

Intraoral Approach to Zygomatic Complex Fracture: Modified Technique for Infraorbital Rim Fixation

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Abstract

Diverse surgical approaches are widely used for exposure, evaluation, and treatment of ZMC fracture, orbital trauma and pathology in the orbital floor and infraorbital rim. They were conveniently categorized as either transcutaneous or transconjunctival. The purpose of this research is to see the efficacy of intra oral approach for zygomatic complex fracture and infra-orbital rim fixation.

Patients and methods: 30 patients were subjected to reduction and fixation of infraorbital rim fracture through intraoral modified keen’s approach. Time of surgery, Post-operative Edema, Mouth opening, Occlusion-on 7th day, 3rd week and 6th week, Paresthesia over infraorbital region, continuity of infraorbital rim and Infection were evaluated. All patients were followed up for six months.

Results: All cases included in the current study did not show any lower eyelid complications, postoperative

paraesthesia. However, oedema was noted on 2nd and 3rd day which subsided gradually without any consequences.

Conclusion: Intraoral approach by modified keen’s techniques allows adequate access to the zygomaticomaxillary buttress and infraorbital rim with only 1 incision, optimizes surgical time, decreases complication rates, and avoids periorbital scarring in the patient.

Keywords: Infraorbital Rim, Zygomaticomaxillary, Intraoral Approach, Modified Keen’s Technique.

Introduction

The face occupies the most prominent position in the human body rendering it vulnerable to injuries quite commonly. The prominence of the zygomatic region predisposes it to bearing the strain of facial injuries⁵.The zygoma also comprises a significant portion of the inferior and lateral orbital walls; thus, fracture of the zygoma

warrant investigation into fractures of the orbit. It has four articulations, referred to as the ZMC complex :Zygomaticotemporal (ZT) suture - The temporal process of the zygoma articulates with the zygomatic process of the temporal bone to form the anterolaterally projected zygomatic arch (ZA) Zygomaticomaxillary (ZM) suture and the infraorbital rim (IOR) Zygomaticofrontal (ZF) suture Zygomaticosphenoidal (ZS) suture¹²

It has an important role in protecting the eye, and participates in the formation of orbital cavity, the maxillary sinus, the temporal fossa, and the zygomatic arch. The main causes of fractures are trauma due to RTAs, assaults, falls, sports related injuries, and the civilian warfare's⁸.

The zygomaticomaxillary complex (ZMC) plays a key role in the structure, function and aesthetic appearance of the facial skeleton. It provides normal cheek contour and separates the orbital contents from the temporal fossa and maxillary sinus. It provides lateral globe support necessary for binocular vision., left zygoma is most commonly affected owing to greater incidence of right handed individuals, but this is not so in unilateral fractures caused by motor vehicle accidents, the goal of treatment should be reestablishing both cosmesis and function⁹.

Surgical intervention is not usually taken up unless a functional or esthetic impairment in the form of reduced mouth opening and depression of the cheek prominence is encountered. There are several techniques for the reduction of the fractured zygomatic complex, including the Gillies temporal approach, hook elevation, and the upper buccal sulcus technique. Others include the intranasal trans-antral approach, reduction through the sigmoid notch, and the lateral coronoid technique. Elevation of the zygoma may also be accomplished through a bicoronal or lateral eyebrow incision. The intraoral approach for zygomatic fracture reduction was

first described in 1906 by Lothrop, who elevated fractured zygoma through a fenestration in the canine fossa, elevating the lateral antral wall, and the zygomatic complex, with a blunt instrument. The upper buccal sulcus technique was originally described by Keen in 1909, and has been used successfully for many years, even as an outpatient technique under local anesthesia.⁶

Currently, the intraoral approach for surgical treatment of zygomatic complex fractures has received special attention. It was first described by Keen in 1909, using the upper sulcus technique. Later, other studies showed different variations of this technique to reach the zygomatic arch and buttress. However, in most cases, infraorbital margin fixation was still performed through the subtarsal, subciliary, or transconjunctival approach.

As variety of approaches have been described for the repair of zygomatic complex fractures. These include extra-oral and intra-oral methods. Intra-oral methods reduce the surgical time and are most aesthetically acceptable as compared to the extra-oral methods. However, there is a compromised visibility and access to the fracture site with intra-oral incision. The current technique overcomes the limitations of intra oral technique without any morbidity. The purpose of this study is to describe certain modifications made to the intraoral approach to allow better access to the zygomatic buttress and the choice of the fixation method for these so as to achieve best possible results with minimal surgical morbidity⁶.

