TREATMENT OF TEMPOROMANDIBULAR JOINT (TMJ) PAIN WITH DIODE LASER THERAPY

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Temporomandibular joint (TMJ) pain can be very debilitating for the affected patient, particularly when it is a chronic disorder associated with temporomandibular disorder (TMD). Low reactive laser therapy (LLLT) has been proved effective in a variety of pain etiologies, and low incident levels of diode laser irradiation are very effective in relieving TMJ joint pain associated with TMD, as the first stage in a two-staged strategy in the successful treatment of TMD. The present study reports on four representative cases of TMJ pain treated with a GaAlAs diode laser, 830 nm. continuous wave, 150 mW for 5 to lO sec/point, once per week. Incident energy densities were from approximately 20 J/cm^2 to 40 J/cm^2. One of the possible pain relief mechanisms involves the LLLT-mediated improved microcirculation in the temporal and masseter muscles, thereby relaxing and softening the affected muscles and relieving the pain. This also helps with cases of trismus. LLLT is side-effect free, is easy to apply and is well-tolerated by all ages and conditions of patient. When used in combination with conventional orthodontic maneuvers to remedy the functional defects behind the TMD, LLLT offers the practitioner a safe and effective method for pain relief in troublesome TMJ pain patients.
Key words: Temporomandibular joint disorder, trismus, laser therapy.

Introduction

In general, temporomandibular disorder (TMD) is defined as any case where there is a problem specifically related to the temporomandibular joint (TMJ) and its related anatomical components, such as submaxillary dyskinesia, clicking of the temporomandibular joint, malocclusion and trismus. All of these are usually accompanied by persistent pain in and around the joint, which in chronic patients can spread to involve the masseter and temporal muscles, and other musculature of the head and neck.

Acute TMJ pain is often seen following trauma such as traffic or sports accidents involving the jaw or face, excessive movement of the jaw or postextraction or other major orthodontic procedure. TMJ is not, however, classified as a true TMD, according to the definition published in the Journal of the Japanese TMJ Society in 1996[1]. For true TMD, it is our opinion that treatment must be divided into two stages, the primary and the secondary treatment. LLLT is ideal for the primary treatment to remove the pain associated with the disorder, and then the secondary treatment involves orthodontic or maxillofacial surgical procedures to correct the functional or morphological disorder causing the pain. In both acute and chronic TMJ pain, whether or not it is associated with a TMD, diode LLLT has offered the maxillofacial and orthodontic surgeon a new tool for pain attenuation, and the present study reports on our experiences with submaxillary dyskinesia lock-jaw (trismus), or joint clicking.

Methods

Laser System

The laser used was a gallium aluminum arsenide (GaAlAs) diode laser (Luketron, Mochida Pharmaceutical Co., Ltd. Tokyo, Japan) delivering 150 mW in continuous wave at 830 nm, with an incident power density of 4.2 W/cm^2. The system was applied in the contact mode with light pressure, targeting the masseter and temporal muscles, and then directly on tener areas and contralateral side (normal side). Irradiation time per point was from 5 sec to 10 sec, with a total treatment time per patient of from 2 to 4 min. The incident energy density per point was thus approximately 22 J/cm^2 to 44 J/cm^2.

The higher dosage was used on more severe and intractable pain. Following irradiation of the affected side, we also irradiated the same areas on the contralateral side even if the patient did not complain of discomfort on that side. Patients attended once per week until the pain was totally removed, or until there was no further improvement.

Efficacy Assessment

Pain was assessed subjectively by the patient using the usual 11 point visual analog scale (VAS) (10, worst pain; zero, no pain)[2]. The patient pointed to the area on the scale where they felt their pain was located, and the pain level was noted before and after each LLLT session (Figure 1). In addition to subjective pain, we also measured the degree of opening of the mouth before and after each session, assessed using a standard measuring device which records the distance between the upper and lower incisors. Side-to-side lateral movement of the lower jaw was also measured, and the absence or presence of clicking in the joint.

