REFERRED CRANIOFACIAL PAIN PATTERNS IN PATIENTS WITH TEMPOROMANDIBULAR DISORDER

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ABSTRACT

Background. Referred pain is prevalent in the craniofacial region, and it would be helpful for dental practitioners to have drawings delineating regions with a high probability for a patient's referred pain source.

Methods. The author applied firm pressure for approximately five seconds to trigger points, nodules of spot tenderness, and selected masticatory structures within the head and neck region on 230 patients with temporomandibular disorder, or TMD. As firm pressure was being applied, subjects were asked whether pain was developing or intensifying in a location different than that being palpated.

Results. One hundred ninety-six subjects (85 percent) reported that referred pain was being generated. The cheek area, ear and forehead were the most frequently reported sites of referred pain generation; palpation over the trapezius muscle, lateral pterygoid area and masseter muscle were the most common sources of referred pain to the craniofacial region. The author provides figures displaying common referred pain sites and their sources.

Conclusions. Patients with TMD often report referred craniofacial pain arising from palpation of the head and neck region. The author found that the pattern between referred pain source and site was consistent and predictable.

Practice Implications. Practitioners should consider craniofacial pain's propensity for referral when treating patients with TMD. Practitioners can use the figures presented to determine regions of high probability for a patient's referred pain source.

When patients with temporomandibular disorder, or TMD, describe their pain to practitioners, practitioners may assume the pain's source is the same as its site. Unfortunately, the pain could be referred from a distant location, as is commonly seen with a heart attack. During a heart attack, the site of the pain may be in the left arm or shoulder, while the pain's source is the heart. Treatment for the pain must be directed toward the source, not the site where it is felt.

Referred pain is prevalent in the head and neck region[1,2] and frequently causes confusion for both the practitioner and patient.[3] For example, it has been demonstrated that an often overlooked source for temporal headaches is referred pain from trigger points in the upper trapezius muscle.[4,5] If the pain's source is not identified, the practitioner may make the wrong diagnosis and recommend inappropriate treatment.[1] Fortunately, referred pain patterns tend to be similar from patient to patient, thus enabling practitioners knowledgeable about these patterns to identify the pain's source more readily.[2,4,6-8]

Skeletal muscle trigger points are a common referred pain source and frequently are discussed in the medical literature.[3,4,9] As early as the 1930s, investigators attempted to identify referred pain patterns by injecting hypertonic saline into a variety of skeletal muscles and observing the location of both primary and referred pain sites.[10] Through palpation of muscle trigger points, Simons and colleagues[4] and

Fricton and colleagues[11] mapped referred pain sites for various muscles.

Trigger points are localized, firm, hyperirritable nodules that patients often describe as "knots" within their muscles.[4,9] In the head and neck region, trigger points are small (usually between 2 and 10 millimeters in diameter), while they are larger in the shoulder region (usually 10 to 20 mm in diameter).[12,13] Trigger points are known to become aggravated from muscle use, poor sleep, psychological tension and emotional stress, and their severity can fluctuate as the contributing factors change.[2,4] It appears that trigger points are caused by a cluster of microscopic neuromuscular dysfunctions, scattered throughout the nodule, at a skeletal muscle fiber's motor endplate.[4]

Trigger points cannot be identified by laboratory or imaging test, they cannot be studied electrophysiologically, and they do not have a uniformly distributed histologic change throughout, which leads some investigators to question their existence.[4,14] Practitioners experienced in palpating muscles, however, find that trigger points are very discernible, localized, firm nodules that are tender to palpation and, if sufficiently sensitized, can be the referred pain source.

The easiest and most common way to identify trigger points is through manual palpation.[15] They often are identified by rolling a finger over the muscle and feeling for firm, hyperirritable nodules within the muscle.[13] When a sufficiently irritable trigger point is the referred pain source, moderate sustained pressure applied to the trigger point usually is able to reproduce a patient's referred pain.[4,16,17] Patients often report that this action so precisely reproduces their pain that there is no doubt about the diagnosis.[4,8]

In an attempt to reproduce referred pain from trigger points, Hong and colleagues[18] applied pressure over trigger points until their fingernails blanched (estimated to be 3-4 kilograms per square centimeter). They were able to reproduce the patient's referred pain complaint more than 80 percent of the time. It usually takes a few seconds of sustained pressure against the trigger point to produce the referred pain, but occasionally it may take up to 10 seconds or longer.[3,5-7,19,20]

Locating a trigger point sometimes is difficult, especially when there is no firm structure behind the muscle to support it when the muscle is palpated.

