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## RESEARCH ARTICLE

# SENSORY CHANGES IN THE BRANCHES OF INFRAORBITAL NERVE FOLLOWING ZYGOMATIC COMPLEX FRACTURES

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**ABSTRACT**

**Background:** Zygoma is a prominent bone in face and most commonly injured during trauma. Sensory disturbance of the Infra Orbital region and a palpable fracture displacement of the Infra orbital margins are the typical clinical findings of zygomatic complex fracture. In most cases fracture lines involve the Infra Orbital foramen, canal, or fissure, therefore, fractures of the zygomatic complex are characterized by sensory neuropathy (specifically hypoesthesia) in the area of innervations of the Infra orbital nerve, both as a presenting symptom, and as a postoperative complication.

**Objectives:** Our objectives of the study were to investigate sensory changes in the superior labial, lateral nasal, inferior palpebral branches of infra orbital nerve following zygomatic complex fractures by employing sensory testing over a 6-month period, to identify the most commonly involved branch of infra orbital nerve in zygomatic complex fracture and to document the pattern of sensory recovery in the study subjects.

**Patients & Methods:** The study was carried out in ninety patients fulfilling the inclusion crtiteria were selected. In all patients the sensory changes in the superior labial, lateral nasal, inferior palpebral branches of infra orbital nerve following zygomatic complex fractures analyzed by employing sensory testing by means of mechanical detection threshold and reaction to pin prick, over a 6-month period and to identify the most commonly involved branch of infra orbital nerve in zygomatic complex fracture and its association with fracture severity and to document the pattern of sensory recovery in the study.

**Results:** From our study we found that upper lip (73 cases out of 90 by mechanical method and 65 cases by pin prick test) is the most commonly involved area and hence superior labial branch is the most commonly involved branch in zygomatic complex fractures. All branches had significant recovery after 6 months. Study of pattern of recovery after treatment showed that there is no significant improvement in paresthesia of any branches of infra orbital nerve following closed reduction of zygomatic complex fracture. We had only two cases where open reduction was done and both did not recover from paresthesia



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## INTRODUCTION

Zygoma is a prominent bone in face and most commonly injured during trauma. zygomatic complex fractures often accompanied by subconjuctival and periorbital ecchymosis, additionally flattening of the cheek, diplopia, sensory disturbance of the infra orbital region and a palpable fracture displacement of the infra orbital margins are the typical clinical findings (Kristensen and Tveteras, 1986).

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The face, and in particular the oral and perioral region are among the areas with highest density of peripheral receptors. It is difficult to tolerate neurological disturbances in oral and maxillofacial regions compared to other parts of body (Akal *et al.,* 2000). The sensory disturbances of the infra orbital nerve are frequently present in zygomatic complex fractures[3]. In most cases fracture lines involve the infra orbital foramen, canal, or fissure, therefore, fractures of the zygomatic complex are characterized by sensory neuropathy (specifically hypoesthesia) in the area of innervations of the Infra orbital nerve, both as a presenting symptom, and as a postoperative complication (Rowe *et al.,* 1994). The nerve can be damaged

by a secondary mechanism through a blunt, crush type of injury or by a bony compression of the nerve at the fracture site as it leaves the infra orbital foramen (Benoliel *et al.,* 2005). Signs and symptoms of zygomatic complex fractures are asymmetry of face, difficulty in mouth opening, disturbance of vision (eg, diplopia) or of eye movements, and infraorbital nerve dysfunction. A lack of these signs is therefore a contraindication for surgical intervention. In the acute stage of non- displaced fractures, at least some degree of hypoesthesia is often encountered as well. Thus, the post traumatic paresthesia over the distribution of the infra orbital nerve has even been considered as indicative of fractures. In all treated cases closed reduction was attempted, and if this resulted in a stable reduction of the fragments no further treatment was employed. Unstable reduction was defined as a return of a ‘‘step’’ at the infraorbital rim and/or the zygomaticofrontal suture or as a visible lack of facial symmetry. Where reduction was unstable, the zygomaticofrontal suture was surgically exposed and reduced with wires or a miniplate. Many studies shows that earlier the surgical intervention, more the recovery of the nerve injury is appreciable during the 1 and 6 months follow up period. Studies are still not clear which sensory afferent branch of the Infraorbital Nerve is predominantly affected. Hence the aim of this study is to investigate sensory changes in the branches of infra orbital nerve following zygomatic complex fractures

**Aim**

The aim of the present study is to investigate sensory changes in the branches of infra orbital nerve following zygomatic complex fractures

**Objectives**

- To investigate sensory changes in the superior labial, lateral nasal, inferior palpebral branches of infra orbital nerve following zygomatic complex fractures by employing sensory testing over a 6-month period.
- To identify the most commonly involved branch of infra orbital nerve in zygomatic complex fracture.
- To document the pattern of sensory recovery in the study subject

## MATERIALS AND METHODS

The study was carried out in order to analyze the sensory changes in the superior labial, lateral nasal, inferior palpebral branches of infra orbital nerve following zygomatic complex fractures by employing sensory testing over a 6-month period and to identify the most commonly involved branch of infra orbital nerve in zygomatic complex fracture and its association with fracture severity and to document the pattern of sensory recovery in the study subjects, who were presented or referred to the department of Oral and Maxillofacial Surgery, Government Dental College, Trivandrum after sustaining Zygomatic complex fracture. The entire patients collected from November 2012 to December 2013, those having isolated unilateral zygomatic complex fracture were taken into consideration. An exclusion criterion was: patients with isolated zygomatic arch fractures**,** Midfacial, panfacial, or nasoethmoid fractures Patients with head injuries. The C.T scan or Waters view plain X-ray used to identify the fractures and fractures are classified according to Knight and North classified zygomatic complex fractures in to six groups of which five are taken

Group I - Nondisplaced fractures
Group III - Unrotated body fractures
Group IV – Medially rotated body
Group V – Laterally rotated body
Group VI - Complex (Communited) fractures

The following parameters were noted in the proforma: age, sex, nature of cause, type of fracture, treatment done

**Sensory changes are measured by two methods**

**Mechanical detection threshold**

We have used Prolene 7-0 suture filament of different length for sensory testing. For each measurement, a filament was grasped at one end by forceps and the other end was positioned perpendicular to the area of application, applying enough force to induce slight bending of the filament. Mechanical detection was assessed in the patients by administering the series of different length filaments 2 times each in ascending order. With eyes closed, patients indicated each time a filament touch was detected in the lower eyelid region, side of nose, in the upper lip 2 cm away from midline. Ratio between the lengths of prolene filaments on the injured side divided by the control side is taken. In a normal Situation the ratio is 1.Decreased ratio Indicate hypoesthesia of the injured side.

