Original Article

Management of trigeminal neuralgia by peripheral neurectomy

ABSTRACT

Background: Peripheral neurectomy(PN)is a minimally invasive procedure, for the management of trigeminal neuralgi (TN)consisting of surgical avulsion of terminal branches of the trigeminal nerve.

Aim: To assess the efficacy of PN in the treatment of refractory TN and their recurrences in a follow up of 18 months.

Materials and Methodology: Retro-prospective and prospective study was conducted on randomly selected 30 TN patients irrespective of age, gender and socio-economic status. The branch of trigeminal nerve involved was identified according to the site of pain. Then the PN procedure was performed under local or general aesthesia. The follow up of each patient was done for next 18 months.

Results: Mean age of the TN patients 53.17 ± 13.84 years, with 66.7% of patients were within 60 years of age. Male to female ratio was 1:1.5. All patients showed unilateral TN. Mostly 26.7% trigger point was located in lower lip followed by 13.3% in upper lip. After 3,6 and 9 months follow-up, none of the TN patients treated with PN had pain and none had any effect on general activity. However, from 12 months till 18 months' follow up, 2 (6.7%) patients reported of pain.

Conclusion: PNs are viable treatment alternative for TN, although peripheral neurectomy has chances of reoccurrence but still offer better quality of life in patients for many years without relaps.

Keywords: Carbamazepine, peripheral neurectomy, trigeminal neuralgia, trigger zone

INTRODUCTION

The International Association for the Study of Pain (IASP) defines trigeminal neuralgia (TN) as the "sudden, usually unilateral, severe, brief, stabbing, and recurrent episodes of pain in the distribution of one or more branches of the trigeminal nerve."[1] The International Headache Society (IHS) divides TN into two categories: classical and symptomatic (secondary).[2] Classical TN includes those patients in which no identifiable cause of TN can be found other than a vascular compression of the trigeminal nerve. Symptomatic TN describes those patients in which an identifiable cause can be found, other than a vascular compression, such as an arterio-venous malformation, tumor, or multiple sclerosis (MS). As not every TN patient will fulfil the IHS diagnostic criteria, the diagnosis of atypical or type II TN can be applied to these cases. The English physician John Fothergill in 1773 outlined the major clinical features of TN, clearly establishing the disorder as a discrete syndrome.[3] An annual incidence rate of TN is between 4 and 5 per 100,000.[4] The apparent rise in the

Sapna Tandon, Saurabh Srivastava[1], Madan Mishra[2], Ramesh R. Fry[3], Sanober Sohail, Anusha Sidhwa[3]

Department of Oral and Maxillofacial Surgery, Career Post Graduate Institute of Dental Sciences and Hospital, [1]Department of Otorhinolaryngology, Era Medical College, [2]Department of Oral and Maxillofacial Surgery, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow, Uttar Pradesh, [3]Department of Oral and Maxillofacial Surgery, MM College of Dental Sciences and Research, Mullana-Ambala, Haryana, India

Address for correspondence: Dr. Sapna Tandon, Department of Oral and Maxillofacial Surgery, Trauma Centre, IMS, BHU, Varanasi, Uttar Pradesh, India.
E-mail: drsapnatandon@gmail.com

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incidence of TN is likely to be a result of misdiagnosis and reporting error rather than due to any other reasons.[4] TN can occur in both genders (with a slight female predominance), and the mean age of occurrence is 64 years.[5]

Peripheral neurectomy (PN) was done for the first time in the eighteenth century with limited success. By dividing or avulsing a peripheral branch of the trigeminal nerve, the maxillofacial surgeon can achieve an exact, complete, and long-lasting effect. PN can be done on the supraorbital and supratrochlear/infratrochlear/lacrimal nerves, the infraorbital nerve, inferior alveolar, lingual, and mental nerves. This surgery can be carried out as an outpatient procedure under local anesthesia in the elderly and on debilitated patients who are at an increased risk of undergoing invasive neurosurgical procedures. It is also useful in patients who are reluctant to undergo major neurosurgeries and patients in rural places where facilities for advanced neurosurgical procedures are not available. As many patients and maxillofacial surgeons prefer this treatment due to an advantage of minimum risk of morbidity, PN playsan important role in the treatment of TN.[6]

With this background, the present study was planned to assess the efficacy of PN in the treatment of refractory TN and their recurrences.