In our study we have described the modifications made to the intraoral approach to allow reduction and fixation of the infraorbital rim in zygomatic fracture

Patients and Methods

In the present study Prospective Interventional study on 30, were selected from the Department of Oral and Maxillofacial Surgery of HKES S. Nijalingappa Institute

of Dental Sciences and Research at Basaveshwar Teaching and General Hospital, Gulbarga, Karnataka between the period of 2017 to 2019 Patients who had zygomatic complex fracture involving displaced infra-orbital rim fractures were selected for the study.

Inclusion Criteria included were patients requiring open reduction and internal fixation for zygomatic complex fracture , Minimally displaced fractures(fig.1). Exclusion Criteria were Comminuted orbital floor fracture , Infected fractures ,Patients with oral submucous fibrosis , Medically compromised patients

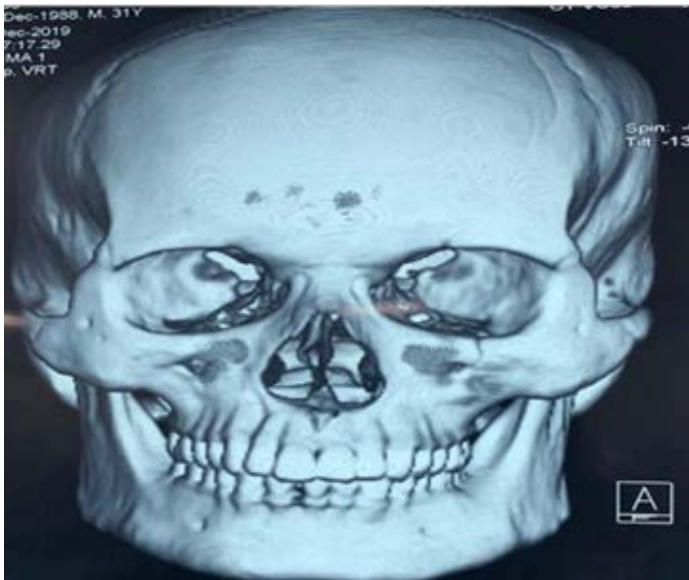


Fig.1

Thirty patients who fulfilled the above criteria were selected for the study. Pre-operative assessment and detailed case history was recorded. Systemic examination was done to rule out the diseases associated with central nervous system, cardiovascular system, respiratory system and gastrointestinal system. General physical examination was done to ascertain the absence of any associated injury to the thorax, abdomen, genitourinary tract or long bones. In the local examination, inspection and palpation of the extra oral and intraoral soft tissues followed by a detailed examination of the underlying hard tissue was done. The following signs and symptoms were checked. Preoperative

assessment :Extra-oral, Fracture sites, Step deformity at infraorbital rim, Infraorbital nerve paresthesia ,Malar prominence(fig.2). Periorbital oedema /ecchymosis, Subconjunctival haemorrhage ,pain ,diplopia .Intra-orally Trismus ,Ecchymosis and tenderness over maxillary buccal sulcus and Occlusion.



Fig. 2

Intraoperatively assessment done for Approach/Incision used for reduction and fixation of the fracture sites (fig.3) ,Time taken for the procedure ,Stability obtained or not with intra oral approach.



Fig. 3

Post operatively all the patients were evaluated clinically and radiologically(fig.4) Patients were evaluated for the following parameters

- a. Oedema
- b. Mouth opening
- c. Occlusion-on 7th day, 3rd week and 6th weeks postoperatively
- d. Parasthesia over infraorbital region
- e. Bimanual palpation to check the continuity of infraorbital rim
- f. Infection



Fig. 4

Routine Blood and Urine investigations & Radiographic examinations were carried out.

Radiographs, 3D CT view from frontal to mandible ,PNS skull.

Before the surgery Physician fitness were obtained for all the patients included in the study and a written informed consent was taken from all the patients included in the study by explaining the risks and benefits associated with procedures. All the thirty patients underwent open reduction and internal fixation using intraoral approach by modified keen`s technique under general anesthesia.