**Reaction to pinprick**

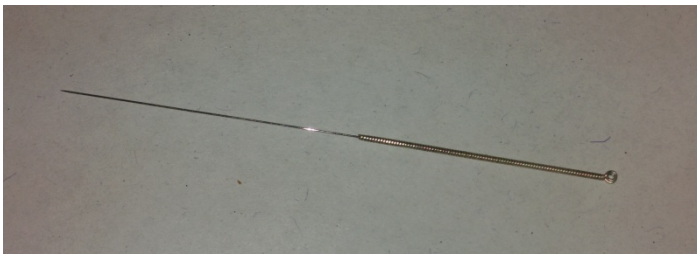
The tip of a 0.2mm diameter blunted acupuncture needle was pushed against the patient’s skin until the needle slightly bends (the skin was dimpled but not penetrated). The patient graded the sensation on a 100-mm visual analog scale (VAS). Difference in VAS values between the control and injured sides are taken. In a normal situation value is 0. Thus, positive values indicate relative hypoesthesia and negative values indicate relative hyperesthesia of the injured side. VAS is usually a horizontal line, 100 mm in length. The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimeters from the left hand end of the line to the point that the patient marks.

**Analysis**

Data analysis done with spss software, statistical analysis completed with descriptive statistics (frequency, proportion) and wilcoxon test.

**Armamentarium used to test paresthesia**


**Prolene 7-0 fibre for mechanical testing**



**0.2 mm acupuncture needle for pin prick test**

**Ethical considerations**

Permission from the institutional ethical committee was obtained prior to conducting the study. An informed consent was taken from patients who agreed to participate in the study

## RESULTS

In our study we have analyzed zygomatic complex fractures with the intention of identifying the sensory changes in the branches of infra orbital nerve, to record which branches are commonly affected and also to identify the pattern of recovery in all cases.

**Distribution of cases according to treatment**

90 cases of zygomatic complex fractures were analyzed. 60 cases were conservatively managed. 27 cases underwent closed reduction of zygoma. One case underwent open reduction of zygomatic complex fracture.2 patients underwent reconstruction of orbital floor (Table 1).

**Distribution of cases according to nerve injury**

Sensory testing of 3 branches of infra orbital nerve was accomplished by two methods. One method was by mechanical testing using prolene 7-0 fibre. The second by pin prick method using 0.2mm diameter blunted acupuncture needle. In sensory testing of infraorbital nerve by mechanical testing we found eyelid paresthesia in 40 cases while 50 cases had normal sensation in eyelid, by pin prick test 30 cases had paresthesia in eyelid and 60 cases had normal sensation in eyelid area (Table 2). 73 patients reported paresthesia in upper lip while 17 had normal sensation in upper lip by mechanical testing. In pin prick test 65 cases had paresthesia in upper lip and 25 cases had normal sensation (Table 3). Only 23 cases had paresthesia in side of nose and 67 cases were normal by mechanical testing. In pin prick test eyelid paresthesia reported only in 15 cases and remaining 75 cases had normal sensation (Table 4).

**Recovery pattern of branches of infra orbital nerve**

**Recovery pattern of eyelid**

Recovery pattern of each branch of infra orbital nerve was recorded at 1 month, 3 months and 6 months interval. Recovery pattern of inferior palpebral branch of infra orbital nerve analyzed by testing paresthesia of lower eyelid region. In mechanical testing, at the time of reporting 40 cases out of 90 cases had eyelid paresthesia, after one month none of the cases have recovered. After 3 months 5 cases have recovered. Statistical analysis using Wilcoxon Signed Rank Test shows it is significant at 0.01 level compared to paresthesia at the time of reporting. After 6 months 15 cases had recovered. Statistical analysis shows it is significant at 0.05 level compared to paresthesia at the time of reporting. By pin prick test at the time of reporting 30 cases out of 90 cases had eyelid paresthesia, after one month none of the cases recovered from paresthesia. After 3 months 2 cases were recovered from paresthesia. Statistical analysis using Wilcoxon signed rank test shows it is significant at 0.01 level compared to paresthesia at the time of reporting. After 6 months mechanical test employed shows 10 cases recovered from paresthesia. Statistical analysis shows it is significant at 0.05 level compared to paresthesia at the time of reporting (Table 5).

**Recovery pattern of upper lip**

Recovery pattern of superior labial branch was analyzed by testing paresthesia of upper lip region. In mechanical testing out of 73 cases of upper lip paresthesia none of the patients recovered after 1 month, only 2 patients recovered after 3 months, statistical analysis showed no significance after 3 month. But after 6 month 48 cases of upper lip paresthesia had recovered with a statistical significance of 0.05 levels. By pin prick method 65 cases of upper lip paresthesia reported none of the Patients recovered from paresthesia after 1 month, only 5 patients recovered from paresthesia after 3 month. Statistical analysis was showing no significance after 3 month. But after 6 month 40 cases of upper lip paresthesia were recovered with a statistical significance of 0.05 levels (Table 6).

