Original Article

Effect of location of fracture line and surgically visible nerve entrapment in recovery of infraorbital nerve following zygomatico-maxillary complex fracture- A prospective study

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Abstract

Background: In zygomatico-maxillary complex fracture infraorbital nerve is commonly affected due to its course in infraorbital canal and vacation at infraorbital foramen. This may result in temporary or permanent neurosensory deficiency resulting in feeling of numbness, or loss of few sensations in upper lip, lateral wall of nose and lower eyelid. The aim of this study was to find out post traumatic pre-operative incidence of infraorbital nerve, its post operative recovery, and its association with location of fracture line, visible nerve entrapment. **Material and method** A prospective study was performed on 88 patients with isolated, unilateral, displaced zygomatico-maxillary complex fracture requiring open reduction. Patients with the age ranging from 18 to 60 were included in study. **Result:** Among eighty eight patients 73.86% had fracture line passing through infraorbital foramen, of which 13.84% had permanent neurosensory deficiency. None of patient with fracture line not passing through infraorbital foramen had permanent neurosensory deficiency. Among eighty eight patients forty five (51.13%) patients had surgically visible nerve entrapment, of which 17.77% of patients had postoperative permanent neurosensory deficiency. While among patients without nerve entrapment 2.32% showed parmanent neurosensory deficiency **Conclusion:** This study conclude that in spite of applying advanced treatment modality that is open reduction and miniplate osteosynthesis for zygomatico-maxillary complex fracture, location of fracture line through the infraorbital foramen and surgically visible nerve entrapment together are strongly associated with some form of permanent neurosensory deficiency of infraorbital nerve.

Key Word: zygomatico-maxillary complex, infraorbital nerve, nerve entrapment, location of fracture line.

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INTRODUCTION

In Oral and Maxillofacial region any neurological deficit either sensory or motor, may sometimes intolerable or detrimental to patient compared to disturbances in other parts of body. This is because Maxillo-facial region is supplied by highest density of peripheral reoeptors, presumably because of their remarkable importance in daily life.[1] In zygomatico-maxillary complex fracture infraorbital nerve is commonly affected due to its course in infraorbital canal and vacation at infraorbital foramen. This may result in temporary or permanent Neuro-sensory deficiency resulting in feeling of numbness, or loss of few or au sensations in upper lip, lateral wall of nose and lower eyelid. Injury to infraorbital nerve may be caused primarily by entrapment of nerve in fracture line, due to severe displacement of fracture. Secondarily it may be caused exposure, traction, compression and manipulation of nerve while treating fracture.[1] These consequences can influence the various functions of oral cavity like ability to eat comfortably, to manage oral secretions, taste and

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speech. Sometimes a more severe complications like burning of a tissue or laceration due to lip biting and other foreign body may occur.[2] Such type of complications has attracted disproportionate attention of oral and maxillofacial surgeons and leads to a discussion of issues such as indication of a particular surgery, technique and also the medicolegal complication[3] so its of utmost importance to check for such nerve injuries, immediately post trauma i.e. preoperatively and post-operatively during regular follow-up of patient along with routine parameters to prevent any major complication and morbidity caused by such injuries. The aim of this study is to find out post traumatic pre-operative incidence of infraorbital nerve, its post operative recovery, and its association with location of fracture line, visible nerve entrapment of nerve and displacement of fracture.