All patients are given prophylactic antibiotics intravenously half an hour before the procedure. Procedures were performed under general anesthesia using nasal endo-tracheal intubation/oral intubation. The patients were scrubbed with 2% cetrimide hydrochloride, normal saline and 5% povidone iodine and draped as per standard protocol. Irrigation of the oral cavity was done with

0.2% Chlorhexidine gluconate solution. Surgical approach for the fractures was through the intraoral approach Infiltration was done with 2% Lignocaine Hydrochloride and 1:80,000 adrenaline. The lip was then retracted and an horizontal incision of around 2 cm length is made by using a no. 15 blade in the upper buccal sulcus, extending from lateral incisor to first molar area(fig 3), modification of the incision, a 1 cm long vertical incision is given in the periosteum starting from the base of the zygomatic buttress and carried upwards along the buttress. The periosteum is then reflected sideways to expose the ascending limb of the buttress. With this modification, complete buttress up to the anterior part of the zygomatic arch can be exposed. After attaining adequate access, the zygomatic bone and infraorbital rim fracture site was exposed, reduced and fixation done ,after obtaining satisfactory occlusion, temporary Intermaxillary fixation (IMF) was done using Erich`s arch bar or ivy loop eyelet wiring if needed. Fixation was done using titanium plates and screws. A water tight wound closure is done using Vicryl intraorally . Adhesive pressure bandage was given extraorally and intermaxillary fixation was released. throat pack removed and extubation was done.

Duration of the procedure was noted. Soft diet was recommended for 6 weeks postoperatively after releasing IMF. Postoperatively patient was recalled for regular follow up to assess the Step deformity at infraorbital

rim(fig.4), Infraorbital nerve paresthesia , Periorbital Oedema, Sub conjunctival haemorrhage, Mouth opening and occlusion .

Results

In concordance with most trauma studies, there is a male predominance observed in this study. Out of the 30 patients who met our criteria, 28 (93.3%) were male, while 2 patients were (6.7%) female. (Table 1and Graph 1)

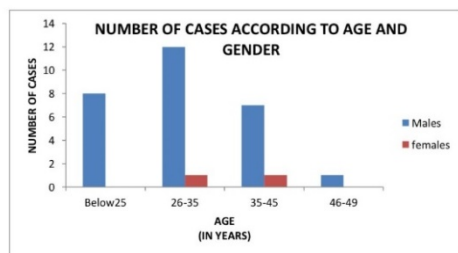
TABLE - 1
AGE AND GENDER WISE DISTRIBUTION OF CASES

AGE	MALE		FEMALE		TOTAL	
	NO.	%	NO.	%	NO.	%
≤25	08	26.7	0	0.0	08	26.7
26-35	12	40.0	01	3.3	13	43.3
36-45	07	23.4	01	3.3	08	26.7
≥46	01	03.3	0	0.0	01	03.3
TOTAL	28	93.4	02	6.6	30	100.0
MEAN±SD	29.79±10.43		45.0		30.3±10.43	

INFERENCE

- ✓ Mean age in the group is 30.3±10.43
- ✓ In the study maximum no. of patients are males 28 (93.4%) and only 2 (6.6%) patient is female

The age distribution range in this study was wide with patients of age, 17 to 59 years included in the study. But, the age group of 26-35 years was the most commonly encountered as seen in 12 patients (40 %). The Mean age of the patients is 30 years. (Table 1and Graph1)



GRAPH 1 - AGE AND GENDER WISE DISTRIBUTION OF CASES

The major etiological factor involved in this study was the road traffic accidents as seen in 20 patients (66.7%), while assaults was the cause in 2 patients (6.6%) and self-fall

lead to the trauma in 8 patients (26.7%). (Table 2 and Chart2)

TABLE - 2
ETIOLOGY WISE DISTRIBUTION OF CASES

ETIOLOGY	NO. OF CASES	PERCENTAGE
RTA	20	66.7
ASSAULT	02	06.7
FALL FROM HEIGHT	08	26.6
TOTAL	30	100.0

INFERENCE

- ✓ Maximum no of cases is due to RTA 20 (66.7%) followed by fall from height cases 8 (26.6%)