MATERIALS AND METHODOLOGY

The study was conducted on 30 randomly selected TN patients (also included already diagnosed and treated TN cases satisfying the study selection criteria) irrespective of age, gender, and socioeconomic status and who were diagnosed in the outpatient department (OPD) of oral and maxillofacial surgery. Institutional ethical clearance was obtained before the start of the study. The inclusion criteria of the study consisted of (1) patients with American Society of Anesthesiologists (ASA) grade I and II who were on carbamazepine, ranging from 600 to 1200 mg/day and had become refractory to medical therapy; (2) patients who were reluctant to undergo major surgical procedures like microvascular decompression or trigeminal tractotomy. The exclusion criteria included (1) medically compromised patients; (2) patients not willing to opt for any surgical procedure; (3) patients not turning up for complete follow-up.

The diagnosis was based on detailed case history, thorough clinical examination including trigger zone identification, and history of tab. carbamazepine consumption. All patients were subjected preoperatively to orthopantomography (OPG) and computed tomography (CT) or magnetic resonance imaging (MRI) of the brain, as per the requirement. The branch of trigeminal nerve involved was identified according to the site of the pain and confirmed with diagnostic block with 2% lignocaine and adrenaline 1:80,000. All the selected patients were informed about the surgical procedure of PN along with associated complications, and a written and informed consent was received from each patient before the procedure. Then depending upon the fifth cranial nerve branch involved, the PN procedure was performed.

PN for Infraorbital Nerve: The infraorbital nerve was accessed through the intraoral approach. Vestibular incision was given and infraorbital foramen was visualized. The infraorbital nerve and its peripheral branches were identified. Dissection of the nerve was performed from the soft tissues and from the infraorbital canal.

PN for Inferior Alveolar Nerve: The nerve was approached, identified, and dissected from the distal end intraorally by Dr. Ginwalla's incision,[7] that is, an incision along the anterior border of the ascending ramus extending buccaly and lingually like an inverted Y. Vestibular incision in the premolar region was given; blunt and sharp dissection on the medial aspect of the ramus region done, temporalis, and medial pterygoid muscles split at their insertion, the entire length of inferior alveolar nerve along with its mental branch was identified and avulsed from the canal and the surrounding soft tissues.

PN for Mental Nerve: Isolated mental nerve neurectomy was performed through intraoral vestibular incision; the mental nerve was identified and avulsed from the mental foramen and soft tissues.

All the procedures were performed under local anesthesia of 2% lignocaine and 1:80,000 adrenaline or general anesthesia. Antibiotics and analgesics (or anti-inflammatory drugs)were prescribed postoperatively. Oral antibiotics (amoxycillin 500 mg and metronidazole 400 mg eight hourly), analgesics (ibuprofen 400 mg + paracetamol 325 mg eight hourly), B complex once daily for five days, and chlorhexidine gluconate 0.12% mouthwash (thrice daily). The follow-up of each patient was done for the next 18 months for postoperative complications, prognosis, and any additional procedure required in cases of recurrences. Data thus collected was tabulated and statistically analyzed using IBM's Statistical Package for the Social Sciences (SPSS) version 18 software.

RESULTS

The mean age of the diagnosed TN patients (n = 30) was found to be 53.17 ± 13.84 years, with a majority of the patients being within 60 years of age (n = 20; 66.7%) and only 3 (10%) being older than 70 years. The male-to-female

ratio of the study subjects was 1:1.5. All the patients showed unilateral TN, with 6.6% of cases having lower lip involvement (1 right; 1 left) and 93.4% of cases involving the side of the face (14 right; 14 left) [Table 1, Figure 1].

Mean duration of pain in TN patients was found to be 7.57 ± 3.91 years (ranging from 3 to 24 months), with 50% of patients having reported within 6 months while 3.3% reported 12 months after the start of pain.

