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Evaluation Of The Incidence And Recovery Of Neurosensory Deficiencies In Patients Undergoing Major And Minor Surgeries In Maxillofacial Region.

Som Ranjan Pathak[1], Raghavendra K[2], Pillai Arungopinathan[3]*, and Nithin VS[4], and Roopan[5].

[1]Oral & Maxillofacial Surgery, Dr.Mini's Dental & Implant Centre,Shiva Narayan Complex ,Bangalore
[2]Oral & Maxillofacial Surgery,Sri Siddhartha Dental College & Hospital,Sri Siddhartha Academy of Higher Education, Tumkur, India.
[3]Oral & Maxillofacial Pathology, Sri Sankara Dental College, Varkala, Akathamuri, Kerala, India.
[4]Department of Oral Medicine &Radiology , Sri Sankara Dental College, Varkala, Akathamuri, Kerala, India
[5]Department of Oral Pathology, Sri Sankara Dental College, Varkala, Akathamuri, Kerala, India

ABSTRACT

Neurosensory deficits in maxillofacial surgery are one of the important aspects which are encountered by a surgeon.Retaining neurosensory function after trauma and removal of 3rd molars in close proximity to neurovascular bundle has always been challenging. Neurosensory tests should be simple and should be carried out by the use of easily available materials in day to day clinical practice. To evaluate the incidence of neurosensory deficitsin maxillofacial region following major and minor surgery and to track the course of recovery in follow up of 1 year. 135 individuals belonging to the age group of 18 to 60 years were included in the study. Preoperative and Postoperative Assessment on Subjective evaluation & Objective neurosensory tests were performed to check for any paresthesia or anesthesia of the involved area. Data were subjected to statistical analysis using Chi square test Total 12 patients had neurosensory deficits post operatively & 21 to 30 years age group had the highest incidence of neurosensory deficits. Incidence of Neurosensory deficitsin impaction was 6.5%, trauma 13.3% and cyst 15.3%. Trauma and cyst group of patients showed complete recovery in follow up but in impaction group 2 patients had persistent NSD. Evaluation of NSD is important in determining of timing in which nerve gets repaired and when to intervene before the neurosensory deficiencies become permanent. If no recovery occurs after 3 months, nerve repair should be considered.

Keywords: Neurosensory deficits, Neurosensory tests, Maxillofacial region

**Corresponding author*

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INTRODUCTION

The face, oral and perioral regions have the highest density of peripheral receptors, and at the same time it is difficult to tolerate neurological deficiencies in oral and maxillofacial region compared to disturbances in any other region of the body. Neurosensory deficits(NSD) in maxillofacial region are caused by trauma and pathology [1].

Mandibular third molar extractions are most common procedure carried out and may lead to inferior alveolar nerve or lingual nerve damage[2].Maxillofacial surgeons encountering patients with trigeminal nerve injury must understand the response of a nerve to trauma and the series of events in a nerve injury which depends on type of injury and its severity[3].

Mandibular sagittal split osteotomy is another procedure carried out in orthognathic surgery which leads to NSD [4].The documentation of the NSD has been a neglected area in the Oral & Maxillofacial spectrum. The data regarding the history and long term outcomes of NSD associated with oral & maxillofacial region is very limited.NSD are usually reversible, could be permanentalso [5].Fractures of orbitozygomatic complex often lead to NSD in the region supplied by infraorbital nerve[6].Age of the patient and amount of advancement increases the risk of nerve injury[7].

The pathophysiologies of neuropathies are complex, and treatment prognosis is often disappointing. To evaluate nerve dysfunction it is important to use objective testing rather than to simply ask patient subjectively to report neuropathic changes.Objective data can be obtained by clinical neurosensory tests. Neurosensory testing is designed todetermine the degree of sensory disturbance, to monitor sensory recovery, and to point out whether, surgical intervention may be indicated[5].

The purpose of the study was to evaluate the incidence and recovery of NSD in patients undergoing major and minor surgeries in the maxillofacial region along with presence or absence of neurosensory deficits and its subsequent course of recovery in the follow up of 1 year. The study also aims to perform an examination evaluating the sensory dysfunction by carrying out a series of testing maneuvers that will outline the area of sensory deficit.

