The Role of Sympathetic Activity in Neuropathic Orofacial Pain

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Seventeen patients with neuropathic orofacial pain are presented with reference to precipitating events, pain descriptions, response to treatment, and other aspects of their histories and clinical presentation. Stellate ganglion blocks were done on 14 patients. Ten of 14 patients reported temporary relief of pain with stellate ganglion blocks. Five of these patients noted more prolonged improvement in pain, two reported no change, and two experienced a temporary increase in pain. It is argued that sympathetically maintained pain involving orofacial locations does occur and that stellate ganglion blocks may benefit a subgroup of these patients. It is noted that current diagnostic categories are inadequate to describe a subgroup of these patients. New categories are suggested, and further study is recommended.
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key words: orofacial pain, reflex sympathetic dystrophy, neuropathic pain

Bennett and Sessle[1] discussed the pathophysiology of chronic orofacial pain in the context of four broad categories: pain associated with inflammation; pain of vascular origin; musculoskeletal pain; and neuropathic pain. Included under the heading *neuropathic orofacial pain* are abnormal pain states that are known or suspected to arise when peripheral nerves are damaged by trauma or disease.

The prevalence of neuropathic orofacial pain is unknown. Postherpetic neuralgia is described as the most common type of neuropathic orofacial pain. The incidence is estimated to be approximately 125 per 100,000 per year in the general population.[2] Other neuropathic pain problems involving the mouth and face are relatively rare.[3] Specific neural mechanisms remain poorly understood, and therapeutic approaches are generally unsatisfactory.[2]

Localized neuralgias such as those involving the trigeminal branches and other nerves are well described (Table 1). Neuropathic pain that does not follow the distribution of a particular peripheral nerve is more difficult to characterize. In some cases, one must default to the category *atypical odontalgia* (in the case of tooth pain) or a regional code indicating a diagnosis has not been determined.

Another problem area relates to the role of the sympathetic nervous system in neuropathic orofacial pain. The present taxonomy does not include a category for reflex sympathetic dystrophy (RSD), now called *complex regional pain syndrome type 1* (CRPS type 1), involving orofacial locations. It is acknowledged that sympathetically maintained pain (SMP) can be a feature of several types of pain conditions and that pain relieved by a specific sympatholytic procedure may be considered SMP.[3]

Table 1 Current Categories by the International Association for the Study of Pain That Can Be Used to Describe Neuropathic Pain Involving the Mouth, Face, or Head*

Relatively localized syndromes
Neuralgias of the head and face
1. Trigeminal neuralgia
2. Secondary trigeminal neuralgia (central nervous system lesions)
3. Secondary trigeminal neuralgia (trauma)
4. Acute trigeminal herpes zoster
5. Postherpetic neuralgia (trigeminal)
6. Geniculate neuralgia (seventh cranial nerve)
7. Glossopharyngeal neuralgia
8. Neuralgia of the superior laryngeal nerve
9. Occipital neuralgia
10. Hypoglossal neuralgia
11. Glossopharyngeal pain from trauma
12. Hypoglossal pain from trauma
13. Tolosa-Hunt syndrome
14. Short-lasting, unilateral neuralgiform pain with conjunctival injection and tearing (SUNCT) syndrome
15. Raeder's syndrome (Raeder's paratrigeminal syndrome)

Relatively generalized syndromes
(no category for craniofacial locations)
1. Phantom pain
2. Complex regional pain syndrome type I (reflex sympathetic dystrophy)
3. Complex regional pain syndrome type II (causalgia)

Other syndromes
1. Odontalgia toothache 4 (atypical odontalgia)
2. Glossodynia and sore mouth (burning tongue)
3 Toothache, unknown cause
4. Other and unspecified pain in the jaws

*Merskey and Bogduk[3]

The present report describes a group of 17 patients with neuropathic pain. Fourteen of these patients described symptoms suggestive of a sympathetic component and were given a trial of stellate ganglion blockade. The temporary relief of pain experienced by the majority and more prolonged improvement experienced by a subgroup support a role for SMP in some patients presenting with neuropathic orofacial pain and suggest that a trial of stellate ganglion blocks is a reasonable treatment to consider in diagnosis and management of this difficult clinical problem.