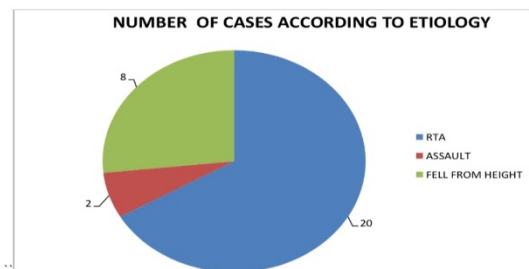


CHART 2 - ETIOLOGY WISE DISTRIBUTION OF CASES

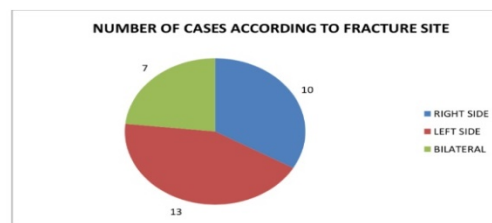
It is observed in this study that, while 10 patients (33.33%) sustained fracture of the right side fracture and 13 (43.33%) had sustained left side fracture and 7 (23.34) had bilateral fracture. (Table 3 and Chart3)

TABLE- 3
DISTRIBUTION OF CASES BASED ON FRACTURE SITE INVOLVED

FRACTURE SITE	NO. OF CASES	PERCENTAGE
RIGHT SIDE	10	33.33
LEFT SIDE	13	43.33
BILATERALLY	7	23.34
TOTAL	30	100

INFERENCE

- ✓ Study reveals that (43.33%) of cases involve left side followed by (33.33%) on right side



GRAPH 3 - DISTRIBUTION OF CASES BASED ON FRACTURE SITE INVOLVED

Time duration for the surgery which was measured from the start of placement of incision to the placement of last

suture ranged between 25 minutes to 55 minutes with mean time duration of 37 minutes. (Table 4 and Graph 4)

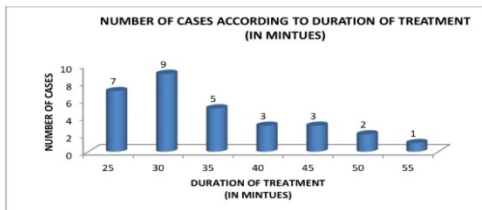
TABLE - 4

TREATMENT DURATION WISE DISTRIBUTION OF CASES

TIME DURATION	NO. OF CASES	PERCENTAGE
25 MINUTES	7	23.3
30 MINUTES	9	30.0
35 MINUTES	5	16.7
40 MINUTES	3	10.0
45 MINUTES	3	10.0
50 MINUTES	2	6.7
55 MINUTES	1	3.3
TOTAL	30	100.0

INFERENCE

- ✓ Mean time duration for the treatment was 37.0±9.43minutes
- ✓ Out of 30 sample cases there are 21 (70%) cases have time duration less than or equal to 35minutes



GRAPH 4 - TREATMENT DURATION WISE DISTRIBUTION OF CASES

Pre-operative step deformity at the infra-orbital margin was present in all the 30 patients (100%). Post-operatively this was persistent in 2 (6.67%) patient. (Table 5 and Graph 5)

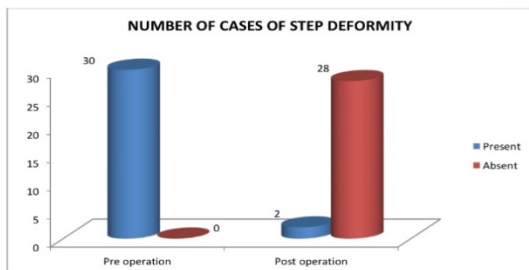
TABLE - 5

COMPARISON OF STEP DEFORMITY IN PRE-OP AND POST-OP

STEP DEFORMITY	PRE-OP		POST-OP	
	NO. OF CASES	PERCENTAGE	NO. OF CASES	PERCENTAGE
PRESENT	30	100.0	2	6.7
ABSENT	0	0.0	28	93.3
TOTAL	30	100.0	30	100.0

INFERENCE

- ✓ $\chi^2=48.817, P<2.81e-12(S)$
- ✓ There is statistically very highly significant difference of step deformity in pre-op and post-op.