MATERIALS AND METHODS

A prospective study was carried out at Siddhartha dental college, Tumakuru, Karnataka, India. Total of 135 Patients were included in the study along with written informed consent.Inclusion criteria were patients within the age group of 18 -70 years, no history of medical illness, maxillofacial surgeries due to pathology, trauma and any minor surgical procedures.Exclusion criteria were patients with history of Cancer or human immune deficiency viral infections , active acute localized oral or systemic infection, presence of any medical condition or therapeutic regimen that alters soft and /or hard tissue healing, i.e.: osteoporosis, hyperparathyroidism, autoimmune diseases, chemotherapeutic or immunosuppressive agents.

Subjective and objective evaluation was carried out preoperatively and postoperatively. Subjective evaluation were evaluated by questionnaire for NSD .Objective evaluationwas carried outusing the following neurosensory tests:

Level A Tests

- Two point discrimination (figure 1)
- Brush directional stroke test (figure 2)

Level B Tests

- Contact Detection or Static Light Touch(/figure 3)

Level C Tests

- Sharp Blunt Discrimination (figure 4)

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- Thermal test(figure 5heat test) &(figure6cold test) [5]

The evaluation of NSD was carried out on affected skin surface.The unaffected contra lateral side was examined for control purposes.In the cases of bilateral fractures, the forehead region (frontal nerve) was employed as control.Objective evaluation was carried out by neurosensory tests based on the specific receptors stimulated through the cutaneous contacti.emechanoceptive and nocioceptive testing.

The mechanoceptive testing included two point discrimination, static light touch and brush direction strokes. This discrimination test was used to evaluate large myelinated slow adapting fibres and slide calipers were used to access it (figure 1).The sensations ofbrush directional stroke with 00 Camel brand brush were used for large myelinatedfibres (/figure 2) and static light touch with proline 4-0 monofilament of length 1.5cm for quickly adapting fibreswereused (figure 3).

