Rheumatoid arthritis-affected temporomandibular joint pain analgesia by linear polarized near infrared irradiation

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Purpose: To describe a new short-term treatment for pain in rheumatoid arthritis (RA)-affected temporomandibular joint (TMJ).

Clinical features: We investigated four female patients (age 42.8 ± 26.0 yr) with chronic rheumatoid arthritis affecting a single TMJ. Patients had received antirheumatic drugs such as sodium aurothiomalate, and as a result showed no symptoms in other body joints.

Linear polarized near infrared radiation using Super Lizer™ was applied weekly with and/or without jaw movement to the unilateral skin areas overlying the mandibular fossa, anterior articular tubercle, masseter muscle and posterior margin of the ramus of the mandible. The duration of irradiation to each point was two seconds on and ten seconds off per cycle and the intensity at each point was approximately 138 $J \cdot cm^{-2}$ at a wavelength of 830 nm.

Interincisal distance was measured with maximal mouth opening in the absence and presence of pain before and after each treatment. Additionally, subjective TMJ pain scores assessed using a visual analog scale were performed for painful maximal mouth opening before and after each irradiation.

TMJ pain disappeared after only four treatments. Moreover, painless maximal mouth opening without pain after irradiation in three patients was on average improved to 5.3 ± 2.1 mm. However, one case was observed where the opening length prior to irradiation did not improve, despite the fact that the RA-affected TMJ pain had disappeared.

Conclusion: Application of linear polarized near infrared irradiation to patients with RA-affected TMJ pain is an effective and non-invasive short-term treatment.

Objectif : Décrire un nouveau traitement de courte durée pour la douleur de l'articulation temporo-mandibulaire (ATM) affectée par la polyarthrite rhumatoïde (PAR).

Éléments cliniques : Nous avons évalué quatre femmes (42,8 ± 26,0 ans) souffrant de polyarthrite rhumatoïde touchant une seule ATM. Les patientes ont reçu un traitement antirhumatismal comme l'aurothiomalate de sodium qui n'a pas affecté d'autres articulations.

Des radiations linéaires polarisées dans le proche infrarouge ont été appliquées à l'aide du Super Lizer™, une fois par semaine avec ou sans mouvement mandibulaire, sur les zones cutanées unilatérales sus-jacentes à la cavité glénoïde du temporal, au tubercule articulaire antérieur, au muscle masséter et au bord postérieur de la branche montante de la mandibule. La durée de la radiation était, à chaque point, de deux secondes suivies d'un arrêt de dix secondes par cycle et d'une intensité d'environ 138 $J \cdot cm^{-2}$ selon une longueur d'onde de 830 nm.

La distance intermaxillaire a été mesurée lors de l'ouverture maximale de la bouche en l'absence et en présence de douleur avant et après chaque traitement. De plus, les scores subjectifs de douleur à l'ATM ont été enregistrés à l'échelle visuelle analogue lors de l'ouverture maximale de la bouche avant et après chaque irradiation.

La douleur de l'ATM est disparue après quatre traitements seulement. De plus, l'ouverture maximale de la bouche sans douleur à la suite de l'irradiation a été améliorée chez trois patientes selon une moyenne de 5,3 ± 2,1 mm. Cependant, dans un cas, l'ouverture précédant l'irradiation ne s'est pas améliorée malgré le fait que la douleur de l'ATM liée à la PAR avait disparu.

Conclusion : L'application de radiations linéaires polarisées dans le proche infrarouge à des patients affectés par des douleurs à l'ATM, influencées par la PAR, constitue un traitement de courte durée, efficace et non effractif.

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SYMPTOMS of rheumatoid arthritis (RA)-affected temporomandibular joint (TMJ) include restricted jaw movement and pain in the TMJ area associated with mouth opening. Current management of temporomandibular disease (TMD), as with RA, includes physiotherapy, drug medication, occlusal therapy, injection therapy, surgery and psychotherapy. In general, it takes a long time to improve symptoms of TMD, and no specific short-term effective treatments have been established. Near infrared irradiation improves the symptoms of RA in other RA-affected joints.[1] No studies have investigated RA-affected TMD. In the present pilot study, the first light therapeutic device to provide a linear polarized near infrared ray was used to improve the symptoms of TMD in patients with RA. The patients were effectively relieved from arthralgia of TMD after receiving only four weekly treatments. The data were represented as means ± standard deviation (SD).

Case report

We enrolled four female patients (age 42.8 ± 26.0 yr) presenting with chronic rheumatoid arthritis affecting a single TMJ to ensure an equal exposure time of irradiation. This pilot therapy conformed to the ethical standards set out in the Declaration of Helsinki and was performed after patients gave informed consent. Patients received antirheumatic drugs such as sodium aurothiomalate, and as a result showed had no symptoms in other body joints. Patients complained of pain from the unilateral TMJ area associated with jaw movement. The painless maximal mouth opening length was 31.5 ± 6.2 mm, and the painful maximal mouth opening capacity was 34.5 ± 6.5 mm. The observed interincisal distances were shorter than for healthy women.[8] Magnetic resonance imaging of the affected side of TMJ revealed anterior displacement of the articular disk with joint effusion and deep erosion in the mandibular condyle.