Both infraorbital and the mental nerves were involved in 66.7% of cases (n = 20 with 10 right; 10 left); the remaining 30% of cases (n = 9) involved the inferior alveolar nerve and 3.3% (n = 1) only the infraorbital nerve [Table 2, Figure 2].

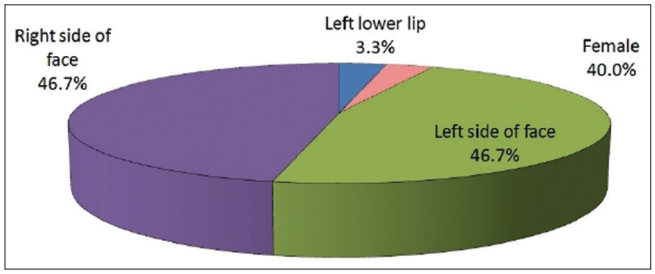

Figure 1: TN pain distribution in patients

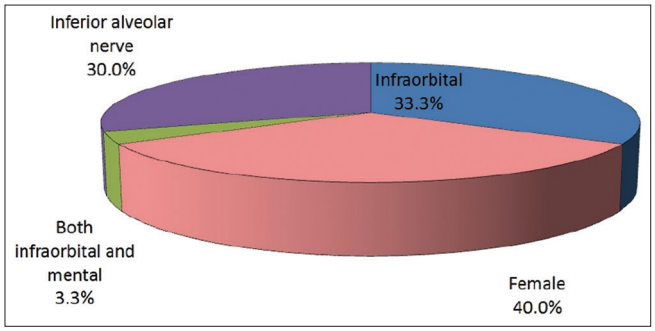

Figure 2: Patient distribution according to fifth cranial nerve branches involved in TN

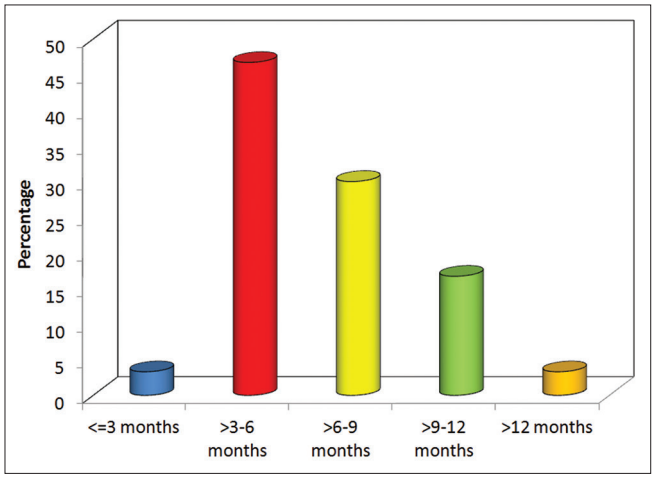

Figure 3: Different parameters for TN at baseline

At baseline, all the patients had pain. Half of the patients (n = 15; 50%) had episodes of pain at hourly intervals, 40% (n = 12) had a days' interval, and 10% (n = 3) had minutes' interval. Duration of pain was reported to last for minutes in 20 (66.7%) patients and hours in 10 (33.3%) patients [Table 3, Figure 3].

The most common trigger point was located in the lower lip (n = 8; 26.7%) followed by the upper lip (n = 4; 13.3%); the lower posterior alveolus and upper anterior alveolus had three trigger points each (n = 6; 20%); the cheek, lower anterior alveolus, lower anterior alveolus with tongue, and the lower lip with posterior alveolus had two each (n = 8; 26.7%); and the lower anterior alveolus with tongue, lower

Table 1: TN pain distribution in patients

Complaints	No. of patients	Percentage
Pain in left lower lip	1	3.3
Pain in right lower lip	1	3.3
Pain in left side of face	14	46.7
Pain in right side of face	14	46.7

Table 2: Patient distribution according to fifth cranial nerve branches involved in TN