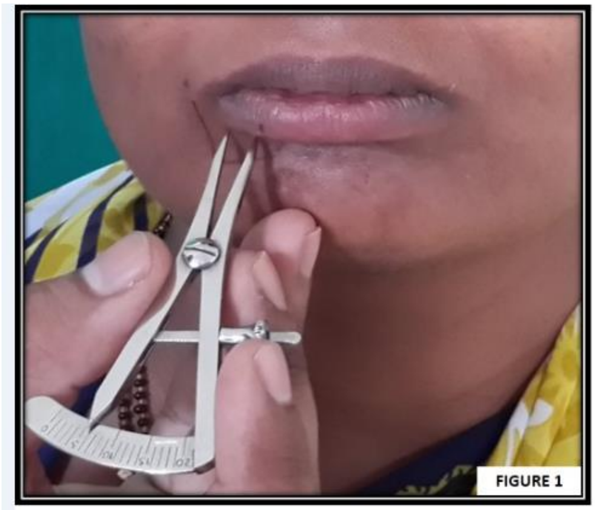

Figure 1: Two point discrimination test

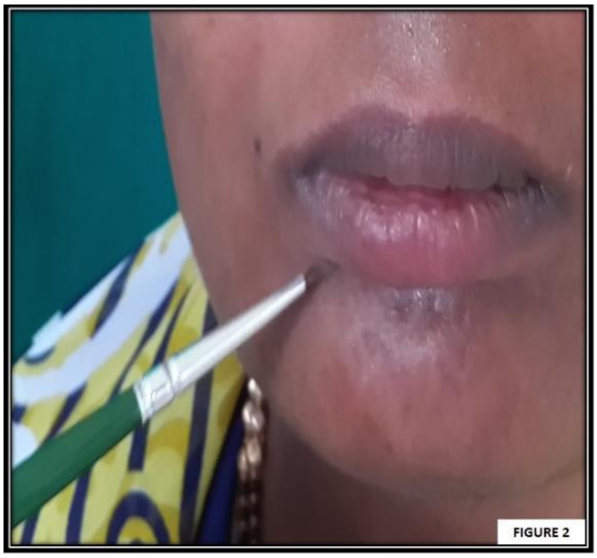

Figure 2: Brush directional stroke test

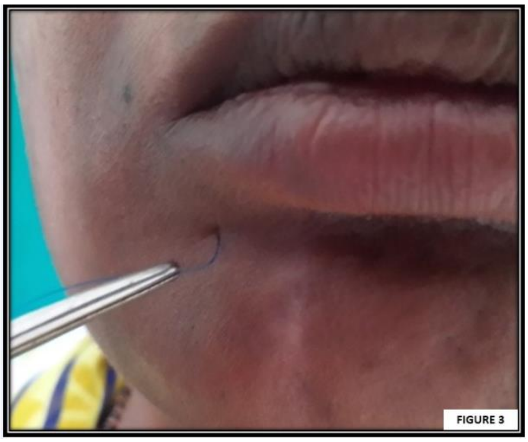

Figure 3: Contact Detection or Static Light Touch

The nocioceptive testing included pin prick and thermal discrimination. Pin prick was used to evaluate small, myelinated, A delta and C sensory nerve fibres. Periodontal probe with a rubber stopper was used for pin prick test (figure4).Temperature discrimination evaluation was used for small myelinated and unmyelinated fibers. Warm water in a test tube with temperature of 50° c and cold water at 15°c was used in the study (figure5 &figure 6).

Figure 4: Sharp Blunt Discrimination

Figure 5: Thermal test (Heat)

Figure 6: Thermal test (Cold)

Both Preoperative and Postoperative Assessment on Subjective evaluation & Objective neurosensory testswere performed to check for any paresthesia or anesthesia of the involved area.The patient were evaluated preoperatively and post operatively on 1st,7th, 14th day 1st post op month, 2nd post op month and 6th month from the day of treatment carried out.

The obtained scores were tabulated and subjected to statistical analysis usingChi square test to draw the significance between the variables.

RESULTS

Total 135 patients were included in the study of which 79 males & 56 females were evaluated for incidence and recovery of NSD. The age group in the study ranged from 18 to 60 years & were divided into 5 groups based on age. In 18 to 20 years age group, there were 12 patients, in the 21 to 30 year age group there were 81 patients,in the third age group of 31 to 40 years there were 32 patients, in the 41 to 50 years age group there were 5 patients, whereas in the 5thage group of 51 to 60 years there were 5 patients.

Based on the type of surgical procedure carried out 3 groups were formed for evaluation of NSD which were Impaction, Cyst and Trauma group. In the impaction group there were total 92 patients which comprised of 43 males & 49 females. These patients werefurthersub grouped based on the type of impaction of which 3 patients had Distoangular impaction, 65 patients had Mesioangular impaction, 11 patients had Horizontal impaction, 13 patients had vertically impacted mandibular third molars. In the Cyst group, 13 patients were evaluated, and biopsy revealed 2 dentigerous cysts, 6 radicular cysts and 5 residual cysts.In the trauma group, 30 patients were evaluated, of which 29 were males & 1 was a female patient.4patientshad bilateral condylar fracture,12 patients had parasymphysisfracture ,7 patients had zygomatic complex fracture ,other fractures comprised of 7 patients .(Table 1)

Table 1: Female and Male distribution of each group

Type	Female	Percentage	Male	Percentage	TOTAL
CYST	6	10.71	7	8.86	13
IMPACTION	49	87.50	43	54.43	92
TRAUMA	1	1.79	29	36.71	30
TOTAL	56	100	79	100	135

Chi square value: 23.36 **p value: <0.001**

All the 135 patients in the study group were assessed for NSD preoperatively.Total 12 patients hadneurosensory deficits post operatively which constituted 8.88%among the 135 patients in the study. Of which 6 patients belonged to the impaction group, 4 patients from the trauma group & 2 patients were from the cyst group. (Table 2)

Table 2: Incidence of NSD in each group

Type	Neurosensory deficit				
	Absent	**Percentage**	**Present**	**Percentage**	**TOTAL**
CYST	11	8.94	2	16.67	13
IMPACTION	86	69.92	6	50.00	92
TRAUMA	26	21.14	4	33.33	30
TOTAL	123	100.00	12	100	135

Chi square value: 2.05 p value: 0.35

The 21 to 30 years age group had the highest incidence of NSD at 66.67% which was 8 in number.(Table 3).Thus Incidence of neurosensory deficit in cyst, trauma and impaction was found to be 15.38%, 13.33% and 6.5% respectively.