The reliability and validity of identifying trigger points within the masticatory musculature has not been established in patients with TMD.[21] In one controlled study of trigger points that generated referred pain when needled, researchers found that only 62 percent generated referred pain when palpated.[18] The natural fluctuation of trigger point irritability also may cause an inconsistent ability to generate referred pain over time.[22]

It has been demonstrated to apply pressure directly to the trigger point to generate the patient's referred pain. Palpating over a muscle band that contains a trigger point or an adjacent band within the same muscle often is all that is needed to reproduce the patient's referred pain; however, it does require greater palpating pressure.[22] Locating a trigger point sometimes is difficult, especially when there is no firm structure behind the muscle to support it when the muscle is palpated. It also has been found that palpating nodules of spot tenderness is a highly reliable method for generating the patient's referred pain, if the examiner is skilled at detecting these nodules.[4,6,11,23]

Masticatory and cervical muscles are not the only structures that can refer pain to the orofacial region. It has been demonstrated that other structures—including the temporomandibular joint, or TMJ, sinuses and teeth—also can produce referred orofacial pain.[6,7,10,12]

I speculate that referred pain patterns generated from controlled palpations of a population of patients with TMD may be quite similar to the referred pain patterns that practitioners treating these patients are likely to observe. In this prospective study, I assessed a large group of patients with TMD for the occurrence of referred pain elicited by palpating trigger points, nodules of spot tenderness, and selected masticatory structures within the head and neck region.

SUBJECTS AND METHODS

I evaluated all patients referred to a TMD specialty clinic at

Lackland Air Force Base, Texas, using a medical history and a clinical examination. A total of 230 patients with TMD met the TMD research diagnostic criteria,[21] or RDC. I evaluated them for referred pain in the craniofacial region.

During the clinical examination, I identified myofascial trigger points and nodules of spot tenderness within the head and neck region by sustaining finger pressure while sliding my fingers along the muscle's length. I applied firm pressure, up to the subject's tolerance, for approximately five seconds to the identified trigger points, nodules and other selected masticatory structures.[6]

I palpated the following muscles for trigger points and nodules of spot tenderness in the following locations:

- temporalis muscle—the entire portion of the muscle superior to the zygomatic arch;
- masseter muscle—the entire body;
- trapezius muscle—the upper portion within the region of the neck (this muscle has many other cervical muscles beneath it, which are nearly impossible to differentiate, so I made no attempt to distinguish between it and the underlying muscles[6]);
- splenius capitis muscle—the upper portion between the trapezius and sternocleidomastoid muscles (this muscle has many layers of cervical muscles below it, so I made no attempt to distinguish it from the underlying muscles);
- sternocleidomastoid muscle—the full length of the muscle (by squeezing it between my thumb and index finger);
- anterior digastric muscle—the full length medial to the inferior border of the mandible;
- posterior digastric muscle—the portion accessible from behind the angle of the mandible (by sliding my finger toward the earlobe along the anterior border of the sternocleidomastoid muscle).

I palpated the following selected masticatory structures as indicated:

- TMJ—the lateral pole and posterior aspect with the mouth wide open;
- lateral pterygoid area—the lateral side of the alveolar ridge above the maxillary molars (using my fifth digit);
- medial pterygoid muscle—the portion just posterior to the typical site for an inferior alveolar injection intraorally (using my index finger);
- coronoid process—the medial and anterior portion intraorally (using my index finger); this is where the temporalis muscle's tendon inserts into the mandible.

As I was applying firm pressure against these structures, I asked subjects whether pain was developing or intensifying in a different location than that being palpated. For subjects who felt pain in locations other than the areas being palpated, I recorded the referred pain site and point of palpation on drawings such as those shown in Figures 1 and 2 (pp. 1310-11).

RESULTS

Of the 230 subjects with TMD whom I evaluated for this study, 196 felt pain develop or intensify in locations other than the area being palpated. The subjects' ages ranged from 18 to 78 years, with a mean age of 27.5 years. I determined that the primary source of TMD pain was the masticatory muscle for 157 subjects and the TMJ for 73 subjects.