Materials and Methods

A review of files of all patients presenting to the Pain Management Unit, Dalhousie University, Halifax, Nova Scotia, Canada, between January 1989 and December 1993 revealed 17 patients who met inclusion criteria for the study. Specific neuralgias such as those in Table 1 were not included. The authors were interested in the group of patients with posttraumatic or postprocedural orofacial pain who were thought to have suffered from nerve damage. No subject met criteria for posttraumatic glossopharyngeal or hypoglossal pain. In all subjects with facial pain, the distribution of pain went beyond anatomic boundaries of one specific branch of the trigeminal nerve. All patients met the following criteria:

1. Patients reported chronic orofacial pain that had lasted 6 months or longer.
2. Patients described the onset of the pain following a specific precipitating event, such as surgery or trauma.
3. Patients exhibited sensory abnormalities, such as hyperesthesia or allodynia, and/or exhibited evidence of autonomic dysfunction, such as swelling.

All patients were examined by a physician specializing in pain management. The majority were also examined by an oral pathologist specializing in orofacial pain disorders. Primary dental, otolaryngologic, intracranial, and other known physical disorders were ruled out. Various aspects of their symptoms, histories, clinical presentations, and responses to treatment were tabulated and compared.

In 14 patients, stellate ganglion blocks were done. Blocks were offered to patients who were thought to have a possible sympathetic component to their pain. This judgement was made by the clinician involved, based on the report of aching, burning, or hot pain associated with hyperesthesia, allodynia, or other symptoms such as swelling. An anterior or paratracheal approach was used as described by Cousins and Bridenbaugh,[4] and 10 to 15 mL of 0.25% bupivacaine hydrochloride (Marcaine, Sanofi Winthrop, Markham, Ontario, Canada) was used. Details are presented in the following section.

Results

Of 5,000 patients who presented to the Pain Management Unit between January 1989 and December 1993, a total of 17 patients (0.3%) met the criteria for the study. The majority (15 patients) were women. Ages ranged from 26 to 58 years (Fig 1). Fifty-five percent of patients had experienced their pain for 2 years or more at the time of pre-

Fig 1 Distribution of patients by age.

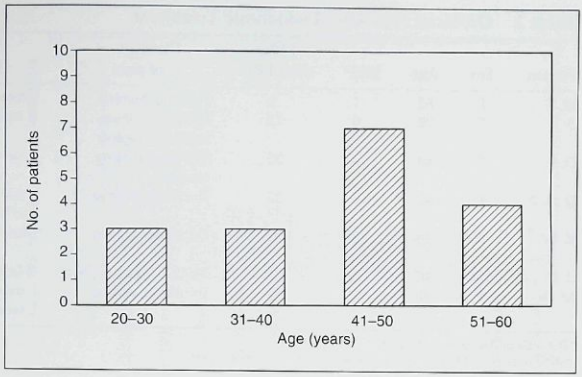
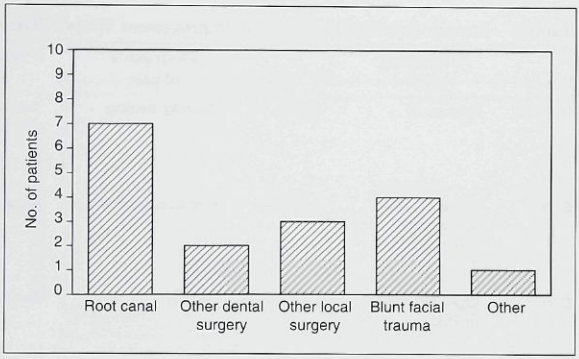


Fig 2 Event or procedure precipitating pain.