**Recovery pattern of side of nose**

Recovery pattern of lateral nasal branch was tested by analyzing paresthesia of side of nose region. In mechanical testing 19 cases had paresthesia in side of nose region; cases did not recover in 1 month. After 3 month only one case had recovered, statistically not significant. After 6 month 8 cases had recovered from paresthesia statistically significant at 0.01 levels. In pin prick test 19 cases had paresthesia in side of nose region cases did not recovered in 1 month and 3 months. After 6 month 5 cases were recovered from paresthesia statistically significant at 0.01 level (Table 7).

**Comparison of Mechanical Testing vs Pin prick test – Pattern of recovery**

After 6 months 50 % of cases recovered from paresthesia in lower eyelid when tested mechanically while only40% cases have recovered from paresthesia in eyelid when tested by pin prick test. Similarly it was 27.3% cases vs 26.1% in the upper lip. Side of nose recovery revealed 47.3% vs 33.3% when two methods were compared.

**Relation of recovery pattern of lower eyelid with treatment**

Recovery pattern of nerve branches according to different treatment approaches are compared. By mechanical testing in patients who were conservatively managed 20 % cases of lower eyelid paresthesia recovered in 3 months, 46.7% cases recovered in 6 months and 33.3 % cases did not recover. In patients with closed reduction of zygoma 9.1% cases recovered in 3 months and 31.8 cases recovered in 6 months.59.1 cases did not recover. In the only one patient who underwent open reduction of zygoma, sensation of lower eyelid did not recover in six months. Both the patients who underwent reconstruction of orbital floor did not recover from paresthesia.

**Table 1. Percentage distribution of the sample according to treatment**

| Treatment | Count | Percent |
|---|---|---|
| Patients who were conservatively managed | 60 | 66.7 |
| Patients who underwent elevation of the ZMC fracture using of closed reduction | 27 | 30.0 |
| Patients who underwent open reduction of the ZMC fracture and fixation | 1 | 1.1 |
| Patients who underwent reconstruction of the orbital floor | 2 | 2.2 |

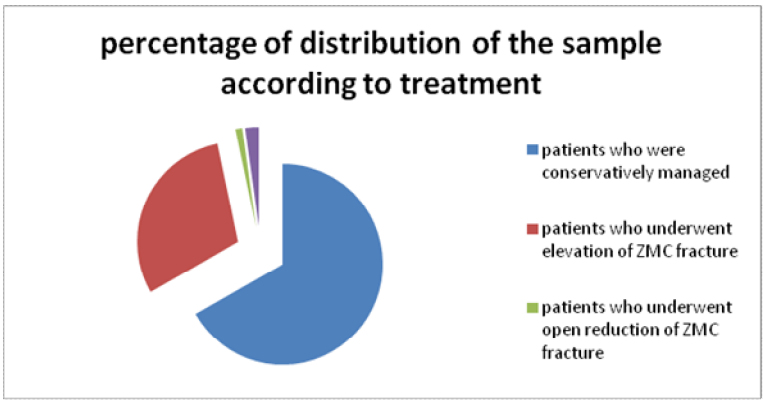



**Fig. 1. Percentage distribution of the sample according to treatment**

**Table 2. Distribution of paresthesia of eye lid**

| Mechanical testing | Count | Percent | Pin prick test | Count | Percent |
|---|---|---|---|---|---|
| Paresthesia | 40 | 44.4 | Paresthesia | 30 | 33.3% |
| Normal | 50 | 55.6 | Normal | 60 | 66.6% |

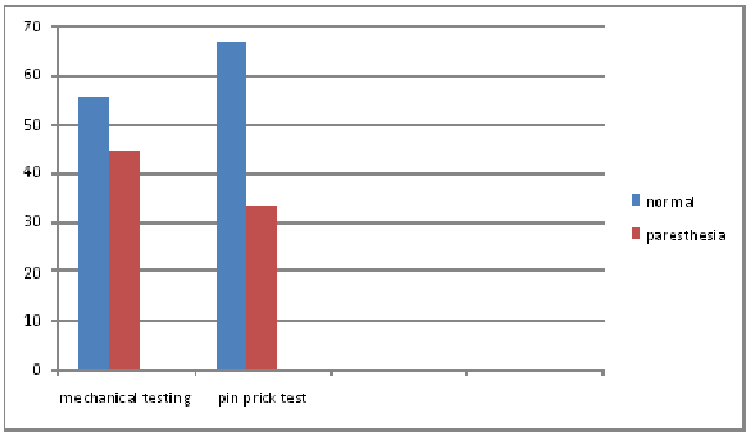



**Fig. 2. Distribution of paresthesia of eye lid**

**Table 3. Distribution of paresthesia of upper lip**

| Mechanical testing | Count | Percent | Pin prick test | Count | Percent |
|---|---|---|---|---|---|
| Paresthesia | 73 | 81.1 | Paresthesia | 65 | 72.2 |
| Normal | 17 | 18.9 | Normal | 25 | 27.8 |

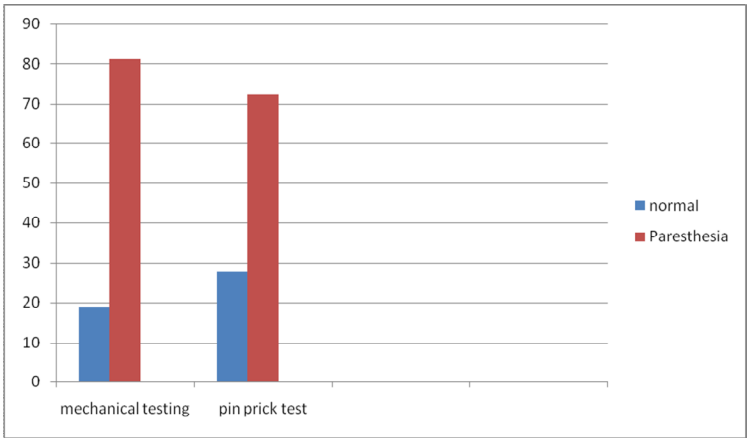



**Fig. 3. Distribution of paresthesia of upper lip**

**Table 4. Distribution of paresthesia of side of nose**

| Mechanical testing | Count | Percent | Pin prick test | Count | Percent |
|---|---|---|---|---|---|
| Paresthesia | 23 | 25.6 | Paresthesia | 15 | 16.6% |
| Normal | 67 | 74.4 | Normal | 75 | 83.3% |