MATERIAL AND METHOD

A prospective study was performed on 88 patients with isolated, unilateral, displaced zygomatico-maxillary complex fracture requiring open reduction. Patients with the age ranging from 18 to 60 were included in study. Patients with head injury, and medically compromised patients suffering from, Diabetes mellitus, hypertension, ischemic heart disease, renal diseases, liver diseases and other neurological disorder like carbamazepine, excluded from study. Patients on medications that my affect normal physiology of neurons, were not considered for study. Patients were examined as soon as following trauma, and generalised condition of the patient stabilised with primary treatment. A detailed history and clinical evaluation carried out followed by computed tomography of paranasal sinus area. The evaluator was blinded as to the surgical management of the patient, and surgeon was not allowed access to the results of sensory assessment. Pre-operative Neurosensory evaluation of infraorbital nerve done using visual analogue scale, where he marked his own grading of discomfort caused by altered sensation like numbness, heaviness, anaesthesia, hyperesthesia and parasthesia. After this subjective examination performed using clinical neurosensory testing that include static light touch test, two point discriminations test, Brush stroke directional test, thermal detection test (hot and cold), and pin trick test. The test was performed on four cataneous zones supplied by infraorbital nerve, i.e. lower eyelid, nasal ala, upper lip and cheeck as shown in Figure-1 contralateral cutaneous area were chosen as control. All patients were operated for open reduction and plate fixation using either 2 point fixation or 3 point fixation including infraorbital rim plate. Intraoperative location of fracture line was noted whether it is passing through or medial or lateral to infraorbital foramen. Entrapment of nerve in fracture line was also documented. A regular post-operative follow-up of patient done at 1 week, 6 week and 12 week of time points to assess temporary neurosensory deficiency and at 1 year to asses permanent neurosensory deficiency.[1]

Figure 1: Figure showing shaded area used to check neurosensory deficiency of infraorbital nerve

Table1: master chart showing analysis of all patients

No. Patients with zygomatic bone			**88**		
Total no. Patients with preoperative neurosensory deficiency of infraorbital nerve			Present 79		Absent 9
Location of fracture line	Through infraorbital foramen			Medial or lateral to infraorbital foramen	
		65			
Surgically visible nerve entrapment	Yes	No	Total		
	45	20	65		
Post-operative neurosensory evaluation				14	
At 1 week	32	4	36	7	4
At 6 week	17	1	18	0	1
At 3 months	10	1	11	0	0
At 1 year	8	1	9	0	0

Table 2: Parameter I. Location of fracture line

Total no. Of patients with zygoma fracture	88	
Location of fracture line	Total no of patients with fracture line passing through infraorbital foramen 65 (73.86%)	Total no. Of patients with fracture line not passing through infraorbital foramne 14 (15.90 %)
No of patients with with post operative neurosensory deficiency evaluation		
At 1 week	36 (55.38%)	7 (50 %)
At 6 week	18 (27.69%)	0
At 3 months	11 (16.92%)	0
At 1 year	9 (13.84%)	0

Table 3: Parameter II :Surgical visible nerve entrapment

Total no. Of patients with zygoma fracture	88	
Sugical visible nerve entrapment	Yes 45 (51.13%)	No 43 (48.86%)
No of patients with with post operative neurosensory deficiency evaluation		
At 1 week	32 (71.11%)	4 (9.30%)
At 6 week	17 (37.77%)	1 (2.32%)
At 3 months	10 (22.22%)	1 (2.32%)
At 1 year	8 (17.77%)	1 (2.32%)

RESULT

A total of eighty eight patients were included in the study consisting 80 male and 8 female. Road traffic accident was main etiology of trauma in 78 patients, followed by assault in 5 patients, 5 patients had injury due to sport activity. Mean age of patients was 38.3 years. Among 88 patients 79 i.e. 89.77 % patients had posttraumatic preoperative neurosensory deficiency of infraorbital nerve. (Table number 1) Among eighty eight patients 73.86% had fracture line passing through infraorbital foramen. On postoperative follow-up it was found that 55.38% and27.69% patients had temporary neurosensory deficiency at 1 week and 6 week post op follow-up. This gradually reduced to 16.92% and 13.84% at 3 month and 1 year post op follow-up respectively. None of patient with fracture line not passing through infraorbital foramen had temporary or permanent neurosensory deficiency. (Table number 2) Among eighty eight patients forty five (51.13%) patients had surgically visible nerve entrapment while forty three (48.86%) were without nerve entrapment. Patients with surgically visible nerve entrapment showed that 71.11%, 37.77%, 22.22% and 17.77% of patients showed postoperative neurosensory deficiency at 1 week, 6 week, 3 months and 1 year follow-up respectively. While patients without nerve entrapment showed 9.30%, 2.32%, 2.32% and 2.32% of patients showed postoperative neurosensory deficiency at 1 week, 6 week, 3 months and 1 year follow-up respectively. (Table number 3)