sentation. All patients dated the onset of pain to a particular procedure or event (Fig 2). The largest group was made up of patients who had experienced the onset of pain following a root canal or endodontic procedure (Table 2). All patients had consulted with numerous other specialists, both dental and medical, prior to their referral to the Pain Management Unit. The mean number of specialists seen was 5.3 per patient. All patients had received numerous treatments prior to referral. Fifty percent of patients had undergone further dental surgical procedures in an attempt to relieve pain. In all cases, further surgical procedures had led to no change or had exacerbated the pain. Eighty percent of patients had tried medications from several drug categories. Drugs most commonly used were the antidepressants, nonsteroidal anti-inflammatories, carbamazepine, baclofen, mexiletine, and the benzodiazepines. Drugs reported as helpful for pain included clonazepam (one patient), amitriptyline hydrochloride (one patient), carbamazepine (three patients), sertraline (one patient), and meclizine niacin (Antivert, Pfizer, Kirkland, Quebec, Canada) (one patient). Thirty-five percent of patients had tried transcutaneous electrical nerve stimulation (TENS) or acupuncture; two patients reported acupuncture was helpful and one reported TENS was helpful in reducing pain.

Eight patients reported pain involving facial and oral locations. Seven patients reported facial pain only, and two patients reported only tooth or

Table 2 Orofacial Pain After Endodontic Treatment

Patient	Sex	Age	BDI*	MPQ total PRI†	Descriptors of pain	Location	What helped
M. S.	F	52	1	8	Pinching, burning	L face, L lip	Stellate block
B. L.	F	26	0	13	Throbbing, sharp, stabbing, tingling	R incisor, lip	Stellate block
D. B.	F	44	–	32	Shooting, burning, stinging	L maxillary	Carbamazepine, relaxation, massage
D. R. 2	F	42	–	22	Throbbing, aching	L maxillary teeth and face	Stellate block
K. W.	F	36	3	33	Throbbing, aching	Mandibular molar	Carbamazepine, stellate block
J. F.	M	48	–	44	Tender, pressure, hot	R face	Stellate block, extraction
M. B.	F	45	12	12	Throbbing, aching	L maxillary gingivae, L face, nasolabial fold	Stellate block

*BDI = Beck Depression Inventory
†MPQ total PRI = McGill Pain Questionnaire pain rating index, total

Table 3 Patients Exhibiting Long-Term Improvement With Stellate Ganglion Blocks

Patient	Precipitating event	Duration	Descriptors of pain	Associated signs	Response to stellate block
M. S.	Root canal	4 years	Pinching, burning	Tenderness, light pressure, allodynia	100% pain relief after 3 blocks; pain returned 3 months later; 3 more blocks given; pain remains resolved (1-year follow-up)
B. W.	Biopsy, R palate, adenocystic carcinoma	6 months	Pressure, squeezing	Allodynia	5 blocks given every 2 weeks, then at 2-month intervals; able to discontinue all narcotics (3-year follow-up)
D. H.	Open arthrotomy of TMJ	7 months	Tingling	Swelling	Significant reduction in pain; able to increase activity; blocks given every 2 months (3-year follow-up)
D. R. 2	Root canal	1 year	Throbbing, aching	Hyperesthesia, allodynia	3 blocks over 2 weeks, pain ↓ 50% in 3 months; then 1 block/month; pain remains ↓ 50% (10-month follow-up)
M. B.	Root canal	5 years	Throbbing, aching	Swelling	30% ↓ after first block 50% ↓ after second block; (1 year follow-up) pain remains 50% reduced

tooth-site pain. Ten percent of patients reported bilateral pain. All patients reported constant pain. Descriptors of pain verbalized by patients are reported in Fig 3.

The McGill Pain Questionnaire[5] was available for 14 patients. The majority of patients obtained a total pain rating index score of 31 to 40 (Fig 4). The Beck Depression Inventory was available for eight patients. The majority of these patients (five) obtained scores between zero and nine (nondepressed). Two patients obtained a score of 10 to 16 (mild depression). One patient obtained a score of 30, indicating a severe range of depression.