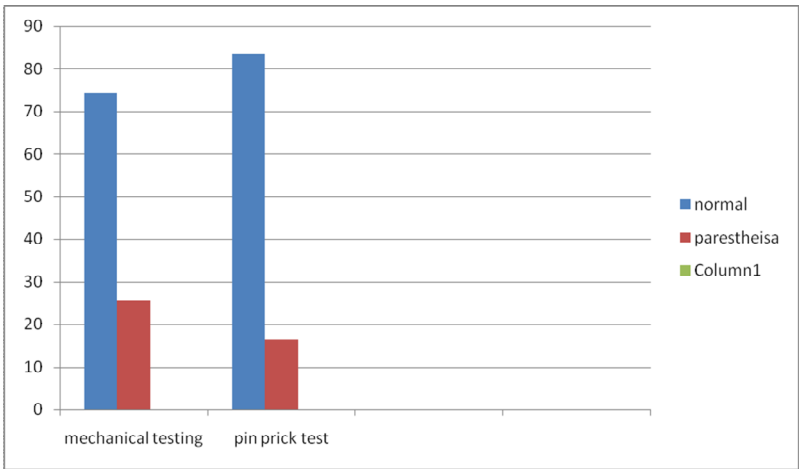



**Fig. 4. Distribution of paresthesia of side of nose**

**Table 5. Recovery Pattern of lower eyelid**

| Eye lid | | Paresthesia | | Normal | | Pair | Z | P |
|---|---|---|---|---|---|---|---|---|
| | | Count | Percent | Count | Percent | | | |
| At the time of reporting | M | 40 | 44.4 | 50 | 55.6 | | | |
| | P | 30 | 33.3% | 60 | 66.6% | | | |
| After 1 month | M | 40 | 44.4 | 50 | 55.6 | At the time of reporting vs 1 M | 0 | 1.000 |
| | P | 30 | 33.3% | 60 | 66.6% | At the time of reporting Vs 1M | 0 | 1.000 |
| After 3 months | M | 35 | 38.9 | 55 | 61.1 | At the time of reporting vs 3 M | 2.24* | 0.025 |
| | P | 28 | 31.1% | 58 | 64.4% | At the time of reporting Vs 3 M | 1 * | 0.317 |
| After6 month | M | 20 | 22.2 | 70 | 77.8 | At the time of reporting vs 6 M | 4.47** | 0.000 |
| | P | 18 | 20% | 72 | 80% | At the time of reporting vs 6 M | 2* * | 0.036 |

Wilcoxon Signed Ranks Test **: - Significant at 0.05 level*: - Significant at 0.01 level

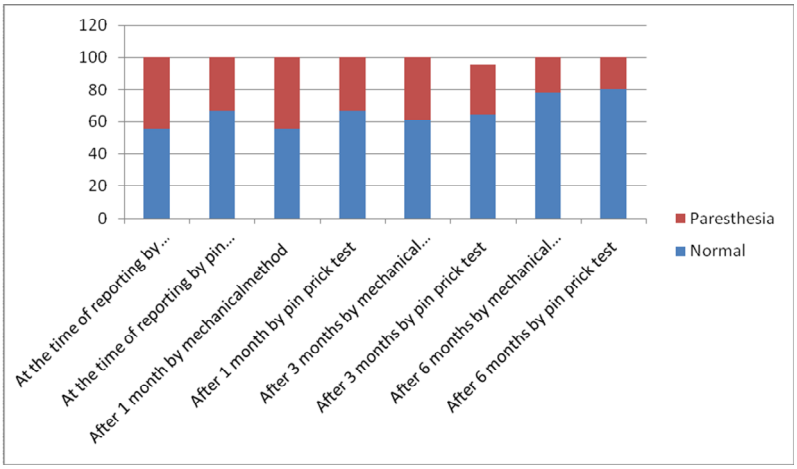



**Table 5. Recovery Pattern of lower eyelid**

**Table 6. Recovery pattern of upper lip**

| Upper lip | | Paraesthesia | | Normal | | Pair | Z | P |
|---|---|---|---|---|---|---|---|---|
| | | Count | Percent | Count | Percent | | | |
| At the time of reporting | M | 73 | 81.1 | 17 | 18.9 | | | |
| | P | 65 | 72.2% | 25 | 27.8% | | | |
| After 1 month | M | 73 | 81.1 | 17 | 18.9 | At the time of reporting vs. 1 M | 0 | 1.000 |
| | P | 65 | 72.2% | 25 | 27.8% | At the time of reporting vs. 1 M | 0 | 1.000 |
| After 3 month | M | 71 | 78.9 | 19 | 21.1 | At the time of reporting vs. 3 M | 2.24 | 0.025 |
| | P | 60 | 66.6% | 30 | 33.3% | At the time of reporting vs 3 M | 1.41 | 0.157 |
| After 6 month | M | 53 | 58.8 | 37 | 41.1 | At the time of reporting vs 6 M | 4.69* | 0.000 |
| | P | 48 | 53.3% | 42 | 46.6% | At the time of reporting vs 6 M | 4.69* | 0.00 |