Table 3: Incidence of NSD according to age group

Age group	Neurosensory deficit				
	Absent	**Percentage**	**Present**	**Percentage**	**TOTAL**
18 to 20	12	9.76	0	0.00	12
21 to 30	73	59.35	8	66.67	81
31 to 40	28	22.76	4	33.33	32
41 to 50	5	4.07	0	0.00	5
51 to 60	5	4.07	0	0	5
TOTAL	123	100	12	100	135

With regards to Recovery of NSD, after a follow up for 1 year it was found that there was complete recovery in NSD among trauma and cyst group. However recovery of NSD in the Impaction group was limited to 33.33% and 2 patients continued to persist with NSD.(Table 4)

Table 4: Recovery of NSD in follow up of one year in different groups

Type	1st Post Op. Day		3rd Post t Op. Day		7th Post Op. Day		11th Post Op. Day		2nd Post Op. Week		3rd Post Op. Week		3rd Post Op. month		6th Post Op. month		1 year post op	
	Present	Recovered	Present	Recovered	Present	Recovered	Present	Recovered	Present	Recovered	Present	Recovered	Present	Recovered	Present	Recovered	Present	Recovered
CYST	2	0	2	0	0	2	0	2	0	2	0	2	0	2	0	2	0	2
IMP	6	0	6	0	6	0	6	0	6	0	6	0	4	2	3	3	2	4
TRAUMA	4	0	4	0	4	0	4	0	3	1	2	2	1	3	0	4	0	4
TOTAL	12	0	12	0	10	2	10	2	9	3	8	4	5	7	3	9	2	10

DISCUSSION

Evaluation of neurosensory functions in maxillofacial region should be ideally carried out before any surgical procedure. In this study neurological tests were performed for up to one year post operatively with a regular follow up at intervals along with the clinical evaluation involving various neurosensory testing methods.

In the evaluation of NSD Seddon's and Sunderland's classifications were incorporated. Seddon classified the neural injuries as neuropraxia, axonotmesis and neurotmesis. Seddon's classification was based on the time of injury and degree of observed sensory recovery. Sunderland expanded the Seddon's classification (Table5)to include 5 degrees of nerve injury[15].

Table 5: Seddon's and Sunderland's classification of Neural Injuries

TYPE OF NEURAL INJURY	CAUSE & MECHANISM	SENSORY CHANGES & HEALING
Neuropraxia (Seddon) (Sunderland first- degree injury)	Minor compression or traction of the nerve trunk, which results in a temporary conduction blockade	Sensory disturbance last from hours to months & complete recovery occurs
Axonotmesis(Seddon) (Sunderland second-degree injury)	Crush or significant traction injuries which results in vallerian degeneration. No degeneration of the endoneureum, peroneurium or epineurium	Sensory recovery is usually complete in 2 to 4 months but may take up to 1 year for complete recovery.
Third and fourth degree Sunderland injuries do not have a corresponding Seddon category	Third- degree injuries result from moderate to severe crushing. Vallerian degeneration is present Fourth- degree injuries occur with endoneural and perineural disruption.	Sensory recovery is usually complete in 2 to 5 months Recovery is incomplete. Adversely affects the prognosis for recovery
Neurotmesis(Seddon) (Sunderland fifth-degree injury)	Complete transection of the nerve trunk affecting all layers of the nerve. complete disruption of the nerve with possible neuroma formation	Poor prognosis for spontaneous recovery

