Case Study - TMJ

This is a case study of a thirty two year old woman with a history of intractable TMJ and facial pain for nine years. She had seen dentists, oral surgeons, pain management specialists, a neurologist, a chiropractor, physical therapists and an ENT. She has seen a DMD who specialized in TMD. None of the therapies were successful. She saw her current primary care provider, an internist, for the first time on October 12, 2005. Her doctor called and asked if she might be a candidate for laser therapy. She was referred to Jerry Koziej, DC (the author) the same day for consultation and examination as a possible candidate for Class IV infrared laser therapy.

Prior to that she had considered Botox therapy as the next step. Her medical history which complicates treatment for her TMD is a history of ulcerative colitis requiring a total colectomy. She was unable to tolerate multiple oral medications. At the time of initial evaluation by me she had been giving samples of Celebrex and Skelaxin that day which are anti-inflammatory and muscle relaxant, respectively. She had not taken either medication at the time of my initial evaluation. She had also seen a chiropractor and found that cervical manipulation gave her relief for 24-48 hours.

She presented with TMJ pain, facial pain, bilaterally, exacerbated by any jaw movement, including smiling, talking, chewing, and brushing her teeth. Her symptoms were progressively getting worse, extending to her neck, trapezius. She said her jaw "zigzagged" as she opened and closed it. She had tried mouth bite guards muscle stimulation, physical therapy, medications, lidocaine and steroid injections into her TMJ. She was considering botox injections by an ENT in Lexington.

This is the medical history as related by the patient for TMD:

Purchases

2005	purchased a Sleep Number Bed and a memory foam pillow.
2000	purchased a TENS unit.
1999-present	purchased magnets

Physicians

2005-present	New primary care doctor referred for laser therapy
2000-presetn	Chiropractor – cervical manipulation.
2005	Visit to TMD specialist DMD
1998-present	DMD – night guard prescribed
2000	Neurologist diagnosed her with Shy-Drager syndrome
1999	MRI

Allergy and Sinus

2004	ENT for reconstructive sinus surgery.
Multiple times	Asthma inhalers, allergy medications, allergy shots and drops.

Physical therapy

1998	Ultrasound over her TMJ and surrounding tissues.
2000	Stretching exercises

Other

2004	Therapeutic massage
2005	Yoga and resistance exercise
2003	One session of acupuncture

Entire colon removed in 1996 due to serious ulcerative colitis. Two months later iliostomy reversal.

Medications

800 mg Ibuprofen	It worked immediately, but upset stomach too much.
Naproxen	stomach upset.
Skelaxin	No comment by patient.
Vicoden	Intolerable side effects.
Hydrocortizone	Intolerable side effects.
Effexor	Intolerable side effects, less severe than others.
Xanax	Intolerable side effects.
Amytriptiline	Intolerable side effects.

Upon inspection, the patient appeared distraught, tense, and in obvious pain. She was relatively expressionless. She had somewhat of pallor. She found it difficult to talk, and this author found it difficult to understand her at times. Cervical spine and cranial nerve examination were unremarkable.

The TMJ region and muscles of mastication were tender to palpation.

Materials and Methods

Infrared images were taken to see if information of diagnostic value could be gleaned, and to establish a base line to determine if pre- and post-treatment images would reveal changes. Thermal images were obtained by a Meditherm high-resolution digital infrared thermal imaging scanner. The patient was disrobed from the waist up, acclimated to the imaging room at 69 degrees ambient temperature and positioned to view the anatomy being scanned. The A-P head and face image was taken, and left and right lateral head and face images.

The patient was to return in two days to begin treatment. The laser used was an Avicenna class IV infrared laser. Two wave lengths of light are generated: a visible red light at 635 nm, and infrared wavelength at 980 nm. A "template" was made using a small piece of cardboard with a 2 cm x 3 cm hole cut out of it to ensure that the same area in square centimeters was lasered each treatment. This was affixed to the patient's face. The template was place so that on the right side, the TMJ occupied the left superior-posterior corner of the hole, (the "northwest" corner) and on the left, the right posterior-superior corner (the "northeast" corner). The hand-held wand stylus was secured to the wand so the laser was at a constant 2 cm distance from the patient. The stylus was kept in constant light contact to ensure that the laser wand stayed at a consistent distance.