DISCUSSION

Sensory disturbances along the distribution of infraorbital nerve are almost always present in orbitozygomatic fracture. Literature suggests that posttraumatic neurosensory deficiency of infraorbital nerve varies from 24% to 94%. In our study it was 89.77%.[4] Various factors have been described that may alter the incidence and outcome of infraorbital nerve deficiency in zygomatic fracture. These factors may include type, direction, and amount of energy of impact; displacement of fracture, time of surgical intervention, type of treatment given (closed reduction, intraosseous fixation or miniplate osteosynthesis.), location of fracture line and surgically visible nerve entrapment. Type of trauma Buffane *et al* (2013) demonstrated a statistically significant association between infraorbital sensory nerve deficiency and assualt and sport accidents. The severity of injury and the absorption of middle energy and high energy forces by the zygomatic complex only associated with infraorbital nerve sensory deficiency.[5] In our study 9 (13.84%) patients had persistent neurosensory deficiency of which four patients had trauma due to assault and sport activity. Time of surgical intervention. P. Kumar *et al* evaluated the incidence and recovery of persistent sensory disturbance of the infraorbital nerve after the zygomatic complex fracture and fracture of infraorbital rim. Their result showed that some form of infraorbital nerve deficiency was present in almost all patients at 1 month post op follow-up. But after 6 months all patients showed near to normal improvement comparable to contralateral side. They concluded that earlier the surgical intervention. More the recovery of the nerve is appreciable during 1