NSD are one of the major complications during removal of mandibular third molars. It may affect inferior alveolar nerve or more commonly, the lingual nerve. The greatest probability of recovery occurs in the first 3 months and the probability of recovery from IAN injury is about 60% after 3 months, 55% after 6 months, 45% after 9 months, and 17% even up to 15 months post injury. While for lingual nerve, the probability of recovery decreases rapidly after 6 months and is about 60% at 3 months, 35% at 6 month and <10% at 9 months or longer[8].In terms of fracture, a faster spontaneous recovery of temperature and nociception than the light touch, 2 point discrimination and directional stroke sensibilities were observed. The author concluded that nondisplaced fractures had better prognosis than displaced, and midface fractures had better prognosis[9].Open reduction and internal fixation, fracture displacement of 5mm or more, were associated with an increased risk for deterioration of the inferior alveolar nerve neurosensory score after treatment of mandibular fracture[10].Chronic neuropathic pain following zygomatic fractures is rare and plate fixation allows for significantly better restoration of infraorbital nerve function[11].Following repair of the nerve after injury, a study revealed that the mean duration between injury and repair was 4.5+/-2.3 months and between repair and postoperative visit was 11.9+/-0.9 month. Majority of the patients experienced improvement in neurosensory status[12]. In a study, it was proposed that during preoperative examination, examination of thermal discrimination should be done in order to establish prognosis and approximate recovery time[13].With regards in orthognathic surgery, to avoid NSD in genioplasty, a study concluded that sagittal curving osteotomy was a simple, safe and effective technique for advancement genioplasty[14].

The incidence of lingual and inferior alveolar nerve injuries reported ranges from 0.4% to 22%. Sensory deficits that last longer than 1 year are likely to be permanent, and attempts for microsurgical repair are often unpredictable after that time[15].The relationship between objective NSD and subjective patient report of altered sensation is not always consistent and persistent NSD with increasing age is not significant[16]. The date of the incident or onset of sensory changes is important as there is certain time for pathophysiologic response of a peripheral nerve to injury. In humans, the time for repair is between 9 and 15 months[17]. Post injury to the nerve, if neuroma formation is there, it should be excised. External decompression by removing excess bone and internal neurolysis should be performed. Neurorrhaphy and nerve grafting are the other treatment modalities [18].

Following nerve damage, there is series of events collectively termed as Wallerian degeneration. The nerve cell body enlarges and increases metabolic activity as it attempts to produce new axonal growth. This process is estimated to begin at 1 to 2 month after injury and passes a point of no return after 9 to 15 months. Successful repair is most likely if nerves are surgically repaired within 9 months of injury [19]. Recommendations for the management of trigeminal nerve injuries are, tension-free primary repair provides the optimal result, if direct primary repair is not possible, autogenous nerve grafts should be used or hollow conduits used for entubulization of nerve gaps are equally successful for delayed reconstruction of gaps of 3cm or smaller [20].The surgical treatments included external neurolysis, repair by direct suturing, autogenous vein graft to bridge a nerve defect and Gore-Tex tube to bridge a nerve defect. The non-surgical treatment included acupuncture and low level laser treatment. Most treatment showed an improvement in the sensation, but the outcomes were variable[21].

The limitations of the present study were i.e only the incidence & evaluation of NSD were done but the treatment aspect was lacking, fracture group were not categorized as different as zygomatic fracture only or mandibular fracture only. Lastly in trauma patients the degree of displacement with NSD were not considered.

CONCLUSION

Incidence and duration of recovery in NSD has been a neglected area in oral and maxillofacial surgery. In patients with trauma and pathology, a proper case history should evaluate incidence of NSD.Evaluating preoperative NSD aids the surgeon to assess the recovery by evaluating NSD postoperatively. If NSD persists post operatively the option of exploring the area and decision can be taken for micro neuro surgical repair.

In our study, with regards to incidence of NSD, we recommend evaluation of NSD pre operatively, if NSD is present and if persistence for 3 months, the prognosis for the recovery becomes less. After 1 year if NSD still persists then nerve repair/grafting should be considered.

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The authors declare no conflicts of interest.

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