Nerve Involved	No. of patients	Percentage
Infraorbital	10	33.3
Mental nerve	10	33.3
Both infraorbital and mental	1	3.3
Inferior alveolar nerve	9	30.0

Table 3: Different parameters for TN at baseline

Parameters	No. of patients	Percentage
Pain	30	100
Frequency of pain		
Minutes	3	10.0
Hours	15	50.0
Days	12	40.0
Duration of pain		
Minutes	20	66.7
Hours	10	33.3
Trigger point		
Cheek	2	6.7
Lower anterior alveolus	2	6.7
Lower anterior alveolus with tongue	1	3.3
Lower cheek	1	3.3
Lower cheek posterior alveolus	2	6.7
Lower lip	8	26.7
Lower lip with posterior alveolus	2	6.7
Lower posterior alveolus	3	10.0
Upper anterior alveolus	3	10.0
Upper cheek	1	3.3
Upper cheek and lower lip	1	3.3
Upper lip	4	13.3
Effect on general activity	30	100

cheek, upper cheek, and upper cheek with lower lip had one trigger point each ($n = 4$; 13.3%) [Figure 4]. In all the patients, general activity was affected [Table 4].

After three, six, and nine months of follow-up, none of the TN patients treated with PN had pain and none had any effect on general activity. However, from 12 months till 18 months of follow-up, two (6.7%) patients reported pain. On comparing the data from baseline, the difference was statistically significant. Moreover, at the 12- and 18-month follow-up, both the patients had pain at hourly intervals whereas at 15 months, one patient had pain at minute intervals and the other had pain at hourly intervals. Statistically, at all these follow-up intervals, change in pain status and frequency was significant ($P < 0.001$) [Tables 5 and 6, Figures 5–7].

Regarding general activity of treated TN patients on follow up, 6.7% of patient's ($n = 2$) activity was affected, and statistically, the change from follow-up was significant at all the follow-up intervals [Table 7, Figure 8].

DISCUSSION

TN is a clinical diagnosis that is dependent on a history of sudden lancinating or stabbing pains with pain-free periods between attacks and the absence of clinical findings. Injection of local anesthetic solutions can be useful in the diagnosis of TN as well as confirming the trigger zone. The response to anticonvulsant drugs is useful to confirm the diagnosis, and drug therapy is convenient and well-tolerated by most

Table 4: Follow-up evaluation of presence of pain parameters after PN

Time interval	No. of patients with pain	%	Significance of change from baseline
Baseline	30	100	-
3 months	0	0	$\chi^2=60$; $P<0.001$
6 months	0	0	$\chi^2=60$; $P<0.001$
9 months	0	0	$\chi^2=60$; $P<0.001$
12 months	2	6.7	$\chi^2=52.5$; $P<0.001$
15 months	2	6.7	$\chi^2=52.5$; $P<0.001$
18 months	2	6.7	$\chi^2=52.5$; $P<0.001$