Among the 230 subjects, 73 (32 percent) reported having a history of neck pain at least once a month, and 40 (17 percent) were aware of at least monthly neck tightness. Once their referred pain was generated, 115 subjects (50 percent) reported that this pain occurred or intensified when their TMD symptoms were aggravated, and 65 subjects (28 percent) were aware that this pain occurred or intensified when their neck symptoms were aggravated.

The site for referred pain generation reported most often was the cheek area, followed by the ear and forehead. Subjects reported feeling referred pain in these areas on 260, 178 and 170 occasions, respectively. Table 1 (p. 1312) gives the frequency distribution for the evaluated sources and perceived sites of referred pain.

The most common referred pain source in the craniofacial region was from palpating the trapezius muscle, followed by the lateral pterygoid area and masseter muscle. Palpating these muscles caused referred pain on 238, 194 and 184 occasions, respectively.

When subjects reported that pain was referred to the teeth, they frequently reported that they also perceived some degree of pain in the gingiva and alveolar process of the corresponding teeth. The frequency distribution of referred pain to the teeth is given in Table 2 (p. 1313).

The specific sites where referred pain was reported are shown in Figure 1. Red designates the areas where referred pain was more commonly produced; yellow designates less

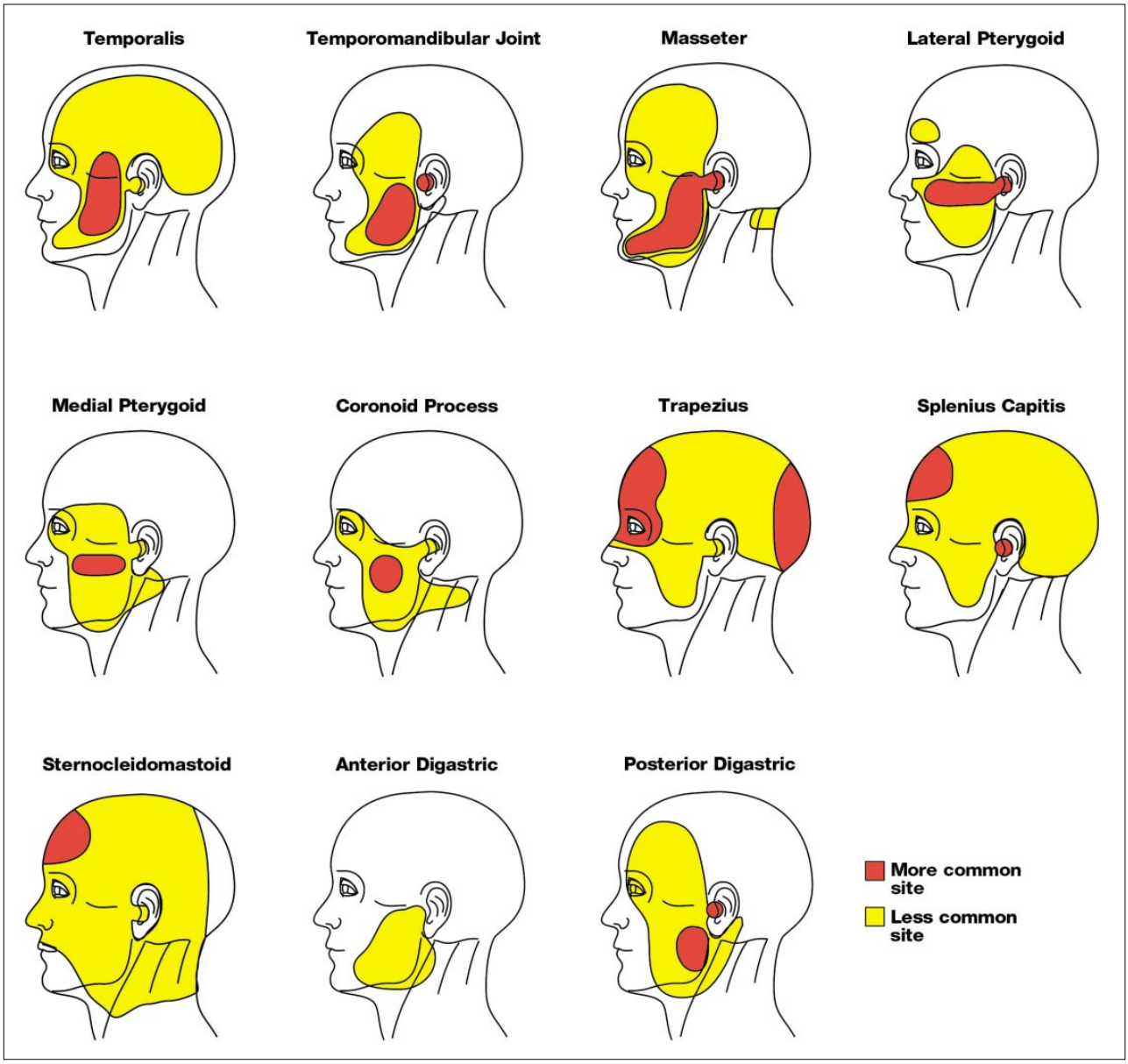

Figure 1. Map of referred pain generated by palpation of labeled anatomic areas.