Wilcoxon Signed Ranks Test *: - Significant at 0.05 level

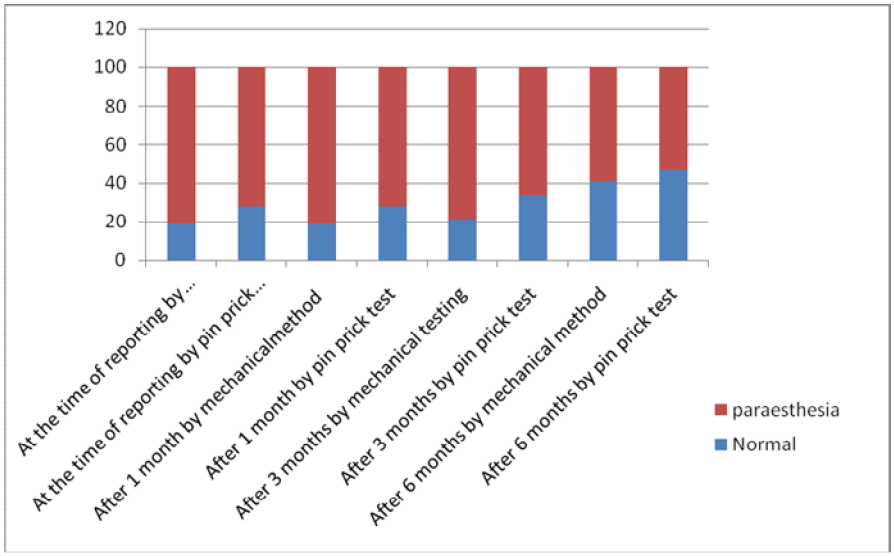



**Fig 6. Recovery pattern of upper lip**

**Table 7. Recovery pattern of Side nose**

| Side of nose | | Paraesthesia | | Normal | | Pair | Z | P |
|---|---|---|---|---|---|---|---|---|
| | | Count | Percent | Count | Percent | | | |
| At the time of reporting | M | 19 | 21.1 | 71 | 78.9 | | | |
| | P | 15 | 16.6% | 75 | 83.3% | | | |
| After 1 month | M | 19 | 21.1 | 71 | 78.9 | At the time of reporting vs 1 M | 0 | 1.000 |
| | P | 15 | 16.6% | 75 | 83.3% | At the time of reporting vs 1 M | 0 | 1.000 |
| After 3 months | M | 18 | 20.0 | 72 | 80.0 | At the time of reporting vs 1 M | 0 | 1.000 |
| | P | 15 | 16.6% | 75 | 83.3% | At the time of reporting Pre Vs 3 M | 0 | 1.000 |
| After 6 months | M | 10 | 11.1 | 80 | 88.9 | At the time of reporting vs 6 M | 3.61** | 0.046 |
| | P | 10 | 11.1% | 80 | 88.8% | At the time of reporting Pre Vs 6 M | 2.43* | 0.023 |

Wilcoxon Signed Ranks Test *: - Significant at 0.05 level

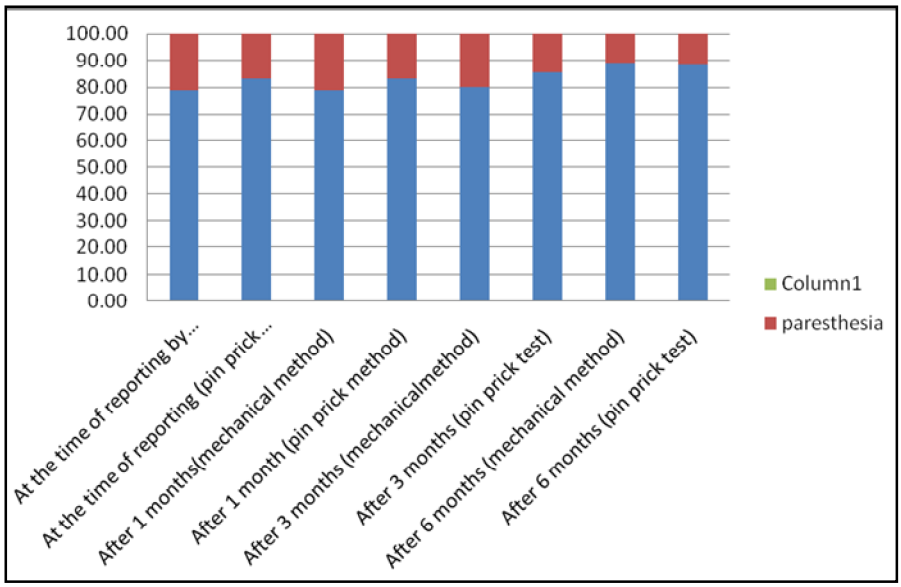



**Fig 7. Recovery pattern of Side nose**

**Table 8. Relation of recovery pattern of eyelid with the treatment**

| eyelid | | Conservative management | Elevation of ZMC | Open reduction of ZMC | Reconstruction of orbital floor |
|---|---|---|---|---|---|
| Recovered after 1 month | M | 0 | 0 | 0 | 0 |
| | P | 0 | 0 | 0 | 0 |
| Recovered after 3 months | M | 3(20%) | 2(9.1%) | 0 | 0 |
| | P | 2(20%) | 0 | 0 | |
| Recovered after 6 months | M | 7(46.7%) | 7(31.8%) | 0 | 0 |
| | P | 6(50%) | 4(22%) | 0 | 0 |
| Not recovered | M | 5(33.3%) | 13(59.1) | 1(100%) | 2(100%) |
| | P | 4(40%) | 11(73.3%) | 1(100%) | 2(100%) |

