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Cervical Plexus Block Helps in Diagnosis of Orofacial Pain Originating from Cervical Structures

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Shinozaki, T., Sakamoto, E., Shiiba, S., Ichikawa, F., Arakawa, Y., Makihara, Y., Abe, S., Ogawa, A., Tsuboi, E. and Imamura, Y. *Cervical Plexus Block Helps in Diagnosis of Orofacial Pain Originating from Cervical Structures*. Tohoku J. Exp. Med., 2006, **210** (1), 41-47 —— Headache associated with cervical lesions is called cervicogenic headache and involves the occiput but not the orofacial region. However, patients occasionally present with orofacial pain accompanied by neck symptoms. This study investigates whether orofacial pain can originate from the neck and whether cervical plexus block can help in diagnosis. We enrolled eight patients suffering from chronic orofacial pain that had not been relieved by dental treatment. Radiographic and magnetic resonance imaging revealed abnormal findings in the neck in seven of them. To identify the origin of the orofacial pain, we firstly blocked peripheral sensory input from the oral cavity and surrounding tissues, followed by that from deep cervical structures. We injected local anesthetics around the painful orofacial region, then to the tender points in the masticatory and superficial cervical muscles (trigger point injection), and consequently around the cervical plexus. Pain was assessed using a pain relief score compared with pre-treatment control values. Local anesthesia in the painful oral region provided insufficient relief whereas trigger point injection significantly relieved pain. The amount of pain relief generated by the deep cervical plexus block was more significant than that produced by any other procedures. We conclude that certain types of orofacial pain originate from cervical structures and that a deep cervical plexus block can be helpful in differentially diagnosing such pain. ——
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Referred pain frequently arises in the orofacial region and when headache arises that is of cervical origin, it is often referred to as cervicogenic headache. The International Classification of Headache Disorders; 2nd Edition (ICHD-II) describes cervicogenic headache as a type of

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secondary headache (Headache Classification Subcommittee of the International Headache Society 2004). Since it was first classified (Sjaastad et al. 1983), the signs and symptoms of cervicogenic headache have been documented as being associated with problems of the upper cervical roots, especially C2 (Bovim et al. 1992; Pikus and Phillips 1996; Leone et al. 1998; Bogduk 2001; Inan et al. 2001; Aprill et al. 2002). Cervicogenic headache is therefore usually observed in the occiput (Inan et al. 2001) and rarely in the orofacial region. However, the cause and mechanism of cervicogenic headache remains controversial and this condition has not been clearly defined (Fishbain et al. 2003). Patients can develop atypical orofacial pain with neck problems and some dentists have reported that neck and shoulder pain is relieved by occlusal treatment (Ueda et al. 2005). The treatment of neck pain, for example, by trigger point injection into the sternocleidomastoid, trapezius and splenius muscles also alleviates orofacial pain (Simons et al. 1999). We therefore supposed that the orofacial pain in these patients is of cervical origin. The present study investigates whether pain in the orofacial region can originate from the cervical structures. Differential diagnosis and the mechanism of orofacial pain arising from cervical structures are discussed.

Materials and Methods

This study was conducted in accordance with the Helsinki Declaration and was approved by the Nihon University School of Dentistry Bioethics Committee (2006-1). All patients gave their written consent for participation in this study.

Subjects

We enrolled six female and two male patients aged from 37 to 70 yrs who suffered from chronic unilateral (without sideshift) oral or perioral pain located around the mandibular body and the temporomandibular joint that had not been relieved by dental treatment for at least six months. A routine x-ray screening at our clinic revealed no dental or maxillofacial lesions that might cause such pain and no intra or extra-cranial lesions or conditions were evident. All of the patients characterized the pain as dull and aching, with periodical fluctuation. Palpation of the temporal, masseter, medial pterygoid muscles that were ipsilateral to the orofacial pain revealed moderate oppressive pain, and the most specific finding was that palpation of the neck disclosed moderate to severe tender points at the transverse processes and in the cervical muscles (trapezius, elevator of the scapula, sternocleidomastoid, greater and smaller posterior rectus and splenius muscles) of the affected side in all patients. Six of the patients had a history of neck disorders. The posterior longitudinal ligament was ossified in two patients, one had a cervical disc hernia, one had undergone laminectomy and bone implantation due to ossification of the posterior longitudinal ligament, one had rheumatoid arthritis and one had whiplash injury (Tables 1

Table 1. Subjects enroeled in this study.