common areas where at least two subjects perceived the pain.

The referred pain sources for the different craniofacial regions are shown in Figure 2. The more common sources for each region are designated by orange, and the less common sources (with at least two subjects reporting this source) are designated by blue. In some muscles, identified sources were evenly distributed throughout the muscle, while in other muscles the identified sources were concentrated in a particular portion of the muscle. Because of this distribution variation, some muscles with a higher frequency of referred pain generation are designated by blue, while a specific portion of another muscle with an overall lower frequency of referred pain generation is designated by orange. Since minimal information would be trayed for the soft palate/retromolar and throat figures, I did not include them in Figure 2.

Occasionally, referred pain was generated on the side contralateral from the structure being palpated. Of the 89 subjects who reported referred forehead pain—sometimes from multiple sources—18 reported it was generated bilaterally from unilateral palpation. Of the 51

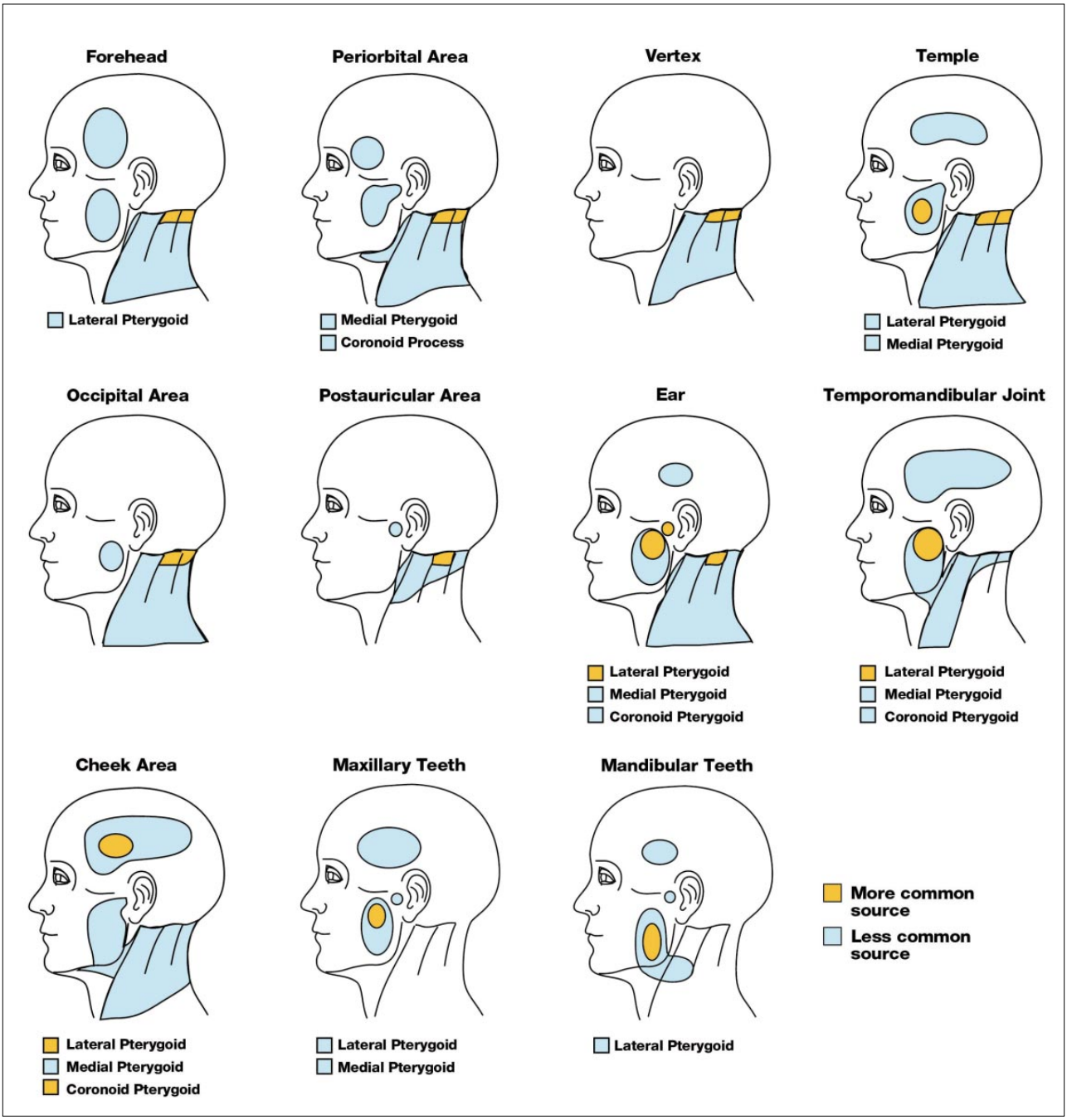

Figure 2. Map of palpation locations that generated referred pain to the labeled anatomic areas. The boxes below some of the figures represent intraoral sites.

periorbital pain—sometimes from multiple sources—five reported it was generated bilaterally from unilateral palpation.

DISCUSSION

During the 18 months I conducted this study, 85 percent of the subjects reported referred pain generation from my palpating the evaluated head and neck regions. Referred ear and maxillary and mandibular tooth pain were generated from masticatory structures on 133 and 138 occasions, respectively (Table 1). This common referral pattern may help explain the clinical observations in which ear or tooth pain have concomitantly resolved with TMD therapy.[24,25]

A recent study showed that if practitioners tell patients that they expect to observe referred

TABLE 1

FREQUENCY OF REFERRED PAIN FOR EVALUATED SOURCES AND PERCEIVED SITES.*