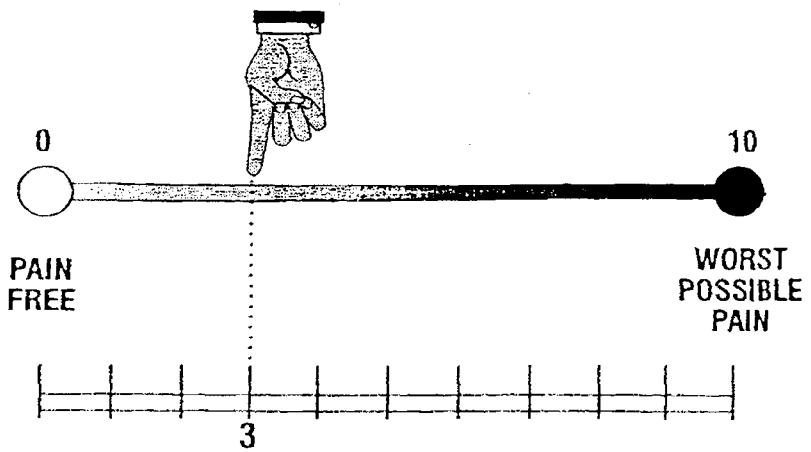

Fig 1: Typical VAS with evaluation method. The patient points to the area on the score line which corresponds to their pain at that moment. The VAS scores from 0 (pain free) to 10 (worst possible pain), so there are thus 11 points on this scale. In the example shown, the point the patient has indicated corresponds to 3 on the 11 point scale. The VAS score is thus 3.

Patients

The trial period was the twenty months from April 1997 to December 1998, and patients were admitted to the trial with TMJ pain with or without any TMD such as submaxillary dyskinesia, trismus or TMJ clicking. We made no note of any analgesic requirements before, during or after the trial. There were 16 patients, 12 with acute pain (6 male, 6 female) and 4 with chronic pain (3 female, 1 male). Ages ranged from 14 yr to 56 yr (mean age 30.7 ± 12.4 yrs). There were nine patients with right-side TMJ pain, five with left side pain and two with bilateral pain (Table 1).

The average number of treatment sessions required for the acute cases was twice, with eleven sessions being required on average for the chronic cases. In only one of the chronic cases was LLLT ineffective, and in all other cases the final VAS ranged from 2 to zero. No patient reported exacerbation of the pain, and there were no adverse side effects reported either.

Representative Case Reports

Case 1: A 25 y.o. male complained of sudden right TMJ pain which had appeared suddenly one month prior to presenting, and he developed trismus. At the first medical examination, the VAS pain score was 5, with a maximal mandibular opening of 10 mm, free lateral movement of the lower mandible, but with pain.

Table 1. Patients, disease and location.

Patients, TMJ Pain Type and Location					
Patient No.	Acute Group		Patient No.	Chronic Group	
1	26 y.o. F	R TMJ Pain	13	26 y.o. M	R&L TMJ Pain
2	25 y.o. M	R TMJ Pain	14	30 y.o. F	L TMJ Pain
3	51 y.o. F	R TMJ Pain	15	56 y.o. F	L TMJ Pain
4	27 y.o. F	L TMJ Pain	16	53 y.o. F	R TMJ Pain
5	33 y.o. M	L TMJ Pain			
6	17 y.o. F	R TMJ Pain			
7	27 y.o. M	L TMJ Pain			
8	23 y.o. M	R TMJ Pain			
9	30 y.o. F	R TMJ Pain			
10	20 y.o. M	R TMJ Pain			
11	14 y.o. M	R&L TMJ Pain			
12	33 y.o. F	R TMJ Pain			

After the first LLLT session, the VAS score dropped to 1.5, with a mandibular range of 25 mm. One-week later, pretherapy VAS score was 2 and a mandibular opening of 25. After the second session, the VAS was 1 with a mandibular range of 28 mm. The patient remained at these levels during further follow-up without LLLT, and was satisfied with the result (Figure 2).

Case 2: A 23 y.o. male suddenly developed severe right TMJ pain on opening his mouth or chewing one week prior to presenting. The pain remained extremely severe on presentation, with a VAS score of 9. He had no trismus and no lower mandible lateral motion limitation. However, he did complain of clicking in the right joint with exacerbated pain.

The VAS score dropped to 7 after the first LLLT session. One week later, the pretherapy VAS was 7.5, with the clicking still present.