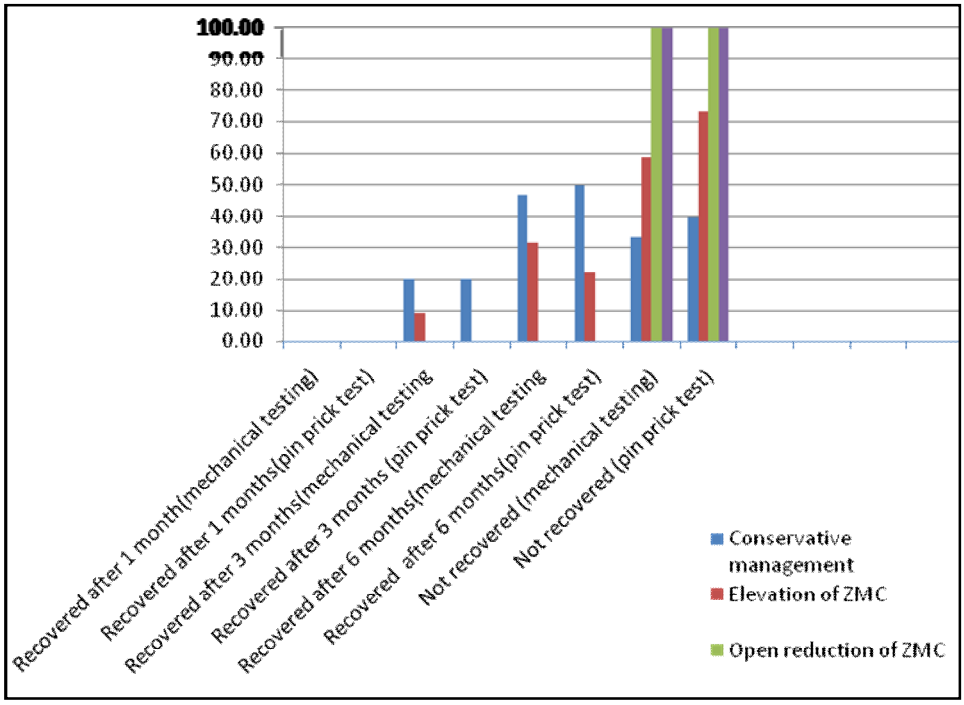



**Fig. 8. Recovery pattern of eyelid with the treatment**

**Table 9. Relation of recovery pattern of upper lip with treatment**

| Upper lip | | Conservative managment | Elevation of ZMC | Open reduction of ZMC | Reconstruction of orbital floor |
|---|---|---|---|---|---|
| Recovered after 1 month | M | 0 | 0 | 0 | 0 |
| | P | 0 | 0 | 0 | 0 |
| Recovered after 3 months | M | 2(4.3%) | 0 | 0 | 0 |
| | P | 5(9%) | 0 | 0 | 0 |
| Recovered after 6 months | M | 12(26%) | 6(25) | 0 | 0 |
| | P | 10(18.1%) | 2(28) | 0 | 0 |
| Not recovered | M | 32(69%) | 18(75%) | 1(100%) | 2(100%) |
| | P | 40(72.2%) | 5(71.4%) | 1(100%) | 2(100%) |

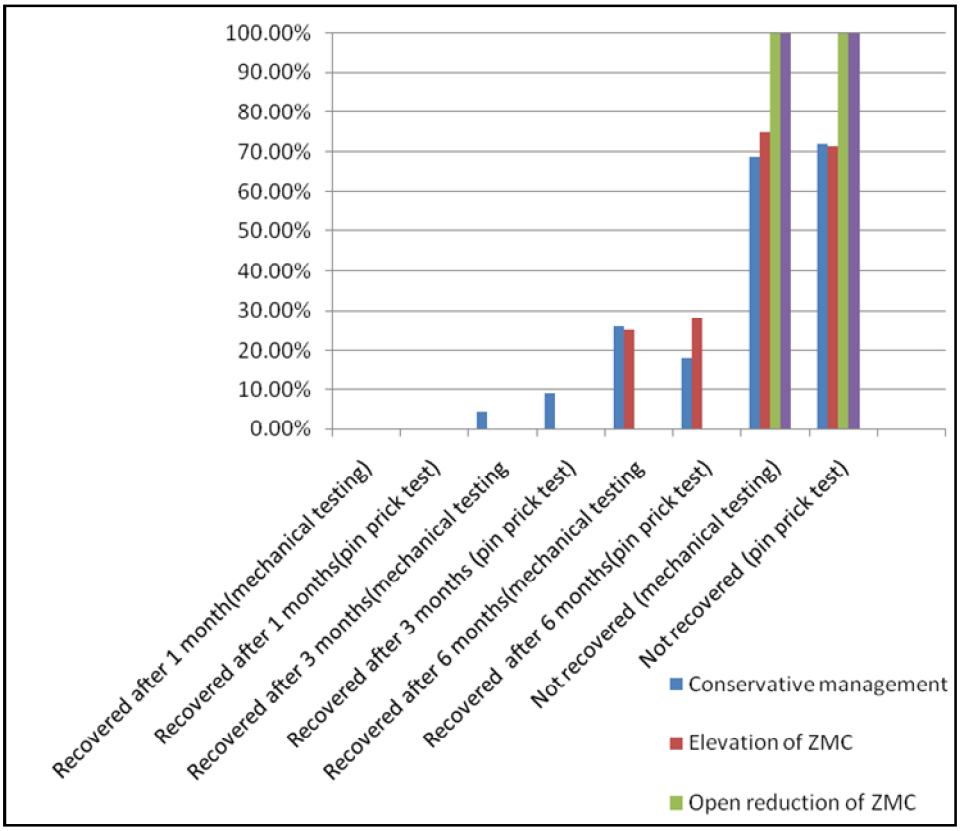



**Fig. 9. Relation of recovery pattern of upper lip with treatment**

**Table 10. Relation of recovery pattern of side of nose with treatment**

| Side of nose | | Conservative managment | Elevation of ZMC | Open reduction of ZMC | Reconstruction of orbital floor |
|---|---|---|---|---|---|
| Recovered after 1 month | M | 0 | 0 | 0 | 0 |
| | P | 0 | 0 | 0 | 0 |
| Recovered after 3 months | M | 0 | 0 | 0 | 0 |
| | P | 0 | 0 | 0 | 0 |
| Recovered after 6 months | M | 5(71.4%) | 4(30.7) | 0 | 0 |
| | P | 3(60%) | 2(28.5) | 0 | 0 |
| Not recovered | M | 2(28.6%) | 9(69.3%) | 1(100%) | 2(100%) |
| | P | 2(20%) | 5(71.4) | 1(100%) | 2(100%) |