Treatment
The first four treatments were focused solely on the TMJ. The following treatments focused on both the TMJ and maxillary sinuses, using the same template to ensure consistency.

Joules = watts x seconds
Power density = watts / area in centimeters (w/cm sq)
Time in minutes
Distance in centimeters

Date	Watts	Joules	Location	Time	Power Density	Distance
10/14	4.0	1200	Rt TMJ	5	.7	2
10/19	5.0	1200	Rt TMJ	4	.8	2
	5	1200	Lt TMJ	4		2
10/20	5	1800	Rt TMJ	6		2
	5	1800	Lt TMJ	6		2
10/24	5	1800	Rt TMJ	6		2
	5	1800	Lt TMJ	6		2
10/27	5	1800	Rt TMJ	6		2
	5	1800	Lt TMJ	6		2
	5	1200	Rt max sinus	4		2
	5	1200	Lt max sinus	4		2
11/02	5	1800	Rt TMJ	6		2
	5	1800	Lt TMJ	6		2
	5	1200	Rt max sinus	6		2
	5	1200	Lt max sinus	6		2
11/16	5	1800	Rt TMJ	6		2
	5	1800	Lt TMJ	6		2
	5	1200	Rt max sinus	4		2
	5	1200	Lt max sinus	4		2
11/30	5	1800	Rt TMJ	6		2
	5	1800	Lt TMJ	6		2
	5	1200	Rt max sinus	4		2
	5	1200	Lt max sinus	4		2
12/21	5	1500	Lt pterygoid & masseter	6	.31 (.3)	
	5	1500	same	6	.31	

A visual analogue scale was used for the last three treatments. I assigned "10" to be the pain she had when she first came to the office, and "0" to be no pain. the patient circled a number on the form itself. The values are as follows:

11/02	pre-treatment: 0	post-treatment	0	4 days after previous treatment
11/16	2.5		0	2 weeks
11/30	1.5		0	2 weeks
12/21	1.5		0	3 weeks

(The patient had had a sinus infection the previous week, [12/14] and thought her pain was because of sinus fullness)

The patient was to return on December 14, but cancelled due to illness.

Another series of thermal images were taken on 11/30/05. the Meditherm program allows us to fix the cursor on any point of the image and gives us the absolute temperature in degrees Celsius. The cursor was used to draw a small square over the areas of the face, bilaterally and symmetrically, and the program was able to give an average temperature of the enclosed area. The sinuses and temporomandibular joints were compared left to right, and pre- and post-laser treatment.

The temperature of her face was recorded in degrees Celsius:

Pre-treatment:

A-P right maxillary sinus: 24.36 left maxillary sinus: 24.50
Left lateral TMJ: 27.15
Right lateral TMJ: 27.09

Post-treatment:

A-P right maxillary sinus: 22.99 left maxillary sinus: 22.98
Left lateral TMJ: 25.09
Right lateral TMJ: 25.46

Delta T (difference between pre- and post-treatment temperatures).

Right maxillary sinus: 1.37
Left maxillary sinus: 1.52
Right TMJ: 1.63
Left TMJ: 2.06

Patient Comments

10/14 (After treatment) her right jaw was “not grinding”.

10/19 “Big improvement”.

10/20 She was “sleeping better” and in the morning “felt refreshed”.

10/24 She had some pain but was “relaxed”.

10/27 There was no jaw “deviation” when she opened her mouth. (She described a lateral “zigzag” motion of her jaw as it opened and closed

11/16 She was completely pain-free until a few days before, then a little tightness in her cheeks. There was no “clicking” in her jaw.

11/30 There was “hardly any pain”.

Discussion

There has been a growing interest in the last two decades in TMD as a cause of facial and head pain. Mechanical disorders of the joint, congenital and acquired deformities can all give rise to head and facial pain.

The temporomandibular joint (TMJ) is a gliding joint, formed by the mandible and temporal bone. The articular surfaces of the of the mandible and temporal bone are separated by and articular disk, which divides the joint cavity into two small spaces.