The Super Lizer™ (HA-550 of KSK Tokyo Iken, Japan) uses the latest in optical electronics technique, such as a superiodine lamp for light generation and an optical fibre for the light path to emit a near infrared ray (Figure 1). The Super Lizer™ is the first linear polarized light therapeutic equipment with a wavelength of 600 to 1600 nm (Figure 2). At the above wavelengths, the infrared rays are not readily reflected, dispersed or absorbed at the surface of the body and are thus capable of reaching the deeper tissues.[2] The maximum power output is 1800 mW at a wavelength of 830 nm and is approximately 20 times as high as that of gallium aluminum arsenide (GaAlAs) 830 nm diode lasers. This high energy light is partially converted to thermal energy and thus produces a warm sensation.

The irradiation points used included the skin areas of the unilateral RA-affected TMJ, the mandibular fossa where the patients were suffering pain, the anterior articular tubercle where the mandibular condyle slides, the middle portion of the masseter muscle and the posterior margin of the ramus of the mandible related to the jaw movement (Figure 3). The duration of irradiation to each point was two seconds on and ten seconds off per cycle. Initially, with the patient's mouth closed the four points were irradiated in 15 cycles. Next, with the patient opening the mouth maximally for 12 sec, the four points were again irradiated. Then, with the patient's mouth closed for 12 sec, the four points were irradiated. A series of patterns of irradiation was performed in eight cycles as shown in Figure 4 with the intensity at each point being approximately 138 $J \cdot cm^{-2}$ at a wavelength of 830 nm. These irradiation treatment regimens were performed once a week.

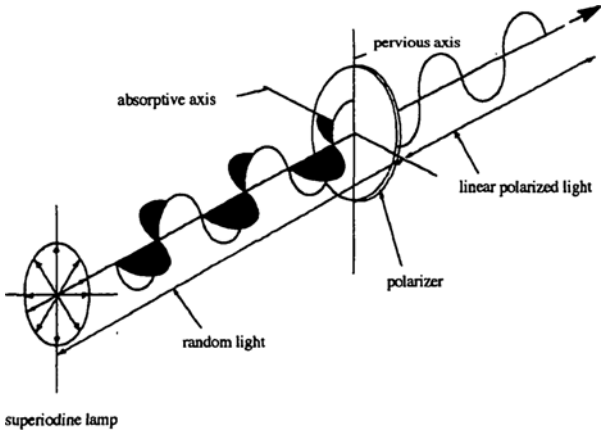

FIGURE 1 The structure of Super Lizer™

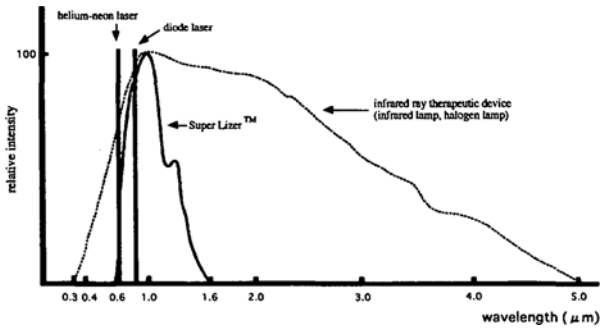

FIGURE 2 A unique characteristic wavelength of Super Lizer™

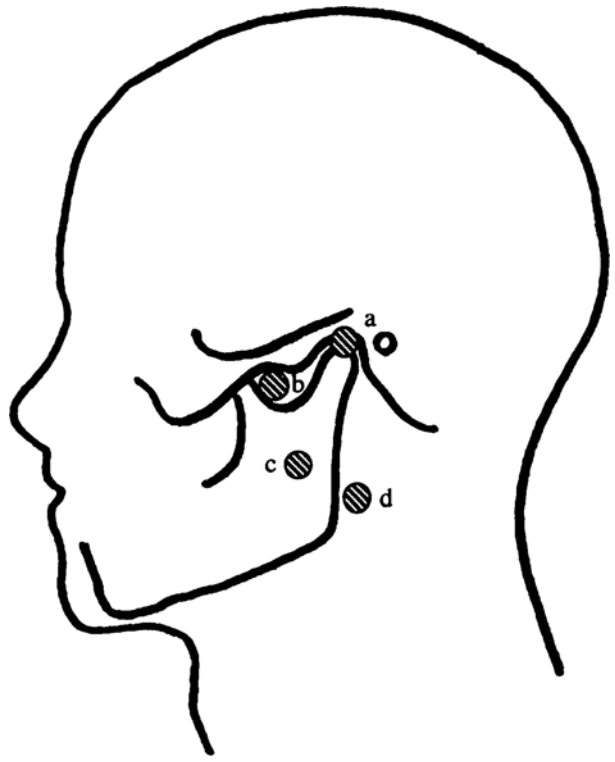

FIGURE 3 The points where the probe was placed over a) the mandibular fossa, b) the anterior articular tubercle, c) the middle part of the masseter muscle and d) the posterior margin area of the ramus of the mandible.