After LLLT, the VAS dropped to 2.5. One week later, the pretherapy VAS was 3, and after LLLT the VAS score dropped to zero, with no clicking. This has been maintained in follow-up with no further LLLT necessary (Figure 3).

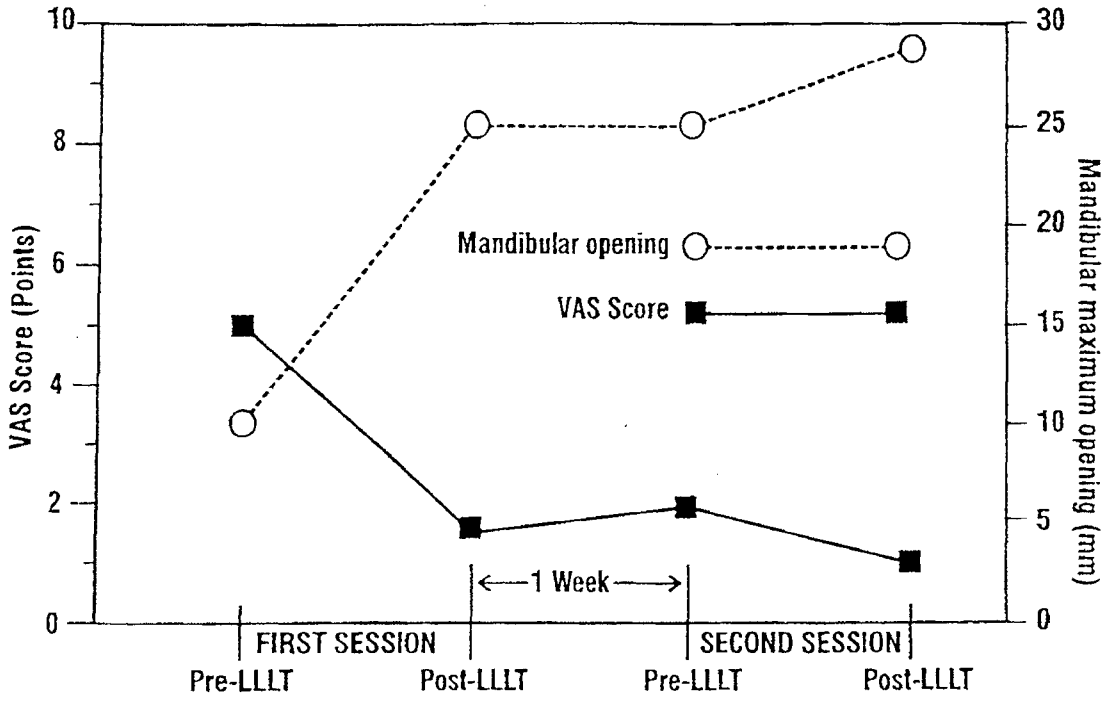

Fig 2: Changes in VAS score and maximal mandibular opening in representative Case 1, a 25 y.o. male (Patient 2 in Table 1), showing the results over two laser sessions, one week apart.

Case 3: A 17 y.o. female was struck hard on her right maxillary area by the ball during a basketball game. As the TMJ and surrounding area was very painful, she presented on the same day at the accident and emergency outpatient department of our university hospital for a check-up. X-rays revealed no bony damage, so she was simply followed to observe any progression of the pain. Two days after that, her pain was still fairly severe and she had developed trismus. Her first pretherapy VAS score was 7 with a maximal mandibular opening of 15 mm. After the first LLLT session, the VAS score dropped to zero, and her mandibular range increased to 35 mm. One week later, these scores were the same, and she required no further treatment (Figure 4).

Case 4: A 51 y.o. female, a professional golfer, presented with pain in her right ear, maxillary zone and neck which had persisted for one month. She presented to the ENT outpatient clinic where the diagnosis was exudative tympanitis. By the following week, she had been diagnosed as having TMD and was put under follow-up observation only. Three weeks later the pain had not subsided, and she was referred to our clinic. Her first pretherapy

VAS score was 4, with no trismus, but with tension pain of the masseter muscle on lateral motion of the lower mandible. The TMJ pain was also affecting her posture, and she had some unnatural curvature of the cervical spine. After the first LLLT session, her VAS score dropped to zero, and the abnormal tension in the masseter muscle was relaxed. One week later, her VAS score was still zero, there was no abnormality of the masseter muscle and her posture had improved to normal. She required no further treatment.