Case	Age	Gender	History of head/neck injury	Cervical X-P, CT, MRI findings
1	37	Female	Whiplash injury (3 years ago)	Strait neck
2	50	Female	None	OPLL
3	45	Female	None	NAD
4	51	Female	None	OPLL
5	70	Female	None	Disc herniation at C5/6/7
6	70	Male	Laminectomy due to OPLL C3-7	Artificial bone implantation
7	62	Male	None	Deformity of C5/6/7
8	42	Female	Whiplash injury (6 years ago)	Buldging of C4/5

Three of eight patients had a history of neck injury. Radiographic and MR imaging revealed that seven of eight patients had anormaly.

OPLL, ossification of posterior longitudinal ligament; NAD, nothing abnormal detected.

TABLE 2. Characteristics feature of the pain.

Case	Symptomatic area	Characteristic feature of pain	Pain was aggravated by		
			Head position/ movement	Compression test	Pressure at the cervical vertebrae
1	Left Mandibular Angle, Neck, Occiput	Continuous, Dull, Aching without sideshift	N/A	N/A	Lt C3/4/5
2	Right Mandibular Molars, Neck, Occiput	Continuous, Dull, Aching without sideshift	Extension	Jackson test	Rt C2/4/5
3	Left Mandibular Molars, TMJ, Occiput	Continuous, Dull, Aching without sideshift	Right Lateroflexion	N/A	LtC2/3
4	Left Mandibular Angle, Left Neck	Continuous, Dull, Aching without sideshift	N/A	N/A	Lt C3/4/5
5	Right TMJ, Occiput Neck, Shoulder, Arm	Continuous, Dull, Aching without sideshift	Left Lateroflexion	Jackson test, Spurling test	Rt C4/5/6
6	Right TMJ, Occiput Neck, Shoulder, Arm	Continuous, Dull, Aching without sideshift	Extension Left Lateroflexion	Jackson test, Spurling test	Rt C3/4/5/6
7	Left Mandibular Angle, Left Molars	Continuous, Dull, Aching without sideshift	Right Lateroflexion	Jackson test	Lt C3/4/5/6
8	Left Mandibular Angle, Left Molars	Continuous, Dull, Aching without sideshift	N/A	N/A	Lt C4/5/6

All patients complained of spontaneous pain around mandibular molars and the temporomandibular joint, and oppressive pain on cervical transverse processes ipsilateral to the orofacial pain.

and 2). None of the patients fulfilled the diagnostic criteria for cervicogenic headache and we did not diagnose them as having cervicogenic headache.

Diagnostic tests and procedures

To identify the origin of the orofacial pain, 1 ml of 2% lidocaine with epinephrine was infiltrated around the painful area in the orofacial region followed by 0.5 ml of 1% mepivacaine without epinephrine for each tender point (myofascial trigger point) in the temporal, masseter, trapezius, sternocleidomastoid muscles (trigger point injection) at minimal intervals of 30 min. Myofascial trigger points in each stiff muscle were defined by palpation. The diameter of myofascial trigger points is only a few millimeters and injection outside the trigger point does not alleviate the pain. Only when a needle was placed on the exact point, did the muscle twitch and the patient felt a radiating sensation during the injection (Simons et al. 1999). Therefore, highly skilled practitioners performed the trigger point injections and a radiating sensation was confirmed every time. A 26-gauge needle was inserted into the myofascial trigger points and 0.5 ml of 1% mepivacaine was injected. Rigid pressure was maintained on the plunger during injection. The intensity of the original orofacial pain was assessed after trigger point injection. On a later day, all patients received a deep cervical plexus block as follows. Normal saline (1 ml) was applied around each painful cervical vertebral transverse process followed by the same volume of 1% mepivacaine at intervals of at least

15 min. The patients were blinded to the agents. Pain relief after each procedure was evaluated ten minutes after the injection using a pain relief score based upon pain intensity before treatment (Control: 10).

Statistical analysis

Median pain relief scores were obtained for all evaluation points (after each of oral infiltration, trigger point injection and cervical plexus block with normal saline and 1% mepivacaine). We applied Friedman's test followed by Wilcoxon's signed rank test to analyze pain relief scores among the procedures. A significant difference was indicated at $p = 0.05$.