TMJ syndrome or temporomandibular disorder (TMD) is the most common cause of facial pain after toothache. There is no clear agreement as to an exact definition. Broadly, TMD is (1) secondary to myofascial pain and dysfunction (MPD) or (2) secondary to true articular disease. The majority of cases are myofascial in origin. It is frequently associated with bruxism and daytime jaw clenching. The muscular pain will mimic TMD, when actually it is dysfunction of the muscle rather than derangement of the joint itself.

TMD affects more women than men, at a ratio of 4:1. Incidence is higher in young adults.

Pain can be exacerbated by chewing. It can be unilateral or bilateral. There may be clicking or popping of the joint. The muscles can feel stiff. There may be limited jaw opening. Pain can be present over the TMJ, cheeks, neck and into the shoulder. One third of the patients have a history of psychiatric problems. On palpation, there may be joint and muscular tenderness.

The masseter muscle refers pain to a number of areas, with some broader spillover areas. Different parts of the muscle refer to different areas of the face. This includes the cheek, lower jaw, superciliary arch, and the zygomatic arch near the ear. Pain can also be referred to the ear. Pain can be referred to the lower occiput. The masseter is innervated by the masseteric nerve that arises from the anterior branch of the mandibular division of the trigeminal nerve. The referral patterns will often mimic TMJ pain.

The medial pterygoid is innervated by the medial pterygoids nerve which is from the mandibular division of the trigeminal nerve. This will refer pain to the TMJ, and lesser so to the angle of the mandible. Pain is increased by attempts to open the mouth wide for eating. The lateral pterygoids will refer pain to the TMJ and the area over the maxillary sinuses. There can be autonomic concomitants of excessive secretion from the maxillary sinus, mimicking sinusitis. Dysfunction of the lateral pterygoids can produce clicking sounds.

The patient was experiencing increasing pain in her neck spreading across the trapezius to the shoulders. The sternocleidomastoid can refer pain to the cheek, forehead and ear. The trapezius refers to the side of the neck, zygomatic arch, and angle of the mandible.

The maxillary division of the trigeminal nerve supplies sensation to the upper jaw cheeks, maxillary sinuses and part of the external ear. The mandibular branch for the Vth supplies the lower jaw, and buccal mucosa. Motor fibers supply the muscles of mastication: masseter, temporal, internal and external pterygoids. The facial nerve supplies motor nerves to the superficial facial muscles. There are also some proprioceptive fibers carrying deep pressure and position sense from the facial muscles.

Once the laser beam contacts the skin, some of the photons scatter. While lasing the TMJ, some of the photons would have scattered anteriorly and medially, into the muscles of mastication, and also contacting sensory nerve endings in those areas. It was curious at first that she got the most relief after lasering her maxillary sinuses. After some reflection, it seemed that her TMD might be secondary to myofascial dysfunction of the muscles of the face and mastication. The muscles were inadvertently lased while lasing the maxillary sinuses. The pain actually may not have been even caused by TMD; the facial pain and *myofascial dysfunction* may have caused any facial pain and TMD present.

The return of normal function of the muscles would have normalized function of the TMJ. The patient reported that her bite had been altered.

There are differences between TM pain, and TM dysfunction. The pain is directly related to jaw movements, mastication and to palpation. Dysfunction shows restricted movement of the mandible, clicking and changes in occlusion. Did this patient show TMD to be secondary to myofascial dysfunction? The causal relationship should be established. Myofascial pain in the face is also produced by malocclusion. Does muscular dysfunction cause the joint dysfunction or is the reverse true?

There are two reflexes that control muscle function: the muscle spindles and Golgi tendon organs. Muscle spindles lie between regular muscle fibers, and are termed extrafusal fibers. The muscle spindle is composed of a number of specialized muscle fibers called intrafusal fibers. Sensory nerves are wrapped around the spindle and transmit information to the CNS as to the state of stretch. In the spinal cord, these nerves synapse with an alpha motor neuron which triggers reflexive muscle contraction to resist further stretch. Gamma motor neurons excite the intrafusal fibers causing a slight pre-stretch. This makes the muscle spindle very sensitive to small degrees of stretch. This information is also sent to the brain, for exact length and contractile state, as well as the rate of change of stretch. This is to maintain muscle tone and posture, and for executing movements.