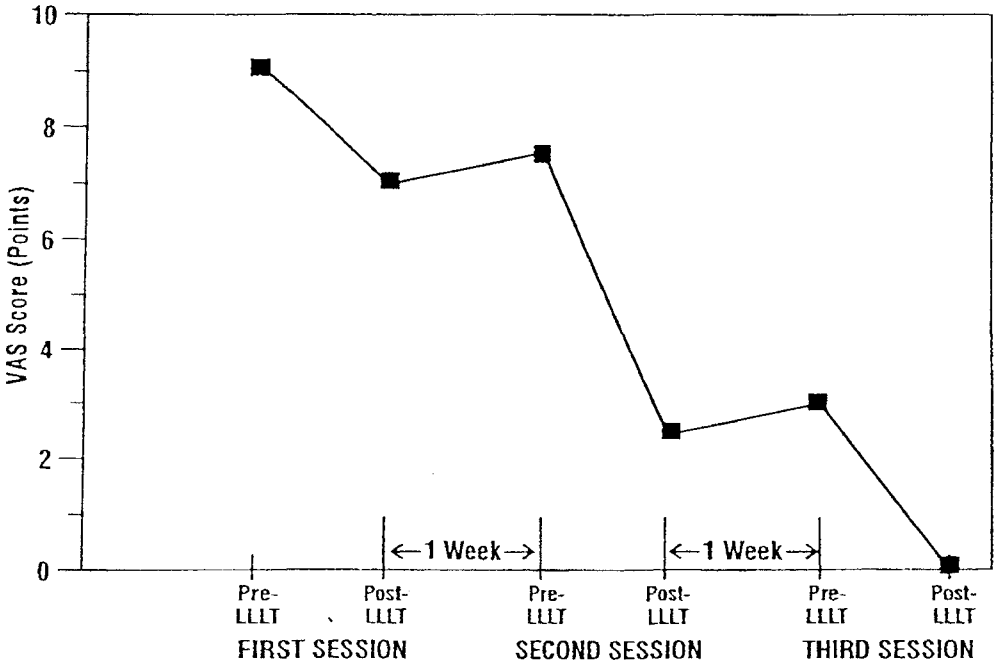

Fig 3: Changes in VAS score in representative Case 2, a 23 y.o. male (Patient 8 in table 1), showing the results over three laser sessions, one week apart.

Discussion

According to the Japanese TMJ Society, the diagnosis of temporomandibular disorder (TMD) is an overall diagnosis given to mostly chronic disease groups with articular clicking in the TMJ, trismus, malocclusion or jaw dyskinesia, all accompanied by TMJ and related pain. The pathology is associated with masticatory myopathy, articular capsule and ligament lesions or disorders, articular disk displacement or hernia, TMJ arthrosis and so on[1]. In addition, the presence of involuntary grinding of the teeth, bruxism, particularly during sleep, is a symptom of abnormal tension in the masseter or temporal muscle groups and surrounding areas, with the secondary complication of exacerbating the existing pain. Pain is an extremely important feedback mechanism to help prevent the organism from causing further injury to itself (biophylaxis), however pain can easily become a vicious circle. It is therefore necessary not only to interrupt the pain cycle, but also to treat the root cause of the pain, for example disease or morphological anomaly[3].