Results

The shapes of four box plots were essentially identical (Fig. 1). The test statistics showed a significant difference among the four groups (Chi-square = 21.960, $p < 0.001$), and the mean rank of each evaluating point was 3.25, 2.00, 3.69 and 1.06, respectively. Local anesthetic injection to the painful orofacial region resulted in mild pain relief. However, all of the patients complained of discomfort due to anesthesia in addition to unsatisfactory pain relief. Pain relief scores varied from 3/10 to 7/10 after trigger point injection in the masticatory and superficial cervical muscles. The pain relief score significantly decreased compared with that after oral anesthetic infiltration ($p = 0.017$). The magnitude of pain relief was acceptable but not satisfactory for four of the eight patients. Deep cervical plexus block with normal saline at the level of C3-5 did not relieve pain, whereas that with 1% mepivacaine significantly relieved pain ($p = 0.011$ vs normal saline) immediately after the procedure and lasted for several days. The period of pain relief was not defined in the present study. The pain relief score obtained after deep cervical plexus block with 1% mepivacaine was significantly lower than that generated by any other procedures ($p = 0.018$ vs myofascial trigger point injection). Most of the patients were satisfied with the quality of the pain relief conferred by deep cervical plexus block with 1% mepivacaine (Fig. 1).

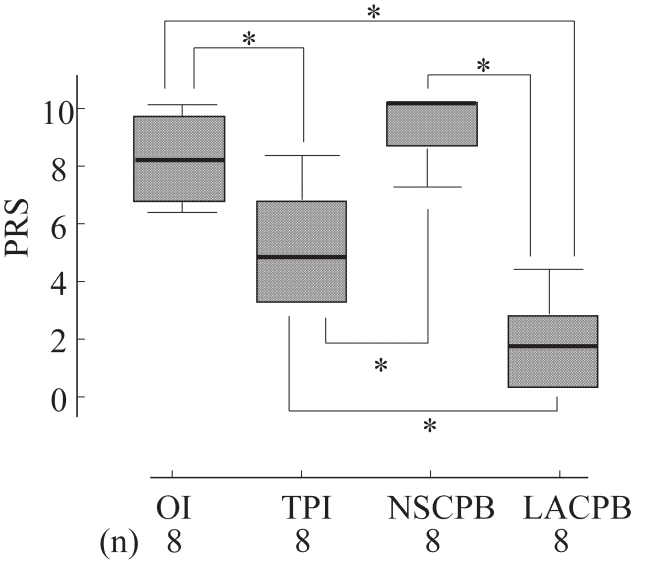


Fig. 1. Pain relief score after each treatment procedure.
OI, infiltration of lidocaine in painful orofacial region; TPI, trigger point injection with 1% mepivacaine; NSCPB, deep cervical plexus block with normal saline; LACPB, deep cervical plexus block with 1% mepivacaine; PRS, Pain relief score.
* $p < 0.05$ between two procedures.
Trigger point injection yielded more pronounced pain relief than local anesthesia around painful orofacial region and deep cervical plexus block with local anesthetics showed the most significant effect.

Discussion

Deep cervical plexus block with 1% mepivacaine and trigger point injection relieved persistent pain that had not been diminished by any prior treatment including dental procedures. Typically tender points determined by muscle palpation were defined as trigger points and injected. An excess dosage of local anesthetics was required to cover all tender points, and treatment was limited to the superficial temporal, masseter, trapezius and sternocleidomastoid muscles. A deep cervical plexus block covers a wide area of cervical muscles, but it does not affect any of the masticatory muscles. The fact that a gradient in pain relief was generated by cervical plexus block with 1% mepivacaine, trigger point injection and local anesthetic infiltration at the painful area in the mouth constitutes evidence that the cervical structures were the source of the undiagnosed orofacial pain in these patients.

The most accepted notion of head pain referred from the neck is cervicogenic headache (Sjaastad et al. 1998b; Bogduk 2001). The diagnostic criteria of cervicogenic headache remain controversial (Fishbain et al. 2003), but the notion that this type of headache is caused by problems in the second cervical spinal (C2) root is generally accepted (Bovim et al. 1992; Pikus and Phillips 1996; Leone et al. 1998; Bogduk 2001; Inan et al. 2001; Aprill et al. 2002). One of the most convincing arguments for the involvement of the C2 root in cervicogenic headache is that the headache is relieved by a C2 nerve block (Bovim et al. 1992; Inan et al. 2001; Silverman 2002). One study concluded that C4 and C5 nerve blocks were probably of little value since although a C2 nerve block allegedly produces excellent pain relief, C3, 4 and 5 nerve blocks do not (Bovim et al. 1992). The same group also reported that cervicogenic headache can be treated with a facet joint block as well as a C2 nerve block (Bovim et al. 1992). This observation indicates that cervicogenic headache partially originates from the medial branches of the posterior rami. However, the results of the present study differed considerably from those of previous reports. The condition we describe here was referred pain that originated from cervical structures and it might be different from cervicogenic headache, because it was relieved only by deep cervical plexus block with a local anesthetic.