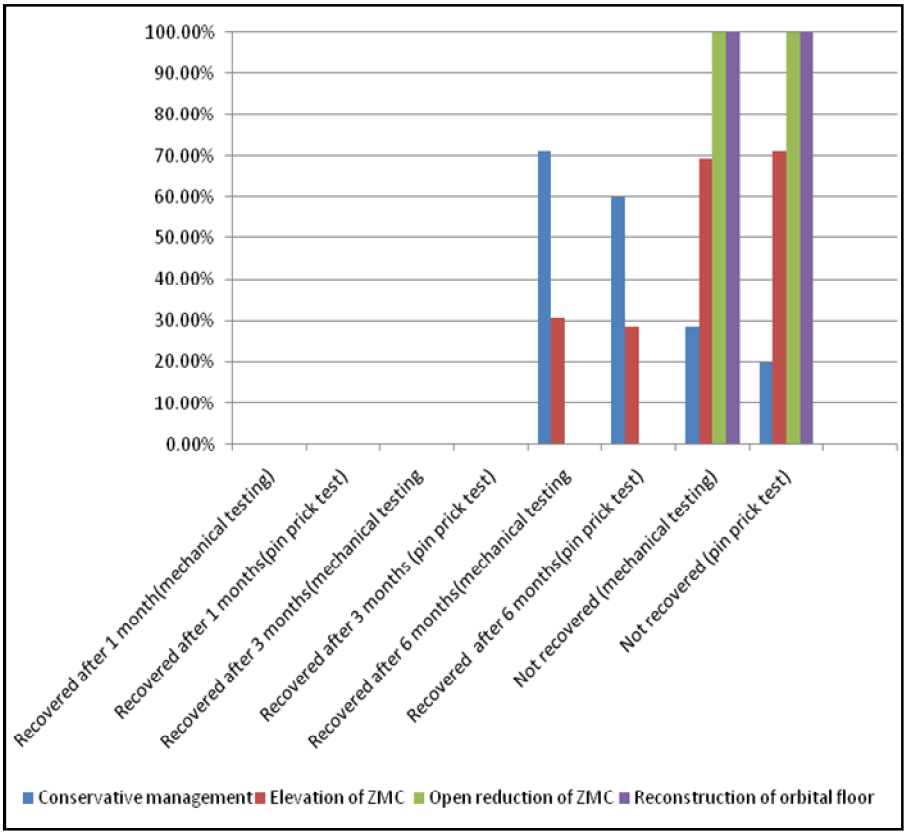



**Fig 10. Relation of recovery pattern of side of nose with treatment**

20% cases recovered from eyelid paresthesia in 3 months, 50% cases recovered from paresthesia in 6 months and 40% cases not recovered from paresthesia. In those who underwent closed reduction of zygoma 22% recovered from paresthesia after 6 months and 73.3% not recovered. Patients not recovered from paresthesia those who treated by open reduction and orbital floor reconstruction (Table 8).

**Recovery pattern of Upper lip with treatment**

By mechanical testing conservatively managed cases did not recover from paresthesia in 1 month. 4.3% of cases of upper lip paresthesia recovered within 3 months, 30.4% cases after 6 months and 65.2% cases did not recover. In those who underwent elevation of zygomatic complex fracture cases did not recover from paresthesia in1month and 3 months, 25% are recovered in 6 months and 75% not recovered from paresthesia. None of the cases recovered from paresthesia that underwent open reduction and orbital floor reconstruction. Recovery pattern of upper lip examined using pin prick test in conservatively treated cases no cases recovered in one month, 9% recovered from paresthesia after 3 months, 18.1% in 6 months and 72.2% are not recovered from paresthesia.

recovered in 6 months and 72.2% not recovered from paresthesia. Those who treated by open reduction and orbital floor reconstruction did not recovered from paresthesia (Table 9)

**Recovery pattern of Side of nose with treatment**

By mechanical method conservatively managed cases did not recover from paresthesia in 1 month.7.7% cases recovered in 3 months.71.4% patients recovered from paresthesia after 6 months and 28.6% patients did not recover. In patients underwent elevation of zygoma did not recover from paresthesia in 1 and 3 months.23.1% cases recovered in 6 months while69.3 cases did not recover. None of the cases of paresthesia recovered following open reduction of zygoma and those who underwent reconstruction of orbital floor. In pin prick test 60% of conservatively managed cases recovered from paresthesia in 6 months and 20% did not recover. Patients who underwent closed reduction of zygoma 40% recovered from paresthesia in 6 months and 50% not recovered. None of the patients treated by open reduction and orbital floor reconstruction recovered (Table 10).

## DISCUSSION

The infraorbital nerve is often involved in trauma to the zygomatic complex at the site of the infraorbital fissure, infraorbital canal, or foramen. This results in sensory disturbances including paresthesia, neuralgia of skin of the lower eyelid, cheek, lateral side of the nose, and upper lip and to the labial mucosa, gingivae and teeth (Taicher *et al.,* 1993). Our objectives of the study were to investigate sensory changes in the superior labial, lateral nasal, inferior palpebral branches of infra orbital nerve following zygomatic complex fractures by employing sensory testing over a 6-month period, to identify the most commonly involved branch of infra orbital nerve in zygomatic complex fracture and to document the pattern of sensory recovery in the study subjects. Vreins *et al.,* 1998 study shows that following orbitozygomatic complex (OZC) fractures, the reported incidence of long-term sensory disturbances of the infraorbital nerve varies between 24% and 50% (out of 65 cases).

Westermark *et al.,* 1992 reported an impaired infraorbital nerve function up to 80% of cases of zygomatic complex fractures (out of 73 cases). Pedemonteet al[9] reported 92% showed transient neurosensory deficits and 8% showed long-term (more than six months) neurosensory deficits (out of 10 cases). Benolielet al[4] reported prominent pattern of electrical hypoesthesia immediate post injury in 25 patients which were taken in account in their study.