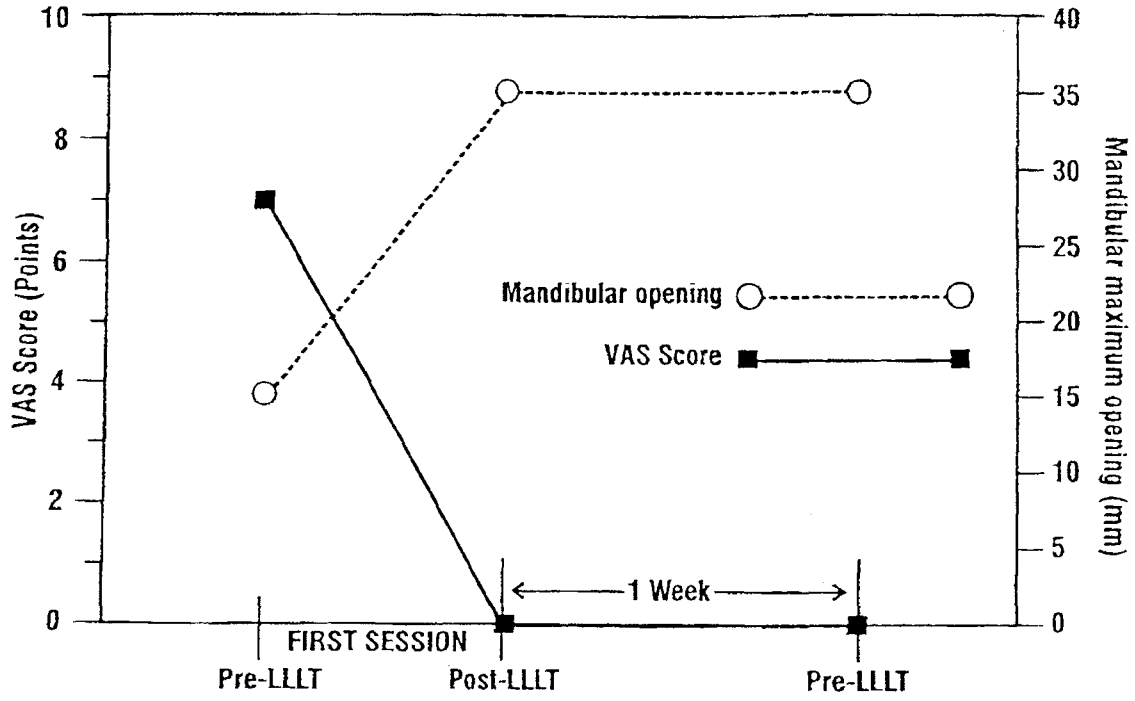

Fig 4: Changes in VAS score and maximal mandibular opening in representative Case 3, a 17 y.o. female (Patient 6 in Table 1), showing the results of a single laser session, and the findings on the following week.

It has been confirmed, both from subjective comments by patients and by palpation of the affected area by the surgeon before treatment of most TMDs, that muscle groups in the affected area are often hard, tense, and tender, and this degree of muscle hardness ahs been recognized as a quantitative measurement of the degree of TMD[4]. It has also been demonstrated by Kitagawa et al. that softening of these overtense and hard muscles occurs after successful treatments, including LLLT, as demonstrated objectively on a muscle hardness scale, and that LLLT is also successful in ameliorating the bruxism resulting from the hypertension of the affected muscle groups[4]. LLLT has been reported before specifically for TMD-related TMJ pain, with an effective percentage of 70%.[5] However, the author reported that the TMJ pain remained relatively untreated, including trismus. The laser being used in that report was a dental pulsed Nd:YAG, applied in the defocused mode, delivering an incident energy density per point of approximately 18 J/cm^2. This is considerably lower than our maximum of 44 J/cm^2, and we also feel that the wavelength-related penetration and absorption patterns are better for 830 nm than for 1064 nm, particularly when considering increased microcirculation. That is perhaps why we had success with trismus in our patients.