SITE OF PERCEIVED REFERRED PAIN	EVALUATED SOURCE OF REFERRED PAIN (LOCATION PALPATED)										
	Temporalis Muscle	Temporomandibular Joint	Masseter Muscle	Lateral Pterygoid Area	Medial Pterygoid Area	Coronoid Process	Trapezius Muscle	Splenius Capitis Muscle	SCM†	Anterior Digastric Muscle	Posterior Digastric Muscle
Forehead	8	1	3	2	0	0	78	27	56	0	1
Periorbital Area	7	2	6	0	2	2	43	15	16	2	3
Vertex	1	0	0	0	0	0	20	7	5	0	0
Temple	5	7	12	6	3	0	31	18	11	0	3
Occipital Area	1	0	2	0	1	1	45	12	9	0	0
Postauricular Area	1	3	0	0	1	0	2	6	6	0	2
Ear	5	51	27	35	3	4	10	30	5	0	8
Temporomandibular Joint	10	Not applicable	16	46	6	6	3	6	3	3	3
Cheek Area	35	25	22	86	15	36	5	4	16	6	10
Maxillary Teeth	8	4	40	14	2	0	1	0	0	0	0
Mandibular Teeth	3	2	56	5	0	1	0	0	3	2	1
Soft Palate/ Retromolar	0	0	0	0	15	4	0	0	1	0	0
Throat	0	0	0	0	12	2	0	0	2	0	1

* In some subjects, multiple sources generated pain that was referred to one specific site.
† SCM: Sternocleidomastoid muscle.

pain, patients will perceive referred pain in a certain location on palpation; this biases patients to more frequently perceive referred pain.[26] Among their unbiased patients with TMD, 45 percent reported referred pain from 15 seconds of pressure applied to the focal site of maximum masseter muscle tenderness. In the present study, I was careful not to bias the subjects; only 29 percent of the subjects reported referred pain from the masseter muscle. Both studies reported a similar referred pain pattern. The present study's less frequent referred pain generation could have resulted from the shorter time I applied pressure (approximately five seconds), lower palpation pressure (up to patient's tolerance) or possibly less symptomatic patients with TMD.

Simons and colleagues[4] and Fricton and colleagues[11] reported muscle trigger point referred pain patterns very similar to the ones I observed in this study. All three studies found that referred pain was generated from the temporalis muscle to the maxillary teeth; masseter muscle to the teeth, ear and TMJ; lateral pterygoid muscle to the maxillary sinus area and TMJ; and sternocleidomastoid muscle to oral structures and the forehead, which occasionally crossed the midline.