Ahmed *et al.,* 2010 reported infra orbital nerve paresthesia in 86.47% patients in zygomatic complex fractures (out of 133 cases). Prachur Kumar *et al.,* 2012 study preoperative evaluation of the results of skin of the lower eyelid, lateral side of nose, cheek and skin of the upper lip and results with electrical detection threshold test showed hypoesthesia in 80% of patients(out of 25 patients). Our study correlates with the previous studies. We found eyelid paresthesia by mechanical testing in 40 cases while 50 cases had normal sensation; by pin prick test 30 cases had paresthesia and 60 cases had normal sensation. 73 patients reported paresthesia in upper lip while 17 had normal sensation in upper lip by mechanical testing. In pin prick test 65 cases had paresthesia in upper lip and 25 cases had normal sensation. Only 23 cases had paresthesia in side of nose and 67 cases were normal by mechanical testing while in pin prick test paresthesia was noted only in 15 cases and remaining 75 cases had normal sensation. Prachurkumaret al., 2012 study reported hyperesthesia in 20% of the cases on the lower eye lid (out of 25 cases).

In our study no hyperesthesia cases were seen. On Pub Med search of journals there is no information regarding which branch of infra orbital nerve was most commonly involved in zygomatic complex fractures. From our study we found that upper lip (73 cases out of 90 by mechanical method and 65 cases by pin prick test) is the most commonly involved area and hence superior labial branch is the most commonly involved branch in zygomatic complex fractures. Lateral nasal (23 cases out of 90 by mechanical method and 15 cases by pin prick test) is the least involved branch in zygomatic complex fractures. Significant recovery is noted in all the branches after 3 month and 6 months. After 6 months 50 % of cases recovered from paresthesia in lower eyelid when tested mechanically while only 40% cases have recovered from paresthesia in eyelid when tested by pin prick test. Similarly it was 27.3% cases vs 26.1% in the upper lip. Side of nose recovery revealed 47.3% vs 33.3% when two methods were compared. We also found that there is no significant change in recovery according to treatment. In our study upper lip (on average 69 out of 90 cases) was the most commonly involved branch and lateral nasal nerve (19 out of 90 cases) was the least involved. The average is taken of the two tests employed to check the paresthesia. Benoliel et al's[4] study on 25 cases reported sustained nerve injury in 24% to 30% of cases on 6-month recall. Ahmed *et al.,* 2010 study on 133 patients, majority of patients (32.4%) recovered in 4 month and 3% of cases did not recover in 12 months.

Pedemonte et al in a study on 10 patients reported that patients with alterations of both sensitive modalities (thermal and tactile) can expect a recovery period of six or more months, that may be only partial, while patients that only have tactile alterations should recover completely before three months. In our study after 6 months 50 % of cases recovered from paresthesia in lower eyelid when tested mechanically while only 40% cases have recovered from paresthesia in eyelid when tested by pin prick test. Similarly it was 27.3% cases vs 26.1% in the upper lip. Side of nose recovery was 47.3% vs 33.3% when two methods were compared. De Man and Bax, 1988 study on 106 patients with displaced zygomatic complex fractures 38 patients underwent reduction with wire fixation and 68 cases underwent miniplate fixation. In the group with wire fixation, 50% suffered persistent reduced sensitivity in the infraorbital region at follow-up examination, whereas in the group with a miniplate osteosynthesis only 22.1% had persistent neurological sequelae. Zingg *et al.,* 1991 10-year experience with surgical treatment of 813 zygo malateral orbital complex fractures stated that reduction and fixation were important factors in the recovery of sensory disturbances of the IO nerve.

Vriens *et al.,* 1998 study on 65 patients reported that the frequency of sensory disturbance was significantly less after open reduction of zygoma than after closed reduction of zygoma at a 12-month postoperative time of measurement. Taicher et al., 1993 states that recovery rate of sensation depend on several factors, including the nature of injury to the nerve, the time between the injury and surgical intervention and methods of treatment. In our study contrary to the findings of the above authors conservatively managed cases showed improvements in the paresthesia compared to closed reduction. Two cases which were managed by open reduction did not recover the sensation.

Champy *et al.,* 1983 studied two series of treatment methods of zygomatic complex fractures, first 258 cases treated by conventional methods and second 437 cases treated by osteosynthesis with miniaturized screwed plates (MSP). The incidence of postoperative infra-orbital nerve sequelae was diminished by 50% in the second series.

In our study only one case undergone open reduction of zygoma so it cannot be compared but after closed reduction of zygoma no significant improvement in paresthesia seen. Difference in the values from mechanical and pin prick test is due to fact that thermal and painful stimuli are thought to be transduced by thin unmyelinated(C) fibres. Mechanical and electrical stimuli selectively activate thick myelinated fibers (A beta). Physiological studies have confirmed the Lewis theory (Pedemontet and Basili, 2005), stating that when a nerve is compressed, the fibers are affected differently: the bigger the fiber, the more likely to be affected by trauma. On comparison between two methods of sensory testing we found that the

mechanical testing is more sensitive than pin prick test. Reda et al latest study in 2014 reported that, the use of surgical procedures combined with neuromuscular electrical stimulation and exercises program were the good method and open a new link to improve the recovery of infraorbital nerve sensory changes following zygomatic fractures.

**Summary and Conclusion**

This study was undertaken to investigate sensory changes in the superior labial, lateral nasal, inferior palpebral branches of the infra orbital nerve following zygomatic complex fractures by employing sensory testing using mechanical and pin prick test over a period of 6-months. Second objective was to identify the most commonly involved branch of infra orbital nerve in zygomatic complex fracture and to document the pattern of sensory recovery in the study subjects. From our study we found that upper lip (73 cases out of 90 by mechanical method and 65 cases by pin prick test) is the most commonly involved area and hence superior labial branch is the most commonly involved branch in zygomatic complex fractures. Lateral nasal (23 cases out of 90 by mechanical method and 15 cases by pin prick test) is the least involved branch in zygomatic complex fractures. All branches had significant recovery after 6 months. Study of pattern of recovery after treatment showed that there is no significant improvement in paresthesia of any branches of infra orbital nerve following closed reduction of zygomatic complex fracture. We had only two cases where open reduction was done and both did not recover from paresthesia. The probable reason for reduced number of open reduction cases is the lack of adequate operating days.

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