaging technique can lead to difficulty for proper projection in supine position, sharing of common space at the head end with anesthetic equipment are certain difficulties encountered during the procedure. Working consistently with the same team can overcome this drawback and increase the comfort level. Increased operation time and added equipment increases the cost of the procedure but reduces the total financial burden on the patient by preventing the need for secondary surgery for residual deformity.

CONCLUSION

Use of C-Arm plays an adjunctive role in treating zygomatic complex and arch fractures by eliminating operator related error.

REFERENCES

1. Peter Ward Booth. Maxillofacial Surgery (2nd ed). 2007;1:120.
2. Badjate SJ, Cariappa KM. C-Arm for accurate reduction of zygomatic arch fracture: A case report. British Dental Journal 2005;199:275-77.
3. Heiland M, Schulze D, Blake F, Schmelzle R. Intraoperative imaging of zygomatico maxillary complex fractures using a 3D C -Arm system. Int J Oral Maxillofac Surg 2005;34:369-75.
4. Pohlenz, Blessmann, Blake, Heinrich, Schmelzle. Clinical indications and perspectives forintraoperative cone beam computed tomography in oral and maxillofacial surgery. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103: 412-17.
5. Woolley EJ, Jones DC. The use of the image intensifier in fractures of the zygomatic arc: A technical note. Int J Oral Maxillofac Surg 2005;34:440-42.
6. White, Pharoh. Oral Radiology 2002;198-202.
7. Ellis, Kittidumkerng. Analysis of treatment for isolated zygomatico-maxillary complex fractures. J Oral Maxillofac Surg 1996;54:386-400.
8. Linsenmaier, Rock, Wirth, Brandl, Mutschler, Pfeifer. Three dimensional CT with a modified C-Arm image intensifier: Feasibility. Radiology 2002;224:286-92.