Explanations of the pathogenesis of cervicogenic headache are based on evidence from animal studies that found convergence between the trigeminal nerve and the cervical spinal nerves at the dorsal horn in the caudal part of the medulla and in the upper level of the cervical spine (Renehan et al. 1986; Sessle et al. 1986; Piovesan et al. 2003). Nociceptive fibers reach the caudal part of the subnucleus caudalis in the spinal nucleus of the trigeminal nerve mostly from the first division (V1), which led to the hypothesis that nerves converge mainly between V1 and C2 (Browne et al. 1998). If cervicogenic headache is relieved only by C2 root block and facet joint block but not by more peripheral nerve blocks, the main pathology must lie in the C2 cervical vertebrae and the nerve roots. Deep cervical plexus block at the level of C3-5 relieved orofacial pain in the present study. C fibers from deep tissues ascend in the spinal cord before reaching the second order neurons in rats, and the distance of the migration is several segments (Sugiura et al. 1989). Nociceptive fibers from C3-5 might reach the upper part of the subnucleus caudalis. Afferents and efferents of the deep cervical plexus arise from the upper and lower cervical nerve roots. Deep cervical plexus block anesthetizes these afferents including some C2 afferents that are located more peripherally than the point at which the medial branches of the posterior rami diverge. Some patients in the present study had history of neck injuries and/or disorders, and some had undergone cervical compression tests and showed postural exacerbation. These findings suggest that cervical vertebral problems elicited the orofacial pain. However, deep cervical plexus block does not relieve pain originating from the cervical vertebrae and the nerve roots. Orofacial pain in the present study might have originated from more peripheral structures. Palpation before treatment revealed tender points in the trapezius, the elevator of the scapula, the sternocleidomastoid, greater and the smaller pos-

terior rectus and splenius muscles. Administering trigger point injection in the sternocleidomastoid and trapezius muscles alleviated orofacial pain. We suspect that the main cause of the referred pain was primary or secondary cervical muscle strain. Most of the cervical muscles are innervated by C2-7, although the sternocleidomastoid and trapezius muscles are also innervated by the accessory nerve. Deep cervical plexus block with 1% mepivacaine resulted in successful pain relief even though the accessory nerve might not have been blocked. The results of the present study indicated that the orofacial pain in our patients originated from the deep cervical muscles. Deep cervical plexus block might have blocked the barrage of noxious inputs from a wide area of cervical structures. We considered that the tenderness revealed by palpating the transverse processes of the cervical vertebrae was associated with the central excitation of second order neurons (Bartsch 2005) induced by irritation of the cervical muscles.

The characteristics of the pain (Table 2) did not satisfy the proposed diagnostic criteria for cervicogenic headache (Sjaastad et al. 1998a; Headache Classification Subcommittee of the International Headache Society 2004), and we did not suppose that the orofacial pain in the present study represented solely this type of cervicogenic headache. Patients who received deep cervical plexus block reported pain relief lasting several days. We did not confirm the treatment effect of repeated deep cervical plexus block, because the purpose of this study was not to evaluate its effect on orofacial and neck pain. Our results however, revealed the diagnostic value of deep cervical plexus block in orofacial pain of cervical origin. The International Headache Society stated that cervicogenic headache should be resolved after cervical disorders are treated. We considered that the pathogenesis of the orofacial pain described here was due to cervical muscle strain that was either primary or secondary to other conditions, and we suspect that complete and permanent resolution of muscle strain is quite difficult.

Orofacial pain in the present study and cervicogenic headache must comprise a pain reference in trigeminal nerve territories that originated from the cervical structures. We could not find any reports that documented orofacial pain referred from cervical structures in the literature. This seems to be due to the absence of focus on referred pain from the cervical structures by dental investigators. The results of the present study indicate that referred pain from outside as well as inside the trigeminal territories should be considered when diagnosing orofacial pain.

Conclusions

The orofacial pain described here did not satisfy the currently accepted diagnostic criteria for cervicogenic headache. However, persistent pain, which had not been relieved by any previous therapeutic interventions including dental procedures, was alleviated by deep cervical plexus block and trigger point injection, and even more so by deep cervical plexus block. These results shed light on some types of undiagnosed orofacial pain. We conclude that some orofacial pain can originate from the cervical structures, especially deep muscles.

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