GRAPH 5 - COMPARISON OF STEP DEFORMITY IN PRE-OP AND POST-OP

Pre-operative infraorbital nerve paresthesia which was present in 25 patients (83.33%), persisted post-operatively in 3 patients (10%) which resolved over a period of 2- 3 months. (Table 6 and Graph 6)

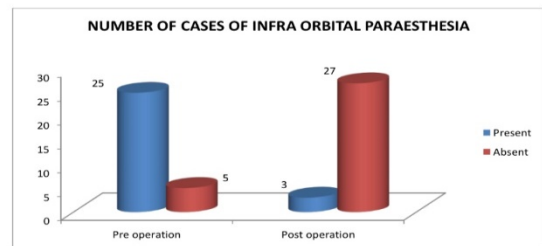
TABLE 6

COMPARISON OF INFRAORBITAL NERVE PARESTHESIA IN PRE-OP AND POST-OP

INFRAORBITAL	PRE-OP		POST-OP	
	NO. OF CASES	PERCENTAGE	NO. OF CASES	PERCENTAGE
PRESENT	25	83.3	3	10.0
ABSENT	5	16.7	27	90.0
TOTAL	30	100.0	30	100.0

INFERENCE

- ✓ $\chi^2=29.531, P<5.502e-08(S)$
- ✓ There is statistically very highly significant difference of infraorbital nerve paraesthesia in Pre-op and post-op



GRAPH 6 - COMPARISON OF INFRAORBITAL NERVE PARESTHESIA IN PRE-OP AND POST-OP

Peri-orbital oedema which was seen in all the 30 patients (100%) is observed to have reduced during the postoperative period. (Table 7 and Graph 7)

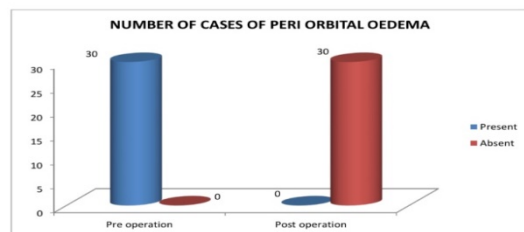
TABLE - 7

COMPARISON OF PERIORBITAL OEDEMA IN PRE-OP AND POST-OP

PERIORBITAL OEDEMA	PRE-OP		POST-OP	
	NO. OF CASES	PERCENTAGE	NO. OF CASES	PERCENTAGE
PRESENT	30	100.0	0	0.0
ABSENT	0	0.0	30	100.0
TOTAL	30	100.0	30	100.0

INFERENCE

- ✓ $\chi^2=56.07, P<7.005e-14(S)$
- ✓ There is statistically very highly significant difference of periorbital oedema in pre-op and post-op



GRAPH 7 - COMPARISON OF PERIORBITAL OEDEMA IN PRE - OP AND POST-OP

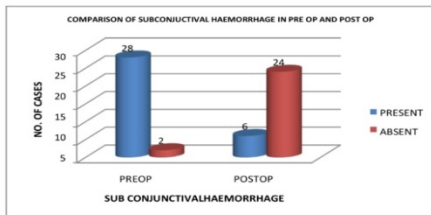
The presence of sub-conjunctival hemorrhage was seen in 29 patients (96.67%) which persisted during the post-operative period in 5 (16.67%) patients. (Table 8 and Graph 8)

TABLE- 8
COMPARISON OF SUB CONJUNCTIVAL HAEMORRHAGE IN PRE-OP AND POST-OP

SUB CONJUNCTIVAL HAEMORRHAGE	PRE-OP		POST-OP	
	NO.OF CASES	PERCENTAGE	NO.OF CASES	PERCENTAGE
PRESENT	29	96.7	05	16.7
ABSENT	01	03.3	25	83.3
TOTAL	30	100.0	30	100.0

INFERENCE

- ✓ $X^2=35.905, P<2.072e-09(S)$
- ✓ There is statistically very highly significant difference of sub conjunctival haemorrhage in pre-op and post-op



GRAPH 8 - COMPARISON OF SUB CONJUNCTIVAL HAEMORRHAGE IN PRE-OP AND POST-OP

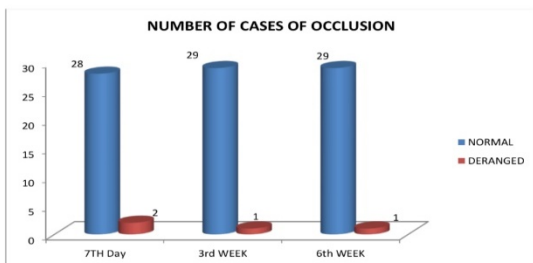
The occlusion was observed to be deranged in 2 patients on 7th day, and normal in 28 patients on 7th day, and 29 patients during 6th week post operative. (Table 9 and Graph 9)