In both this study and that of Fricton and colleagues,[11] referred pain was found to be generated frequently from the cervical protuberance area of the trapezius muscle to the forehead and from the lateral pterygoid and posterior digastric muscles to the ear. Both studies observed that referred pain frequently was generated from the splenius capitis muscle to the forehead, but in this study, I also observed it com-

TABLE 2

FREQUENCY AND SOURCES OF PAIN REFERRED TO THE TEETH.

SITE OF PERCEIVED REFERRED PAIN	EVALUATED SOURCE OF REFERRED PAIN (LOCATION PALPATED)										
	Temporalis Muscle	Temporomandibular Joint	Masseter Muscle	Lateral Pterygoid Area	Medial Pterygoid Area	Coronoid Process	Trapezius Muscle	Splenius Capitis Muscle	SCM*	Anterior Digastric Muscle	Posterior Digastric Muscle
Maxillary Molars	3	2	25	6	0	0	0	0	0	0	0
Maxillary Premolars	3	1	11	6	0	0	0	0	0	0	0
Maxillary Anterior Teeth	2	1	4	2	2	0	0	0	0	0	0
Mandibular Molars	1	2	40	1	0	1	0	0	1	0	1
Mandibular Premolars	1	0	8	2	0	0	0	0	1	1	0
Mandibular Anterior Teeth	1	0	8	2	0	0	0	0	1	1	0

* SCM: Sternocleidomastoid muscle.

monly referred to the ear. Simons and colleagues[4] did not report observations from palpating these posterior cervical areas.

Both Simons and colleagues[4] and this study found that referred pain was generated from the anterior digastric muscle to the throat and the posterior digastric muscle to the ear. In addition to evaluating the muscles palpated in these other studies, this study also evaluated referred pain generation from the TMJ and coronoid process.

The mechanism for the referred pain generated in this study is not fully understood by researchers, and no single mechanism is able to explain all aspects of referred pain.[7] The underlying feature for referred pain is the convergence-projection theory. It is well-known that there are more nerves to carry information into the central nervous system, or CNS, than there are neurons to transfer the information to the higher centers of the CNS. This difference necessitates that information from multiple nerves traveling into the CNS has to converge on fewer neurons to carry this information to the higher centers. It is theorized that the higher centers receive the information in a way such that two or more regions may be perceived as its source.[1,2,7,10]

There is extensive convergence of sensory nerves that serves the orofacial region.[1,19] It has been demonstrated in cat brains that the areas of the higher center receiving input from the TMJ also receive input from facial skin and intraoral sites.[27] Similarly, in rat brains, it has been observed that 80 percent of the neurons from the TMJ and masseter muscle converge in the trigeminal subnucleus caudalis.[28]

It also has been demonstrated that the trigeminal sensory complex receives pain input from the trigeminal nerve, as well as converging input from the facial, glossopharyngeal, vagus and hypoglossal cranial nerves and the upper cervical nerves.[19] It has been shown that at least one-half of the pain-carrying neurons that normally are activated by the trigeminal nerve can be activated by electrical stimulation outside their normal receptive field.[29]

Convergence is believed to occur to a greater degree among neurons carrying information from deeper structures such as muscles, joints or tooth pulp than from cutaneous structures. This has been hypothesized as the reason people with pain from deep structures have difficulty localizing it and often sense it as referred to regions distant

from their source, while people with cutaneous pain can localize it with great accuracy.[2]

Another feature that appears to contribute to the referred pain mechanism is central sensitization.[6,30-32] It appears that a continuous barrage of painful input can activate specific receptors that increase the sensitization of neurons, altering normal processing to the higher centers, expanding the receptive field area and causing nonpainful information to be relayed as painful.[31,32] The referred pain observed in this study could be due to multiple CNS mechanisms, and it appears that the two most prominent mechanisms are convergence and central sensitization.

It was observed and previously reported that to generate a patient's referred, pain practitioners must palpate the trigger point or nodule of spot tenderness with a force beyond what is needed to produce local pain.[4] Additionally, the referred pain generally was not produced immediately but took a few seconds to develop.[3,5-7,19,20]

As indicated in Figure 1, trigger points found in one vicinity may project referred pain to many different sites. I recommend that once practitioners determine a trigger point's referred pain site, they should not assume other trigger points in the vicinity refer to the same site. Occasionally I observed that multiple trigger points in close proximity referred pain to dramatically different locations.