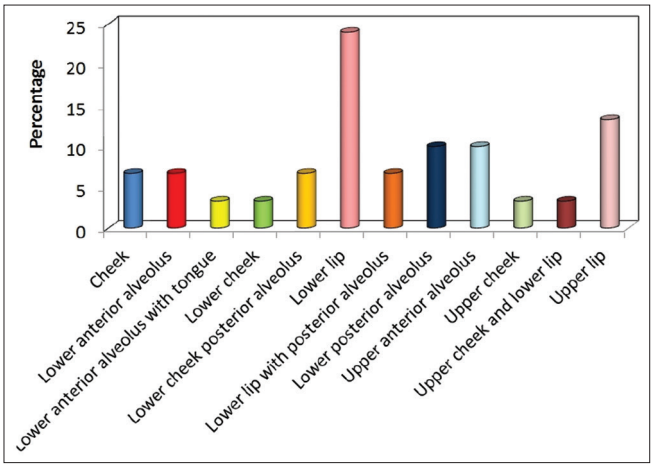

Figure 4: Trigger point distribution

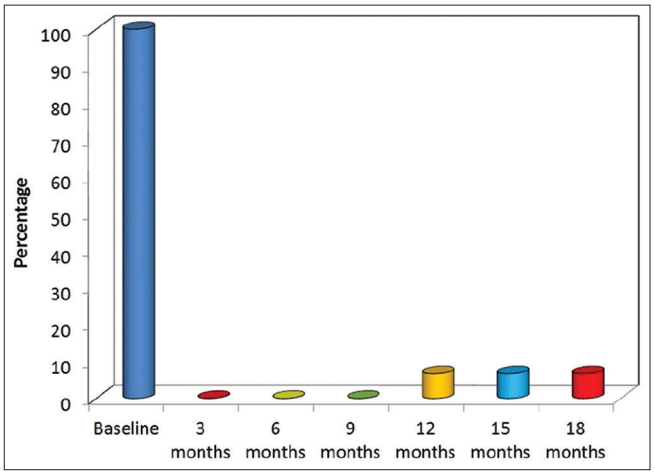

Figure 5: Follow-up evaluation of presence of pain parameters after PN

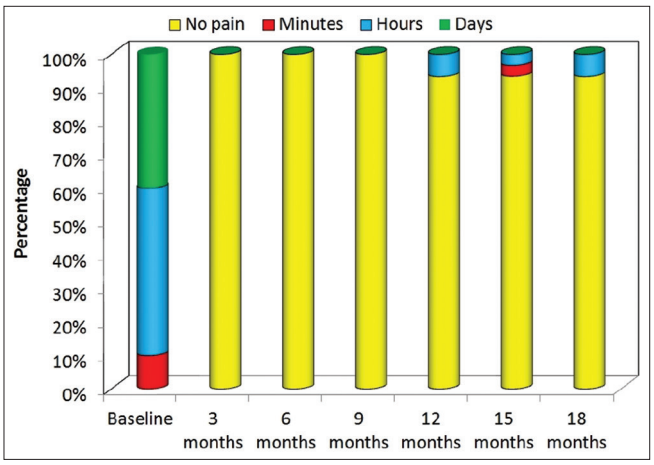

Figure 6: Follow-up evaluation of frequency of pain parameters after PN

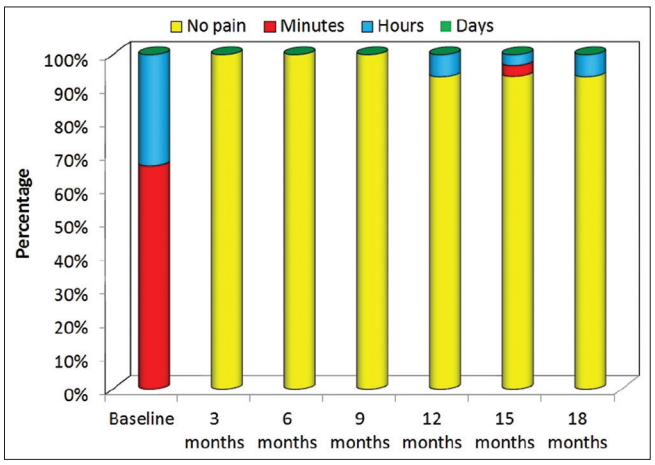

Figure 7: Follow-up evaluation of duration of pain parameters after PN

Table 5: Follow-up evaluation of frequency of pain parameters after PN

Time interval	No pain		Minutes		Hours		Days		Significance of change from baseline
	No.	%	No.	%	No.	%	No.	%	
Baseline	0	0	3	10	15	50	12	40	-
3 months	30	100	0	0	0	0	0	0	$z=4.893$; $P<0.001$
6 months	30	100	0	0	0	0	0	0	$z=4.893$; $P<0.001$
9 months	30	100	0	0	0	0	0	0	$z=4.893$; $P<0.001$
12 months	28	93.3	0	0	2	6.7	0	0	$z=4.800$; $P<0.001$
15 months	28	93.3	1	3.3	1	3.3	0	0	$z=4.873$; $P<0.001$
18 months	28	93.3	0	0	2	6.7	0	0	$z=4.800$; $P<0.001$