TABLE 9
COMPARISON OF OCCLUSION IN POST-OP

OCCLUSION	7 th Day	3 rd week	6 th week
NORMAL	28	29	29
DERANGED	2	1	1

INFERENCE

- $X^2=0.52326, P<0.7698(S)$
- There is statistically very highly significant difference of occlusion in post-op



GRAPH 9- COMPARISON OF OCCLUSION POST-OP

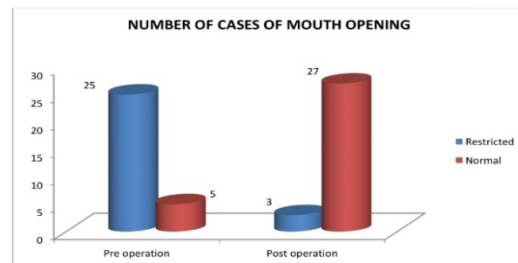
The mouth opening was observed to be restricted in 25 (83.33%) patients which was observed to have improved in 22 patients with the other 3 patients (10%) having restricted mouth opening post-operatively. (Table 10 and Graph10)

TABLE 10
COMPARISON OF MOUTH OPENING IN PRE-OP AND POST-OP

MOUTH OPENING	PRE-OP		POST-OP	
	NO.OF CASES	PERCENTAGE	NO.OF CASES	PERCENTAGE
RESTRICTED	25	83.3	03	10.0
NORMAL	05	16.7	27	90.0
TOTAL	30	100.0	30	100.0

INFERENCE

- ✓ $X^2=29.531, P<5.502e-08(S)$
- ✓ There is statistically very highly significant difference of mouth opening in pre-op and post-op



GRAPH 10 - COMPARISON OF MOUTH OPENING IN PRE-OP AND POST-OP

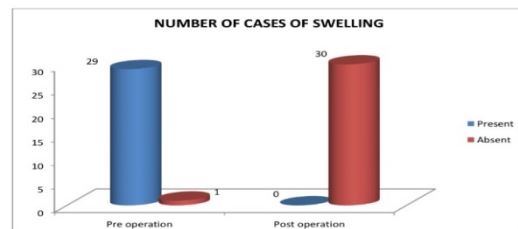
Swelling were present in the 29 patients (96.67 %) pre operatively and not found in any patient Post operatively 3rd week. (Table 11 and Graph 11)

TABLE 11
COMPARISON OF SWELLING PRE-OP AND POST-OP

SWELLING	PRE-OP	POST-OP
PRESENT	29	0
ABSENT	1	30

INFERENCE

- ✓ $X^2=52.325, P<4.074e-13(S)$
- ✓ There is statistically very highly significant difference of swelling in pre-op and post-op.



GRAPH 11 - COMPARISON OF SWELLING IN PRE-OP AND POST-OP

Table 5: comparison of step deformity in pre-op and post-OP

Step deformity	Pre-op		Post-op	
	No. of cases	Percentage	No. of cases	Percentage
Present	30	100.0	2	06.7
Absent	0	0.0	28	93.3
Total	30	100.0	30	100.0

Inference

➤ $X^2=48.817, P<2.81e-12(S)$

➤ There is statistically very highly significant difference of step deformity in pre-op and post-op.

Table 6: comparison of infraorbital nerve paresthesia in pre-op and post-op

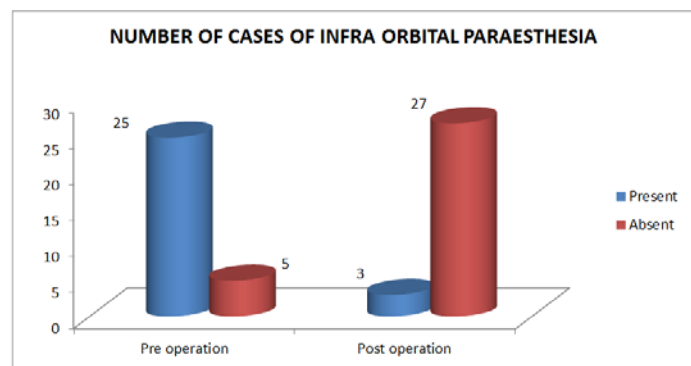
Infra orbital	Pre-op		Post-op	
	No. of cases	Percentage	No. of cases	Percentage
Present	25	83.3	3	10.0
Absent	5	16.7	27	90.0
Total	30	100.0	30	100.0