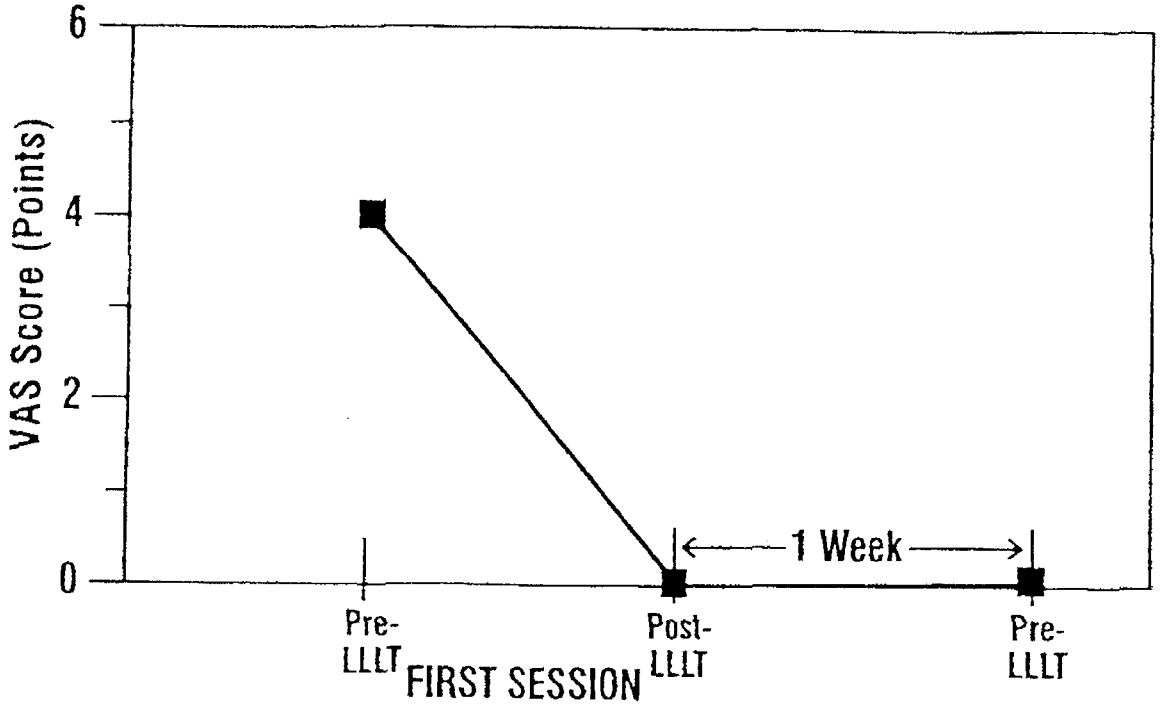

Fig 5: Changes in VAS score in representative Case 4, a 51 y.o. female, (Patient 3 in Table 1), showing the results of a single laser session, and the findings on the following week.

The authors believe that one of the principal mechanisms which brings about the softening of hypertense muscles is improvement in the microcirculation of the muscles following LLLT. Increased blood flow in dorsal flaps in the rat model has been demonstrated clearly by the authors and others following LLLT[6,7]. Other researchers have reported that blood flow and volume increased significantly in LLLT-irradiated muscles in low-back pain patients as measured by laser Doppler, and was accompanied by pain relief in the same muscles[8].

Plog reported that low incident levels of laser irradiation suppress pain as far back as 1980[9]. followed by an increasingly impressive number of publications in the peer-reviewed literature, for a vast range of pain entities. As far as TMJ pain is concerned, the improved microcirculation in irradiated muscles will help remove noxious deposits associated with hypertension of the tissues, such as lactic acid, and will also improve drainage of the muscle through enhanced lymphatic flow[10]. In addition to the blood and lymphatic microcirculatory pathway and mechanisms, other pathways have been proposed including changes in nerve transmission rates, particularly mediated by the descending inhibitory pathways, accompanied by the active synthesis of endorphins and enkephalins[11].

The authors feel however that the primary mechanism of pain suppression following diode LLLT in TMJ pain is firstly improvement of the abnormal tension in the affected muscle groups by a very rapid increase in microcirculatory flow and volume, leading to relaxation of the muscles. This will normalize intramuscular pressure on sensory nerve endings and thus relieve the pain in the muscle, before any of the other recognized mechanisms come into play.

The authors also recommend strongly that LLLT for chronic TMJ pain must be a primary therapy in a two-staged treatment, with the second stage consisting of maxillofacial or orthodontic surgical correction of the disease or condition causing the pain. However, for acute TMJ pain where there is as yet no functional or morphological abnormality, LLLT offers a safe and effective alternative to conventional analgesics in the successful treatment of this uncomfortable and often debilitating pain entitiy. The added advantages of LLLT are its ease of application, its comparatively low cost, its ability to be well tolerated by a variety of patients, and the complete lack of reported adverse side effects in over 20 years of application.

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