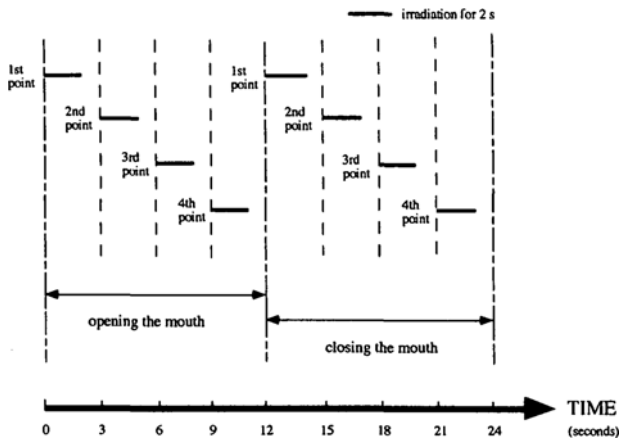

FIGURE 4 Schematic diagram of the pattern of irradiation with jaw movement in a cycle.

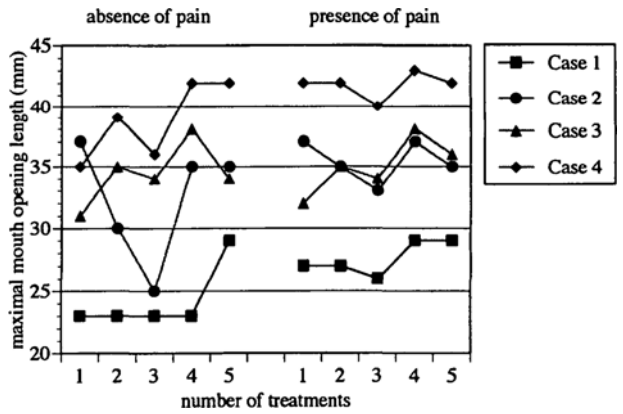

FIGURE 5 Fluctuations in maximal mouth opening lengths before treatment in the absence and presence of unilateral temporomandibular joint pain.

Reduced maximal mouth opening capacity, maximal protrusion, lateral movements of the mandible and pain in the TMJ area proved to be reliable predictors of TMJ involvement. Accordingly, the interincisal distance was measured with maximal mouth opening in the absence and presence of pain before and after each treatment. Additionally, subjective TMJ pain scores assessed using a visual analog scale (VAS) were done to assess painful maximal mouth opening before and after each irradiation.

Painless maximal mouth opening lengths prior to treatment at the fifth visit in case # 1, 3 and 4 were 5.3 ± 2.1 mm longer than at the first visit. In contrast, mouth opening in case # 2 was 2 mm shorter than at the first visit (Figure 5). Four patients showed three instances each of improvements in painless maximal mouth opening as a result of our pilot treatment. The average painless maximal mouth opening lengths after treatment for all cases was 5.3 ± 4.4 mm longer than prior to treatment (Figure 6). However, these improvements were not sustained until the next visit.

Painful maximal mouth opening capacity at the fifth visit in cases # 1, 3 and 4 was on average 2.0 ± 2.0 mm longer than it was at the first visit. Mouth opening in case # 2 was 2 mm shorter at the first visit (Figure 5). Improvements in maximal mouth opening of several millimeters were considered very small and likely not clinically important. The average painful maximal mouth opening capacity after each treatment for all cases was 3.5 ± 3. 1 mm longer than it was prior to each treatment (Figure 6). However, these improvements were not sustained until the next visit.

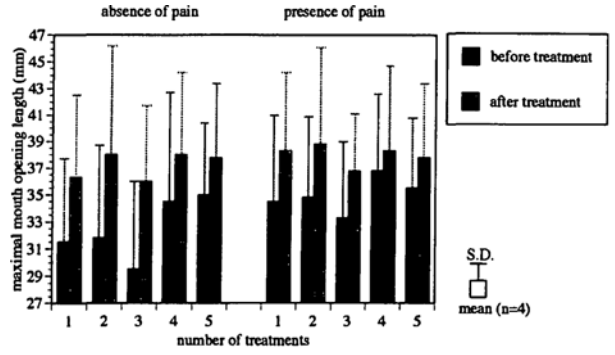

FIGURE 6 Fluctuations in maximal mouth opening lengths in the absence and presence of temporomandibular joint pain before and after treatment.