Inference

➤ $X^2=29.531, P<5.502e-08(S)$

➤ There is statistically very highly significant difference of infra orbital nerve paraesthesia in Pre-op and post-op

during this approach there were no complications encountered . In a study compared four incisions sub ciliary, sub tarsal, infraorbital and trans conjunctival with lateral canthotomy for treatment of orbital rim or floor fractures, it had been reported infraorbital, sub tarsal, single eye lid incision, provided more rapid access to infraorbital rim (8, 10, 14 minutes) than did trans-conjunctival incision (22 minutes).⁴ In comparison with the current study, the time of surgery was (average 14.7 minutes \pm 2.83) indicating that the exposure time of intraoral vestibular approach is comparable with transcutaneous or trans conjunctival approaches.



Graph 6: Comparison of infraorbital nerve paresthesia in pre-op and post-op

Discussion

Several approaches have been used and described in literatures to visualize and access the infraorbital rim and the orbital floor over the years . In the present study intraoral unilateral vestibular approach were performed with no lower eyelid complications reported in any cases. as there is no manipulation or dissection of lower eyelid

Temporary paresthesia of the infraorbital nerve due to its dissection and elevation is the complication associated with the intraoral approach; however, it depends on the fracture pattern and reduction⁶. Taicher et al compared the incidence of persistent sensory disturbance after recovery following four treatment methods; closed reduction without fixation, open reduction without fixation, open reduction with support by an intra antral Foley catheter and open with fixation of the zygomatico-frontal process .

They reported 70% patients were free of paraesthesia after open reduction and internal fixation¹. Sakavicius et al reported improvement in 77.3% of patients after open reduction and internal fixation, These findings are in agreement with the results of the current study.³ A recent study compared the recovery of infraorbital nerve paresthesia following open reduction and internal fixation verses closed reduction in the management of ZMC fractures, it was reported infraorbital nerve recovery in patients treated with open reduction and internal fixation was found 74%.¹⁰ In comparison with the current study this may be in favour for the intraoral approach for infraorbital rim reduction and fixation.

Clinical evaluation of facial oedema revealed that there were no significant facial asymmetry or disfigurement resulted after one month while it had been highly obvious within the first week. Other studies presented moderate surgical oedema postoperatively and disappeared by the third to fifth postoperative day. The present technique has several advantages such as that only one incision is necessary to approach the zygomaticomaxillary buttress and infraorbital rim, it optimizes surgical time, and it avoids periorbital scars. The purpose of this study was to describe the modifications made to the intraoral approach to allow reduction and fixation of the infraorbital rim in zygomatic fractures.¹ Intraoral methods, though aesthetically acceptable, do not provide adequate visibility and access to the fractured site, up to the infraorbital rim region. The current modification to intraoral incision overcomes this limitation of the intraoral approaches in terms of access to fractures of the anterior part of the zygoma. This technique allows complete visualization of the zygomaticomaxillary buttress, access to the anterior part of the zygomatic arch, facilitate reduction and provide adequate fixation in this otherwise inaccessible anatomic region. The possibility of direct visualization

and manipulation of those areas via intraoral approach definitely adds to success especially in terms of morbidity in comparison to trans facial surgical approaches. Additionally, avoidance of facial scar, minimal surgical time, simplicity of the technique and feasibility under local anaesthesia are other benefits of this approach⁷.

This study is completed to explain a modification of the Keen's technique that promotes adequate visualization of the infraorbital rim and permits reduction and fixation of this region in cases of zygomaticomaxillary complex fractures

Conclusion

The zygomatico-maxillary complex (ZMC) plays a key role within the structure, function, and aesthetic appearance of the facial skeleton. Because of its prominent position, the zygoma is the commonest mid-facial bone fractured¹. In the present study of thirty cases of infraorbital rim fracture in cases of zygomaticomaxillary complex, the Intraoral approach by modified Keen's technique was used to treat these fractures and the technique was found to be simple, cost effective and time saving with minimal complications and avoiding any unaesthetic facial scar. However, this approach has proved to be successful at reduction and fixation of the zygomatic complex fractures with infraorbital rim and it is unlikely that other commonly used approaches would have resulted in any significant difference in post operative stability⁷.

Hence, this technique should be considered as a simple and useful alternative to the more complicated procedures, and may be considered as initial and the only procedure for management of most of the zygomatic complex fractures. Further, a prospective randomized study in future with a larger sample size can elucidate the use and efficacy of this technique.

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