and 6 month follow-up period.[6] Type of treatment given It is well established that based on type and displacement of fracture zygoma fracture can be treated by various methods including conservative management, interosseous wiring and miniplate osteosynthesis. De man and Bax WA studied 106 patients with an isolated non communated unstable fracture of zygoma bone 38 patients were treated by osseous wiring 50% suffered with persistent reduced sensitivity while those treated with miniplate osteosynthesis only 22% suffer persistent deficiency.[7] Benoliel R *et al* (2005) evaluated infraorbital nerve recovery in 25 patients consisted of 15 displaced, 10 minimally or non displaced zygomaticomaxillary complex fracture. They divided in 3 groups, 7 patients left untreated (None group), reduced but not fixed in 8 cases (Reduction group) and fixed with miniplate in 10 cases (Plate group). They documented significant improvement in plate group and concluded that plate fixation allows for significantly better restoration of infraorbital nerve function.[8] On the basis of these findings they recommended a miniplate osteosynthesis in all unstable zygomatic bone fracture with displacement. Recently Das AK *et al* also concluded that marked improvement in neurosensory function of infraorbital nerve occurs when some form of treatment either in the form of open reduction and internal fixation or gillies temporal approach or keens intraoral approach were applied as compared to conservative management.[9] These study conclude that high energy forces like assault and sport accidents, delayed treatment that is delayed decompression of nerve, closed reduction, intraosseous wiring for reduction and fixation, displaced fractures are associated with poor prognosis of recovery of infra orbital nerve deficiency. However, low energy forces like road traffic accident, minimal displacement, early treatment and use of miniplate osteosynthesis are associated with better and rapid recovery of infraorbital nerve deficiency. In this study we minimized all above risk factors by operating patients earliest as possible and using miniplate osteosynthesis either with 2 point fixation or 3 point fixation of zygoma. In our study we observed effect of preoperative nurosensory deficiency of infraorbital nerve, location of fracture line and surgically visible nerve compression at fracture site on recovery of infraorbital nerve damage. These parameters are fixed and cannot be altered. Among 79 patients who had preoperative neuro-sensory deficiency five (6.32%) patients had trauma due to assault. Thus our findings were in close resemblance to Buffano *et al* (2013). Location of fracture line. The infraorbital groove and canal travels the floor carrying the infraorbital nerve which further causes the weakening of the floor of orbit. This complex anatomy is responsible for fracture of floor along the course of infraorbital canal and foramen.[10] Schilli reported that in 95% cases of zygomaticomaxillary complex fracture, the fracture line involves the infraorbital foramen and may cause some degree of sensory disturbance.[11] However the course of infraorbital nerve is not fixed and has anatomical variations. Recently in 2015 Ferrence *et al* studied relevant variations in the anatomical course of infraorbital nerve using computed tomography sinus study in 100 patients with 200 samples of bilateral sinuses. Anatomical variants were classified in to 3 types based on the degree to which the nerve course descended from maxillary roof in to the sinus lumen. A total of 60% of infraorbital nerve were entirely present in sinus roof. In 27% the nerve the nerve canal descended in to sinus but remained juxtaposed to it. In 12.5% the infraorbital nerve descended in to the sinus lumen. These observations may help surgeon avoid iatrogenic infraorbital nerve injury.[12] In our study we found that about 42 patients i.e. % had infraorbital course travelling through sinus roof proper. All patients who developed permanent neourosensory deficiency has infraorbital nerve course through maxillary sinus roof proper. In our study among eighty eight patients seventy nine i.e. 89.77% had posttraumatic neurosensory deficiency 73.86 % had fracture line passing through infraorbital foramen. Among these 13.84% suffered by permanent neurosensory deficiency. This proves a higher incidence of neurosensory deficiency in those patients who had preoperative neurosensory deficiency and fracture line passing through infraorbital foramen. Another parameters we observed in our study location of fracture line along the infraorbital foramen and incidence of permanent neurosensory deficiency. Among 88 patients 65 patients (73.86%) had fracture line passing through infraorbital foramen. Out of this 9 patients (13.84%) had permanent neurosensory deficiency. This indicates a strong correlation that some patients with zygoma fracture having fracture line passing through infraorbital foramen suffer from some form of neurosensory deficiency inspite of treatment using open reduction and internal fixation using miniplate osteosynthesis. (Table number-1) Another parameter we observed was surgically visible nerve entrapment at fracture line at infraorbital foramen. Among eighty eight patients forty five (51.13%) patients had surgically visible nerve entrapment while forty three (48.86%) were without nerve entrapment. Postoperative temporary neurosensory deficiency at 3 months follow up period in patients with nerve entrapment was 22.22% and in patients without nerve entrapment was 2.32%, indicating high risk of neurosensory deficiency in case of nerve entrapment. On other hand permanent neurosensory deficiency at 1 year postoperative follow-up in patients with nerve entrapment was 17.77% and in those without

nerve entrapment was 2.32%. Thus permanent neuro-sensory deficiency observed in patients with nerve entrapment (17.77) was much higher against those without nerve entrapment (2.32%). This difference may related primarily with compression, laceration and tearing of nerve at the time of impact of trauma. And secondarily may relate with stretching or compression of nerve against fractured segment during retrieval of nerve intraoperatively.

CONCLUSION

Based on this study we conclude that, following orbitozygomatic fracture, neurosensory deficiency is a frequent finding. Similarly post operative recovery of infraorbital nerve deficiency is strongly influenced by location of fracture line along the course of infraorbital nerve i.e. infraorbital canal in orbital floor and its emergence at infraorbital foramen. Incidence of permanent nerve deficiency is higher when surgically visible nerve entrapment is seen between fracture segments. However inspite of advanced treatment modality using open reduction and miniplate osteosynthesis, patients having both fracture line location at infraorbital foramen and surgically visible nerve entrapment possibility of some form of permanent nerve deficiency is much higher. We recommend that it is mandatory to explain the pattern of recovery of infraorbital nerve and its outcome after the surgery.

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