In 14 patients, it was thought that a sympathetic component may be involved, and a trial of stellate ganglion blocks was done. Ten patients reported a

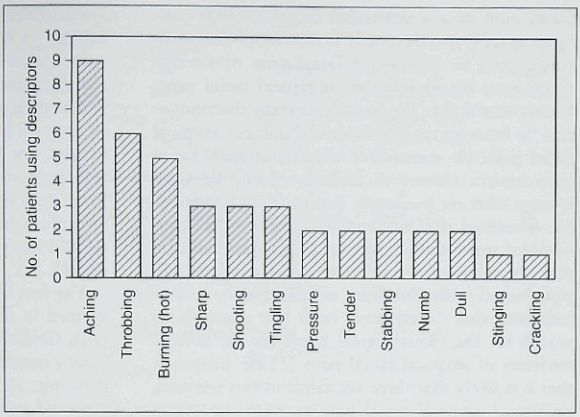


Fig 3 Descriptors of pain verbalized by patients.

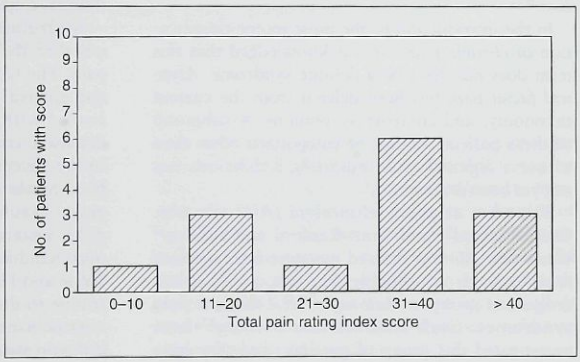


Fig 4 Total pain rating index score of the McGill Pain Questionnaire.

decrease in pain, two reported no change, and two experienced a temporary increase in pain. Five patients have reported more prolonged improvement with repeated blocks (Table 3).

Discussion

The present report has described a group of patients who suffer from chronic orofacial pain, nonanatomic in distribution, which dates to a specific event such as dental or nondental surgery or facial trauma. As discussed by Mock and colleagues,[6] this suggests that these patients may have an organic basis for their pain. This is probably related to deafferentation. There is a growing body of literature[7–10] regarding the multiplicity of changes that takes place in the central nervous system as a result of peripheral injury. Mechanisms include increased excitability, disinhibition, and structural reorganization.[8] This work improves our understanding of the pathophysiologic mechanisms of neuropathic pain and helps to explain why chronic pain persists beyond the time where normal healing would have taken place.

Until recently many of these patients would have been categorized as having atypical facial pain or atypical odontalgia. Loeser[11] described atypical

facial pain as a wastebasket diagnosis that contains several distinct pain syndromes. The term was coined to distinguish facial pain of various types from tic douloureux or typical facial pain. Loeser stated that the most important discrimination is between unilateral and bilateral atypical facial pain. He stated that bilateral atypical facial pain occurs almost exclusively in middle-aged women who are frequently depressed and agitated. He described that unilateral atypical facial pain contains several different pain syndromes. Patients describe constant, usually burning pain, sometimes punctuated with shocklike stabbing pain. Loeser indicated that "there have been few attempts to search for the physiological bases for the several varieties of atypical facial pain."[11] He proposed that it is likely that there are different mechanisms; unilateral atypical facial pain may involve nerve injury, and "those with bilateral atypical facial pain have no evidence... of a neuropathic process."[11]

In the introduction to the most recent classification of *chronic pain*,[3] it is acknowledged that this term does not describe a definite syndrome. *Atypical facial pain* has been deleted from the current taxonomy, and controversy remains. A subgroup of these patients cannot be categorized other than to use a regional code indicating a diagnosis has not yet been determined.

The term *atypical odontalgia* (AO) remains. Graff-Radford[12] and Graff-Radford and Solberg[13] wrote that AO has derived its name from *atypical facial pain*. It is probable that this is also a heterogenous group containing several distinct pain syndromes. Graff-Radford and Solberg[13] have investigated this group of patients, and they have developed the following inclusion criteria:

1. No obvious local cause
2. No abnormality found on radiographs
3. Continuous or almost continuous pain in a tooth or surrounding alveolar bone
4. Pain present longer than 4 months
5. Associated hyperesthesia
6. Somatic block equivocal

These authors stated that patients with AO are usually women in the fourth or fifth decade. The average duration of pain in their group was 2.5 years. Pain was described as aching, burning, or throbbing. Many patients dated the onset of their pain back to a tooth trauma or dental pulp extirpation. Often there was associated hyperesthesia.