It also was not uncommon to observe that multiple pain sources distant from each other generated referred pain to the same site. If practitioners want to test how much impact a specific trigger point has on the identified referred pain site, they can attempt to inactivate it through methods such as a trigger-point injection, trigger-point compression, ice, heat, spray and stretch and massage.

It appears that palpating the muscle against a firm support such as an underlying bone lets practitioners better compress the suspected source and increase the likelihood of causing referred pain. This may be one reason that referred pain often was generated just below the skull's insertion of the trapezius and splenius capitis muscles; this region was palpated against the base of the skull, providing a firm support against which the suspected source could be "pinched."

Once practitioners determine a trigger point's referred pain site, they should not assume other trigger points in the vicinity refer to the same site.

As reported by other investigators, it was common for patients in this study to be minimally aware, or even not aware, of symptoms at the location of their referred pain's source.[2,4-7,20] Practitioners searching for a patient's referred pain source may find Figure 2 helpful in identifying the location, because referred pain patterns tend to be similar from patient to patient.[2,4,6-8]

Twenty-eight percent of the subjects in this study were aware that their referred pain occurred or intensified when their neck symptoms were aggravated, but most subjects were not aware that this pain was referred from their necks. Once their pain was generated when I palpated their necks, all of the subjects were receptive to the referred pain explanation.

In addition, many subjects reported a correlation between their periorbital or forehead pain and their TMD symptoms, despite the fact that their periorbital or forehead pain could be generated only from their cervical musculature. Their observed correlation could be due either to secondary muscle splitting of their cervical muscles in response to an aggravation of their TMD symptoms, to the cervical muscles and TMD symptoms both being aggravated by similar nonspecific factors (for example, psychological tension, poor sleep and emotional stress), or to an unidentified masticatory referred pain source.

Among the subjects in whom referred forehead or periorbital pain was generated, I produced bilateral forehead or periorbital pain from unilateral palpation in 20 percent and 10 percent of these subjects, respectively. Referred pain normally is generated on the same side of the body as the source, but crossing the midline of the body has been reported by other authors.[4,6,11]

CONCLUSIONS

Practitioners should be aware that patients with TMD often report referred craniofacial

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pain generated from head and neck palpation, as well as consider the propensity for referred craniofacial pain. In this study, the pattern between the referred pain source and site typically was consistent and predictable. Practitioners can refer to Figure 2 to determine regions highly probable to be the patient's referred pain source.

During TMD evaluations, I recommend that practitioners keep in mind that periorbital or forehead pain typically is not generated from the temporalis muscle but more commonly is produced from the cervical musculature. It is not uncommon for the cervical musculature to be the source of temple pain, and, if palpating the pain's site does not generate the patient's pain complaint, the pain may be referred from another location.

If a dental practitioner wants to recommend therapy to treat a patient's cervical region and does not have an appropriate treatment protocol, I suggest that the practitioner refer the patient to a family physician. Family physicians commonly treat cervical disorders and usually are familiar with the patient's medical insurance benefits.

I also recommend that if the patient does not have the anticipated response from initial should consider that the patient's pain may be referred from a different source. Referred pain also should be considered if the patient experiences no pain relief after the pain's source has been anesthetized; for example, a patient with a painful tooth that has been anesthetized for endodontic therapy does not report pain relief. ■

The opinions expressed in this article are those of the author and do not reflect the official policy of the Department of Defense or other departments of the U.S. Government.