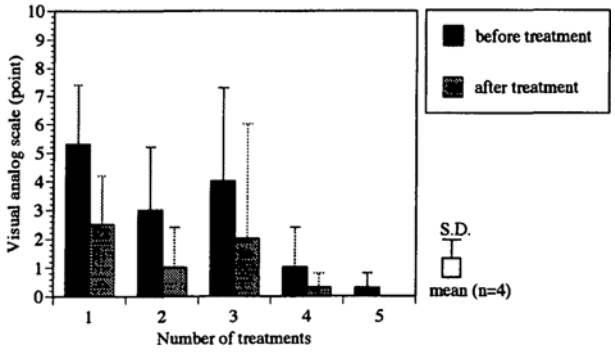

FIGURE 7 Fluctuations in the pain scores with painful maximal mouth opening in unilateral rheumatoid arthritis-affected temporomandibular joints.

All patients there complained of moderate pain (5.3 ± 2. 1 points) associated with jaw movement in the unilateral mandibular condyle area but reported being free of pain in other areas at lst visit. Average pain scores for all cases at painful maximal mouth opening when assessed using the VAS method after each treatment decreased by 2.4 ± 1.8 points relative to scores prior to treatment. Although this improvement was not sustained for a long period of time, pain scores prior to treatment decreased by degrees with the fifth arrival values of VAS being 0.3 ± 0.5 (Figure 7). From that point on, sustained relief has continued for one year without any treatment. Our treatment had an analgesic effect on RA-affected TMJ pain in the short term.

There were no complications in our treatment.

Discussion

The present pilot study involved the first application of linear polarized near infrared ray irradiation to RA-affected TMD patients. An advantage of the present method is that the probe used focuses the light beam to a diameter of 10 mm, enabling it to irradiate a broader region of the joint than the probe of conventional low-power lasers which focus on a diameter of approximately 1 mm. Additionally, no complications were observed in any of the patients irradiated. However, as Super Lizer™ emits a high energy light, there is a greater risk of creating a tingling sensation or of burning the skin when irradiating continuously for more than three seconds at the maximum power output of 1800 mW than there is with low-power lasers.

The present method treatment was effective for treating arthrogenous TMJ pain but did not result in any marked improvements in painful maximal mouth opening capacity. Conti demonstrated that the irradiation using a GaAlAs 830 nm laser applied to non-RA-affected TMD patients improved myogenous pain but did not lead to any marked improvement in arthrogenous pain.[4] Thus, some differences are evident in the mechanism of RA- affected TMJ pain relief between Super Lizer™ and other diode lasers. Super Lizer™ emits not only linear polarized near infrared ray but thermal energy. Low-power laser irradiation was shown to decrease sensory nerve conduction velocity and to attenuate the response of dorsal horn neurons to formalin.[5,6] Therefore, Super Lizer™ may have the same light action as low-power lasers. In terms of the thermal action on analgesic relief of pain, Carpenter showed that thermal energy had an influence on neuronal membrane potential.[7] Additionally, Bellometti and Galzigna showed that thermal mud pack therapy using simple methods of applying heat decreased prostaglandin (PGE2) and leukotriene (LTB4) serum levels in osteoarthrosis. Thus, they concluded that this therapy induced pain relief by reducing the inflammatory reaction.[8] Hence, the heat action of Super Lizer™ can be a potential etiologic mechanism for relief from the RA-affected TMJ pain in short-term treatment.

Although painless maximal mouth opening length was improved markedly using Super Lizer™ in three patients, painful maximal mouth opening capacity was not maintained. An inconsistent relationship was observed between pain scores and painful maximal mouth opening capacity. These results may be related to a degeneration of the joints such as deep erosion of the mandible condyle. Painless and painful maximal mouth opening lengths after each treatment increased, and this increase was associated with an alle-

viation of TMJ pain, but these improvements were not sustained over a long period. Asada *et al.* irradiated using a GaAlAs 830 nm diode laser in the treatment of RA and obtained a marked alleviation of pain in 59.6% of RA-affected joints immediately after treatment.[9] The light and thermal actions of Super Lizer™ can contribute to these temporary immediate improvements. However, a potential exists for an experimental bias and a placebo effect given that all patients were aware that they were receiving a novel treatment for TMD. Further studies involving a random double trial are needed to clarify the precise mechanism of TMJ pain relief using Super Lizer™.

Conclusions

Our treatment in this pilot study involving use of Super Lizer™ provided relief from the RA-affected TMJ pain over a period of four weeks without complications. Additionally, there was a marked improvement in maximal mouth opening capacity. The present findings suggest that both the light and thermal actions of Super Lizer™ may contribute to relief from the RA-affected TMJ pain in short-term treatment.

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