Table 6: Follow-up evaluation of duration of pain parameters after PN

Time interval	No pain		Minutes		Hours		Days		Significance of change from baseline
	No.	%	No.	%	No.	%	No.	%	
Baseline	0	0	20	66.7	10	33.3	0	0	-
3 months	30	100	0	0	0	0	0	0	$z=4.893$; $P<0.001$
6 months	30	100	0	0	0	0	0	0	$z=4.893$; $P<0.001$
9 months	30	100	0	0	0	0	0	0	$z=4.893$; $P<0.001$
12 months	28	93.3	0	0	2	6.7	0	0	$z=4.800$; $P<0.001$
15 months	28	93.3	1	3.3	1	3.3	0	0	$z=4.873$; $P<0.001$
18 months	28	93.3	0	0	2	6.7	0	0	$z=4.800$; $P<0.001$

Table 7: Follow-up evaluation of general activity parameters after PN

Time interval	Affected		Unaffected		Significance of change from baseline
	No.	%	No.	%	
Baseline	30	100	0	0.0	-
3 months	0	0	30	100	$\chi^2=60$; $P<0.001$
6 months	0	0	30	100	$\chi^2=60$; $P<0.001$
9 months	0	0	30	100	$\chi^2=60$; $P<0.001$
12 months	2	6.7	28	93.3	$\chi^2=52.5$; $P<0.001$
15 months	2	6.7	28	93.3	$\chi^2=52.5$; $P<0.001$
18 months	2	6.7	28	93.3	$\chi^2=52.5$; $P<0.001$

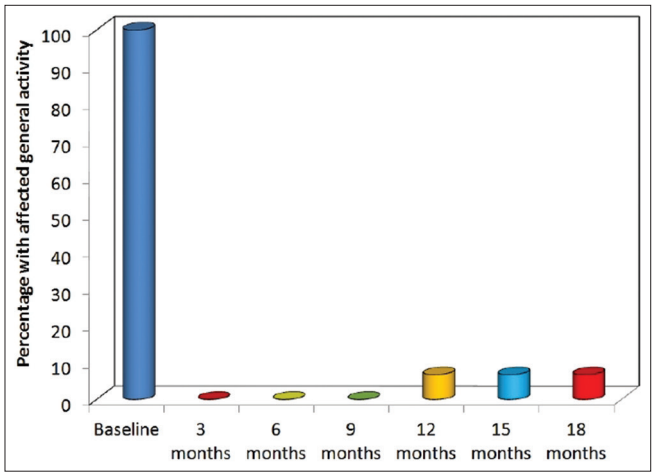

Figure 8: Follow-up evaluation of general activity parameters after PN

patients. When medical treatment fails—owing either to poor or diminishing response to drugs or to unacceptable side effects—it is necessary to consider the surgical management of TN.[8] Even the surgical treatment option for TN should also be selected on individual merits. Peripheral neurectomy is one of the day care procedures carried out under local anesthesia for treatment of TN and requires minimum armamentarium.[9] It is also useful in those TN patients who are reluctant to undergo major neurosurgeries and patients in rural places where facilities for advanced neurosurgical procedures are not available. So many patients and maxillofacial surgeons prefer this treatment due to its advantage of minimum risk of morbidity.

Devor *et al.*[10] put forward the "ignition hypothesis" regarding the pathophysiology of TN. It suggests that TN is precipitated by injury to the axons of the trigeminal nerve root or ganglion. The injury is mainly related to nerve compression in the root entry zone by vascular structures. Evidence of demyelination and remyelination of the nerve in this area was obtained from imaging.[11] These damaged neurons become hyperexcitable and exhibit the "after discharge" burst phenomenon. These bursts can be triggered by external trigger stimuli and perpetuate beyond the duration of the stimulus. The after discharges then recruit adjacent neurons with the help of "ephaptic cross-talk" (electrical cross-over between demyelinated neurons) which leads to the characteristic "electrical explosion" of pain. Moreover, the refractory period is a consequence of post-burst potassium influx hyperpolarization, which renders the neuron refractory to further stimuli.