1. Okeson JP, ed. Orofacial pain: Guidelines for assessment, diagnosis, and management—American Academy of Orofacial Pain. Chicago: Quintessence; 1996:8-10.
2. Okeson JP, Bell WE, eds. Bell's orofacial pains. 5th ed. Chicago: Quintessence; 1995: 61-81, 161-2, 266-9.
3. Davidoff RA. Trigger points and myofascial pain: toward understanding how they affect headaches. Cephalalgia 1998;18(7): 436-48.
4. Simons DG, Travell JG, Simons LS. Travell and Simons' myofascial pain and dysfunction: The trigger point manual. Vol. 1. 2nd ed. Baltimore: Williams & Wilkins; 1999:16, 33-4, 57, 95-7, 297, 309.
5. Fricton JR, Gross SG. Muscle disorders. In: Pertes RA, Gross SG, eds. Clinical management of temporomandibular disorders and orofacial pain. Chicago: Quintessence; 1995: 91-108.
6. Okeson JP. Management of temporomandibular disorders and occlusion. 4th ed. St. Louis: Mosby; 1998:58-63, 180-90, 248-53, 463.
7. Mense S. Referral of muscle pain: new aspects. Am Pain Soc J 1994;3(1):1-9.
8. Jaeger B. Myofascial referred pain patterns: the role of trigger points. CDA J 1985;13(3):27-32.
9. Hong CZ, Simons DG. Pathophysiologic and electrophysiologic mechanisms of myofascial trigger points. Arch Phys Med Rehabil 1998;79(7):863-72.
10. Vecchiet L, Giamberardino MA. Referred pain: clinical significance, pathophysiology, and treatment. Phys Med Rehabil Clin N Am 1997;8(1)119-36.
11. Fricton JR, Kroening R, Haley D, Siegert R. Myofascial pain syndrome of the head and neck: a review of clinical characteristics of 164 patients. Oral Surg Oral Med Oral Pathol 1985;60(6):615-23.
12. Fricton JR. Etiology and management of masticatory myofascial pain. J Musculoske Pain 1999;7(1/2):143-60.
13. Saxen MA. Myofascial pain syndrome: characteristics, diagnosis, and treatment. J Indiana Dent Assoc 1998;77(3):9-12.
14. Quintner JL, Cohen ML. Referred pain of peripheral nerve origin: an alternative to the 'myofascial pain' construct. Clin J Pain investigating the use of diagnostic ultrasound for detecting active myofascial trigger points. Pain 1999;79(1):39-44.
16. Fricton JR. Management of masticatory myofascial pain. Semin Orthod 1995;1(4): 229-43.
17. Travell JG. Temporomandibular joint pain referred from muscles of the head and neck. J Pros Den 1960;10(4):745-63.
18. Hong CZ, Kuan TS, Chen JT, Chen SM. Referred pain elicited by palpation and by needling of myofascial trigger points: a comparison. Arch Phys Med Rehabil 1997;78:957-60.
19. Sessle BJ. Mechanisms of trigeminal and occipital pain. Pain Rev 1996;3:91-116.
20. Kraus SL, ed. Temporomandibular disorders. 2nd ed. New York: Churchill Livingstone; 1994:88, 329.
21. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord 1992;6(4):301-55.
22. Hong C-Z, Chen Y-N, Twehous D, Hong DH. Pressure threshold for referred pain by compression on the trigger point and adjacent areas. J Musculoske Pain 1996;4(3):61-79.
23. Hobson DE, Gladish DF. Botulinum toxin injection for cervicogenic headache. Headache 1997;37:253-5.
24. Keersmaekers K, De Boever JA, Van Den Berghe L. Otalgia in patients with temporomandibular joint disorders. J Prosthet Dent 1996;75:72-6.
25. Reeh ES, elDeeb ME. Referred pain of muscular origin resembling endodontic involvement: case report. Oral Surg Oral Med Oral Pathol 1991;71(2):223-7.
26. Branch MA, Carlson CR, Okeson JP. Influence of biased clinical statements on patient report of referred pain. J Orofac Pain 2000;14(2):120-7.
27. Broton JG, Hu JW, Sessle BJ. Effects of temporomandibular joint stimulation on nociceptive and nonnociceptive neurons of the cat's trigeminal subnucleus caudalis (medullary dorsal horn). J Neurophysiol 1988;59:1575-89.
28. Kojima Y. Convergence patterns of afferent information from the temporomandibular joint and masseter muscle in the trigeminal subnucleus caudalis. Brain Res Bull 1990;24:609-16.
29. Sessle BJ, Hu JW, Amano N, Zhong G. Convergence of cutaneous, tooth pulp, visceral, neck and muscle afferents onto nociceptive and nonnociceptive neurons in trigeminal subnucleus caudalis (medullary dorsal horn) and its implications for referred pain. Pain 1986;27:219-35.
30. Sessle BJ, Hu JW, Cairns BE. Brainstem mechanisms underlying temporomandibular joint and masticatory muscle pain. J Musculoske Pain 1999;7(1/2):161-9.
31. Sessle BJ. The neural basis of temporomandibular joint and masticatory muscle pain. J Orofac Pain 1999;13(4):238-45.
32. Coderre TJ, Katz J, Vaccarino AL, Melzack R. Contribution of central neuroplasticity to pathological pain: review of clinical and experimental evidence. Pain 1993;52: 259-85.