Graff-Radford and Solberg[13] discussed deafferentation as one of the possible mechanisms causing AO. They also presented the issue of a sympathetic mechanism and stated that patients exhibit "a seemingly impressive reduction in pain with sympathetic blockade." Unfortunately, they did not present data supporting this claim.

Ten patients in the present study reported tooth or gingival pain (Table 4). Unlike Graff-Radford,[12] we did not find an impressive reduction in pain following stellate ganglion blocks in all patients. Four patients did experience at least temporary improvement (Table 4). Two of these have experienced longer-term improvement (Table 3, D. R. 2 and M. B.).

The fact that the majority of these patients were women in the fourth or fifth decade is consistent with Graff-Radford's description.[12] Our patients used a number of descriptors in addition to aching, burning, or throbbing (Table 4). Eight patients reported previous antidepressant trials for pain, all with negative results. The majority dated the onset of pain back to an endodontic procedure or tooth trauma. Eight reported associated facial pain.

Graff-Radford and Solberg[13] did not mention whether their group exhibited associated facial pain. The fact that most of our patients with tooth and gingival pain also reported facial pain is consistent with basic science research that reveals extensive convergence in the subnucleus caudalis of the trigeminal brain stem sensory nuclear complex. Sessle and Hu[14] described extensive convergence that involved cutaneous, mucosal, tooth pulp, visceral, muscle, cranial vasculature, temporomandibular joint (TMJ), and neck afferents. Sessle and Hu[14] noted that these neurons may contribute to the spread and referral of pain, which is a particular characteristic of a number of craniofacial pain states.

Of the 17 patients in the present study, 16 presented with unilateral pain. One patient reported bilateral pain dating back to specific events potentially traumatic to nociceptive pathways. Contrary to suggestions by Loeser,[11] this indicates that there may be patients who have bilateral atypical facial pain with a neuropathic mechanism.

With regard to precipitating factors, the largest group of patients experienced the onset of pain following root canal or endodontic procedures (see Table 2). In this group, a variety of descriptors of pain were used. Of interest is the fact that although endodontic surgery precipitated the onset of pain, only four patients in this group reported tooth or gingival pain. All but one reported facial pain. Six of these several patients were given stellate ganglion blocks, and all noted at least a temporary improvement. Three have noted longer-term improvements (see Table 3).

Table 4 Neuropathic Tooth or Gingival Pain

Patient	Age	Sex	Associated facial pain	BDI*	Response to antidepressants	Descriptors of pain	What helped	Precipitant	Response to stellate block
D. D.	44	M	+	0	–	Numb, aching	Nothing	Surgery, other	–
D. R. 1	35	F	+		0	Numb, heavy	Nothing	Wisdom tooth extraction	0
B. L.	26	F	+	0	0	Throbbing, sharp, stabbing, tingling	Stellate ganglion block	Root canal	+
D. B.	44	F	+		0	Shooting, burning, stinging	Carbamazepine, massage, acupuncture, relaxation	Root canal	0
J. J.	51	F	–		–	Tender, aching	Antivert	Removal of fillings	0
D. R. 2	42	F	+		–	Throbbing, aching	Stellate ganglion blocks	Root canal	+
G. O.	58	F	+		–	Aching	Nothing	1 year after root canal	–
M. M.	26	F	+	30	–	Tingling, crackling, shooting	TENS, opioids, psychology	Surgery, other	–
K. W.	36	F	–	3	–	Throbbing, aching	Carbamazepine, stellate block	Root canal	+
M. B.	45	F	+	12	–	Throbbing, aching	Stellate blocks	Root canal	+

*0 indicates the treatment was not given to this particular patient.