Conservative and surgical interventions are the treatment of choice in TN cases. Conservative therapy is instituted by

drug therapy. Carbamazepine (200–1600 mg) is the drug of choice in the management of TN.[12] Peripheral nerve blocks with alcohol or lidocaine in the branches of the trigeminal nerve and injecting botulinum toxin type A (Botox) into the trigger zone of trigeminal neuralgia are the other means of controlling pain in TN.[7]

Surgical therapy includes minimally invasive techniques like alcohol injections, cryotherapy, and selective radio frequency thermocoagulation.[13] Invasive techniques include peripheral neurectomy, open microvascular decompression, percutaneous radiofrequency rhizotomy, retrogasserian glycerol rhizotomy, balloon compression of trigeminal nerve, and stereostatic radiosurgery–Gamma Knife.[14] Trigeminal nerve block with high concentration lidocaine (10%) is capable of achieving an intermediate period of pain relief but only in those patients having low intensity and short duration of pain. Peripheral alcohol injections do produce short-to-medium-term pain relief, but their role in the management of TN remains controversial because repeated alcohol injections can cause local tissue toxicity, inflammation, and fibrosis.

In the present study, the TN showed female predominance which was in accordance with various past studies. The left side was involved in 83.3% of the TN patients in the present study. On the contrary, Agrawal *et al*.[13] in their study showed that the right side was affected in 73.33% of patients and left side in 26.66%. A study by Loh *et al*.[15] showed that three patients had bilateral TN involvement, constituting 6.8% of the series, whereas in our study no bilateral TN case was noted. In our study, the infraorbital and mental nerves were involved in 10 (33.3%) cases each. In one case (3.3%) both infraorbital and mental nerves were involved. There were nine (30%) cases in which the inferior alveolar nerve was involved. The mental nerve alone was involved in 10 (33.3%) cases. In the study by Loh *et al.*,[15] the mandibular division was the most frequently involved branch. Twenty-two patients (50%) reported neuralgic pain confined solely to the mandibular distribution of the face. Eight patients (18.2%) suffered this condition with the additional involvement of the maxillary division on the same side. A study by Bhardwaj *et al*.[16] showed that the third division (inferior alveolar) was most commonly affected by the disease (in 12 patients [80%]). A study by Khan *et al*.[17] showed that the most common peripheral nerve involved was the infraorbital nerve (42.6%) followed by the inferior alveolar nerve (40%).

Twenty-seven patients (61%) presented with trigger zones and these varied widely in location: the upper lip, the upper and lower anterior posterior alveolar ridges, and cheek. There were also many types of triggering stimuli and these included talking, swallowing, laughing, washing, wind-blowing, shaving, mouth opening, touching, and chewing. Most patients responded to different intensities of the provoking stimulus and reacted to more than one type of triggering stimulus.

Freemont and Millac[18] reported that a single neurectomy yielded 26.5 months of pain-free duration on average and serial neurectomies gave, on average, a 59-month pain-free period. However, Quinn and Weil[19] found that there was a pain-free mean period of 37.5 months after mental neurectomy, 38 months after inferior alveolar neurectomy, 44 months after lingual neurectomy, and 38.5 months after infraorbital neurectomy. In comparison with earlier studies, pain relief in our study was found to be more or less similar.

In the present study, none of the patients had postoperative infection and suture dehiscence.

CONCLUSION

Peripheral neurectomies offer benefits, although neurosurgery definitely has a specific role in the treatment of trigeminal neuralgia. However, every patient is not medically fit and may not have access to good neurosurgical facilities, either due to lack of infrastructure in rural places or due to financial affordability. In our view, peripheral neurectomies are a viable treatment alternative for TN; although peripheral neurectomy has chances of reoccurrence, it still offers better quality of life in patients for many years without relapse.

Ethical approval

Ethical Clearence Obtained From Ethical Committee Of Sardar Patel Post Graduate Institute Of Dental And Medical Sciences, Lucknow. With Reference No.SPPGIDMS/2013/005.

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Conflicts of interest

There are no conflicts of interest.

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