The Golgi tendon organs are small encapsulated sensory receptors located just proximal to the tendon fibers' attachment to the muscle. Whereas the muscle spindle senses length, the GTO senses tension, the amount of force exerted on the tendon. They are very sensitive and can detect strain on a single muscle fiver. These are inhibitory in nature; their function is in protection of the muscle. When stimulated, they inhibit the agonist muscle and stimulate the antagonist muscle.

Does muscle spasm need to be present to restrict the joint, or a dysfunction of the muscle spindles and Golgi tendon organs? What are the physiological effects of the infrared beam on these structures? How are changes in cell wall permeability affecting these structures?

MPD can be frustrating both for the patient and physician. It may be that primary care physicians are frustrated because of an incomplete knowledge of neuromuscular function. There is not a way to look at MPD through any imaging techniques, - X-ray, MRI, CT, etc, nor is there a lab test, with the possible exception of CPK. Without these there needs to be an understanding of neuromuscular functional anatomy, along with the right questions asked during the history. Applying Occam's razor, one should firs think myofascial dysfunction, and direct treatment towards that. Muscles play an extremely important role in the pathogenesis and management of various pain syndromes. Even if muscle *pain* is considered, and analgesics or anti-inflammatory drugs are given, muscle *function* needs to be addressed. Jumping to Shy-Drager syndrome as her neurologist did is akin to hearing hoofbeats and thinking Mongolian Yak. It is possible, but very unlikely.

In future cases of this type, another objective measuring device should be used. While infrared imaging is very sensitive, it is not specific. Many variables come into play in thermographic imaging – ambient temperature, make-up, skin lotions, and blemishes – and have to be taken into consideration. However, infrared thermography is sensitive to increases in temperature due to inflammation. One must be careful to take into account the other factors that may give "false positives." The changes in pre- and post-treatment skin temperatures may well have been to a decrease in inflammation in the target tissues, or a decrease in metabolic activity of the muscles as they maintained a hyper tonic state. EMG might be useful to determine activity of the muscles pre- and post-treatment. Other devices should be considered as well, such as inclinometers, electrogoniometers, or simple linear measurements such as measuring the distance between the patient's upper and lower incisors, pre- and post-treatment.

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The infrared laser creates a number of physiological and biochemical changes in the tissues. The beam stimulates blood vessel endothelial cells to secrete a vasodilator termed *endothelium-derived relaxing factor*, which is nitric oxide (NO, specifically produced by NOS-3), causing the underlying smooth muscles cells to relax ,dilating the blood vessels, increasing the amount of nutrients and oxygen to the target area. This also allows greater drainage of lymphatic fluid decreasing swelling of the target tissue and surrounding

tissues. NO also inhibits the aggregation of platelets and keeps inappropriate clotting from interfering with blood flow. The NO produced by NOS -3 also inhibits inflammation of the blood vessels by blocking exocytosis of mediators of inflammation from the endothelial cells. Among these are histamines and bradykinins, which themselves are irritants to surrounding nerve endings.

The laser has antimicrobial properties, which is related to the specific infrared wavelength itself, but also to the fact that NO aids in the killing of engulfed pathogens by macrophages. This is a "double punch" in that NO brings more blood to the area by vessel dilation, bringing more leukocytes, and aiding in pathogen destruction.

The infrared beam accelerates wound healing by stimulating fibroblast production of collagen, and increased organization of tissue granulation.

Other effects which expedite wound healing include change in cell wall permeability, mitochondrial wall permeability, and increased production of serotonin.

Conclusion

This case shows evidence that class IV infrared laser therapy may be an effective, non-invasive modality for some types of intractable pain. It also gives us evidence that infrared imaging may be useful in demonstrating effectiveness of a particular modality. It also seems reasonable, based on the literature and this case history, to first consider myofascial dysfunction as a cause of TMD. I believe this case shows that more research is warranted to fully explore the possibilities of using the class IV infrared therapeutic laser in TMD.

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