There is only one study in the literature regarding pain following endodontic surgery. Campbell and colleagues[15] did a retrospective review of 118 patients who underwent surgical endodontics. These authors found that after surgery, six patients (5%) reported continual pain. Three had pain before the surgery and reported the same pain following surgery. These patients were said to have phantom tooth pain (PTP). The other three patients had no pain before surgery and reported chronic pain after surgical endodontics. These patients were said to be suffering from posttraumatic dysesthesia (PTD). Campbell et al[15] proposed neuropathic mechanisms for both PTP and PTD. A number of investigators[16,17] have reported on changes that take place in brainstem neurons following tooth pulp removal. These include disrupted functional organization, hyperexcitability, and abnormal responses to orofacial stimuli. This may help to explain the possible mechanism of pain following surgical endodontics.

Prior to discussion about the role of the sympathetic nervous system in orofacial pain, it should be noted that there have been changes in terminology reflective of new information regarding pathophysiologic mechanisms of chronic pain. What we have previously referred to as *reflex sympathetic dystrophy* (RSD) is now called *complex regional pain syndrome type I* (CRPS type 1). Causalgia is now referred to as *CRPS type II*.[3] It is stated that sympathetically maintained pain (SMP) may be found in association with these syndromes. Sympathetically maintained pain can be a feature of several types of painful conditions and is not an essential requirement of any one condition. Of importance is the fact that SMP may occur in some patients with CRPS, but it does not occur in all. If there is no evidence of SMP, then one refers to sympathetically independent pain.[3]

A patient with orofacial pain may have a component of pain that is sympathetically maintained. Sympathetically maintained pain is taken to be pain that is maintained by sympathetic efferent innervation or by circulating catecholamines.[3] Animal models support that the hyperalgesia and allodynia seen in neuropathic pain can be sympathetically maintained as well.[8]

Previous authors[18,19] have identified the importance of determining whether SMP is a part of the patient's clinical presentation in cases of orofacial pain. Although earlier literature suggests that SMP most commonly occurs in the extremities,[3,18] its occurrence in orofacial locations has been reported.[18,19,20]

In 1947, Bingham[20] described two cases of orofacial causalgia that were treated successfully by sympathectomy. Saxen and Campbell[18] described an unusual case of sympathetically maintained

facial pain complicated by telangiectasia. Gregg[19] described sympathetic-mediated pain involving the maxillofacial region and reported that this group of patients responded poorly to microsurgery. Graff-Radford[12] discussed facial RSD and stated that the pain is characterized by a hot, burning sensation with associated hyperesthesia. He reported that involved areas often show vasomotor, pseudomotor, or trophic changes and that treatment requires aggressive intervention with sympathetic blockade.

We could find only one published report[18] using stellate ganglion blocks for treatment of orofacial pain. In this case report, the patient experienced good temporary improvement for 24 hours following each of two stellate ganglion blocks. The patient responded well to a course of 0.1 mg of clonidine hydrochloride orally, twice a day.

Overall there is a paucity of literature regarding SMP in orofacial pain. The present study suggests that SMP involving orofacial sites does occur and that there is a role for stellate ganglion blockade in management of these patients. Many questions remain. Earlier literature would suggest that patients with orofacial SMP describe hot, burning pain with swelling or sudomotor changes. In the present study, if we assume that those patients experiencing longer-term improvements following stellate ganglion block have SMP, this would suggest that patients with orofacial SMP do not always report hot, burning pain but use other descriptors as well (see Table 3). In addition, not all patients reported swelling or sudomotor symptoms. Further study using larger numbers of patients and controlled trials are necessary to determine which patients are most likely to benefit from sympathetic blockade.

It should also be noted that in neuropathic pain, several pathophysiologic mechanisms may be involved. The literature suggests that often combinations of agents and therapies must be used for most effective management.[21] Sympathetic blocks should be considered as a component of overall management used in combination with other therapies.

With regard to the issue of taxonomy, there is reason for concern about the terms *atypical facial pain* and *atypical odontalgia*. These terms are too general and have been described as catchall terms.[2,13] There is the additional concern that often these terms imply a psychogenic mechanism to the pain. As mentioned, the recent International Association for the Study of Pain (IASP) taxonomy has deleted the term *atypical facial pain*, but there remains a small group of patients with probable neuropathic pain who are difficult to categorize. It is suggested that additional categories to the current IASP taxonomy be considered. Following are proposed additional categories:

1. Complex regional pain syndrome types I and II. (Add category for orofacial locations.)
2. Posttraumatic orofacial pain (not limited to the distribution of a branch of the fifth cranial nerve).
3. Orofacial pain after endodontic treatment, or postendodontic orofacial pain.
4. Neuropathic orofacial pain not otherwise specified.
5. Orofacial pain not otherwise specified.
6. Tooth or tooth site pain not otherwise specified.

It is also suggested that the terms *orofacial pain* not otherwise specified and *tooth site pain* not otherwise specified be used to describe pain that cannot be categorized otherwise. This is similar to the approach used in the Diagnostic and Statistical Manual of Mental Disorders[22] that does not exhibit the exact criteria in a particular category.

Summary

This study has reviewed a small group of patients who suffer from orofacial pain and who date their pain to surgery or trauma. The pain did not follow any specific peripheral nerve distribution. It is suggested that these patients suffer from organic pain, neuropathic in nature, related to deafferentation and the central changes that result subsequent to nerve injury. It is also suggested that CRPS and SMP can involve orofacial locations. Stellate ganglion blocks may be helpful in some of these patients. There is evidence to support that in this group of patients, surgery is not helpful and may exacerbate the pain. The authors proposed that additional diagnostic categories be considered for the current IASP taxonomy to describe these patients more accurately.

It is acknowledged that this is a small group, and the data suffers from the usual drawbacks of a retrospective review. In addition, when looking at responses to stellate ganglion blocks, outcome criteria were not operationalized. Further study is necessary.

It is important that future studies include data on associated signs, such as allodynia, hyperesthesia, or hyperpathia. In patients who suffer the onset of pain following surgical endodontics, it is also important to note whether there was pain of the same type prior to the procedure. In addition, it may be important to note whether a vital or nonvital tooth was involved.

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Resumen

El Papel de la Actividad Simpática en el Dolor Orofacial Neuropático

Se presentan 17 pacientes con dolor orofacial neuropático en relación a eventos precipitantes, descripción del dolor, respuesta al tratamiento, y otros aspectos de sus historias y presentación clínica. Se efectuaron bloqueos de ganglios estrellados en 14 pacientes. Diez de los 14 pacientes reportaron un alivio temporal del dolor, con los bloqueos. Cinco de estos pacientes notaron una mejoría prolongada del dolor, dos no reportaron cambios, y dos experimentaron un aumento temporal del dolor. Se argumenta que el dolor mantenido simpatéticamente que envuelve sitios orofaciales ocurre y que los bloqueos de los ganglios estrellados pueden beneficiar a un grupo de estos pacientes. Se señala que las categorías diagnósticas corrientes son inadecuadas para describir a un subgrupo de estos pacientes. Se proponen nuevas categorías, y se recomiendan mas estudios.

Zusammenfassung

Die Rolle des Sympathischen Nervensystems bei neuropathischen orofazialen Schmerzen

Siebzehn Patienten mit neuropathischen orofazialen Schmerzen werden hinsichtlich auslösender Ereignisse, Schmerzbeschreibung, Therapieantwort, Krankengeschichte und klinischer Untersuchung vorgestellt. Bei 14 von diesen 17 Patienten wurde eine Blockade des Ganglion Stellatum durchgeführt: 10 dieser 14 Patienten berichteten über eine zeitweilige Schmerzerleichterung. Fünf dieser Patienten spürten eine länger andauernde Besserung. Zwei nahmen keine Aenderung war und 2 erfuhren eine zeitweilige Verschärfung der Schmerzen. Es wird festgestellt, dass sympathisch aufrechterhaltener Schmerz auch im Gesichtsberich vorkommt und dass die Ganglion-Stellatum-Blockade einem Teil dieser Patienten helfen kann. Es wird darauf aufmerksam gemacht, dass die derzeit angewandten diagnostischen Kategorien unzureichend sind, um die Patienten zu erfassen,welche auf die Ganglionblockade positiv reagieren. Genauere Unterteilungen und weitere Studien werden empfohlen.