CLINICAL APPLICATION OF GaAlAs 830 NM DIODE LASER IN TREATMENT OF RHEUMATOID ARTHRITIS

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The authors have been involved in the treatment of rheumatoid arthritis (RA), in particular chronic poly-arthritis and the associated pain complaints. The biggest problem facing such patients is joint contracture, leading to bony ankylosis. This in turn severely restricts the range of motion (ROM) of the RA-affected joints, thereby seriously restricting the patient’s quality of life (QOL). The authors have determined that in these cases, daily rehabilitation practice is necessary to maintain the patient’s QOL at a reasonable level. The greatest problem in the rehabilitation practice is the severe pain associated with RA-affected joints, which inhibits restoration of mobility and improved ROM. LLLT or low reactive level laser therapy has been recognized in the literature as having been effective in pain removal and attenuation. The authors accordingly designed a clinical trial to assess the effectiveness of LLLT in RA-related pain (subjective self-assessment) and ROM improvement (objective documented data). From July 1988 to June 1990, 170 patients with a total of 411 affected joints were treated using a GaAlAs diode laser system (830 nm, 60 mW CW). Patients mean age was 61 years, with a ratio of males: females of 1:5:25 (16%:84%). Effectiveness was graded under three categories: excellent (remarkable improvement), good (clearly apparent improvement), and unchanged (little or no improvement). For pain attenuation, scores were: excellent—59.6%; good—30.4%; unchanged—10%. For ROM improvement the scores were: excellent—12.6%; good—43.7%; unchanged—43.7%. This gave a total effective rating for pain attenuation of 90%, and for ROM improvement of 56.3%.

KEY WORDS: GaAlAs diode laser, Rheumatoid arthritis, Pain, Rehabilitation

Introduction

Arthralgia is closely related to malfunction of joints in rheumatoid arthritis. Synovitis, one of the main lesions, causes inflammatory pains which, in combination with spasmus in periarticular muscles, lead to immobility of the unused joint, and adhesion of tissues in the joint induced by inflammation, which in turn leads to ankylosis, joint laxity, and bony ankylosis. In addition, disused joints induce atrophy in periarticular muscle and bone, leading to osteoporosis, and finally resulting in destruction of the joints. Eventually, complete articular dysfunction, such as typical permanent deformation and bony ankylosis, is caused.

It is very important in inflammatory arthropathy to ensure the mobile range of the affected joint by continuous movement. However, pains in movement impede daily rehabilitation. Therefore, it is a major problem in daily treatment of rheumatoid arthritis to remove pains for acceleration of rehabilitation. We used a diode laser system for patients with rheumatoid arthritis and found its analgesic effects satisfactory and useful for rehabilitation.1

Patients and Methods

A diode laser system (Luketron®, Figure 1) was used for treatment of outpatients visiting our clinic. The system emits a 60 mW continuous wave beam at a wavelength of 830 nm in the near infrared. The system emits laser beam only when the tip of the probe is brought into contact with patient’s skin, with a touch sensor on the tip designed as a safety lock against error emission, and simultaneously sound an alarm to indicate laser emission. From July 1988 to May 1990, 411 joints of 170 patients with mean age of 61 years (33 to 80) were treated: rheumatoid arthritis in 370 joints of 147 patients, post-total hip replacement in five joints, tennis elbow in four joints, frozen shoulder in eight joints, and traffic trauma in eight joints. From the study of rheumatoid arthritis, joints at stage IV of bony ankylosis were excluded because they were so immobile as to receive no benefit from rehabilitation.

The probe of the laser system (Figure 2) was placed exactly on a tender point in affected joints located by palpation and inquiry of the patient and
The reported pain scores were divided into three categories: 0–3, markedly effective; 4–7, effective; and 8–10, ineffective.

Mobile Joint Range (Range of Movement, ROM)

Mobility of the joint was determined in different directions before and after irradiation. The increment of mobility after irradiation was recorded at intervals of 5° and evaluated as follows: less than 5°, no effect; 10–20°, moderate effect; and more than 25°, remarkable effect.

Effect Duration

Our outpatients with rheumatoid arthritis were examined once a week. The present participants were asked how long (hours or days) the effect of the last irradiation continued on the first visit after the irradiation to elicit the duration of the therapeutic effect.

Differences in Therapeutic Effect Between Operators

A second-year resident (operator A) first carried out irradiation at affected joints and the effect was evaluated. And then an orthopaedist of 25-years experience (operator B) performed the irradiation at the same joints to evaluate the effect in the same way. The effects obtained by the former were compared with those by the latter.

Use of Placebo

The diode laser system we used was designed to confirm laser emission by sound. To investigate secondary effects of the sound and pressure of the probe, a probe (placebo probe) was designed to use under the same conditions excluding unavailability of laser from a counterpart channel. The placebo probe was used at a unspecified time in a series of treatments in the same patient to evaluate its immediate effect and duration of the effect.

Results

(1) Figure 3 shows pain scores in all cases after treatment. Pain scores of less than 5 marks, that is, pain removal by a half or more, were obtained in many cases.
(2) Three-level evaluation indicated that the treatment was effective in 90% of the cases (markedly effective and effective cases) (Figure 4).
(3) Pain scores were evaluated at three levels in affected joints. The treatment with the system

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more frequently showed remarkable effect in knee joints that other joints.

(4) Mobility was little or not improved (improvement by 5° or less) in about 40% of 128 joints. Pain removal was not in parallel with improvement of joint mobility (Figure 6).

(5) The improvement was evaluated at three levels (Figure 7). The effective rate was 59.7%, with significant difference from the rate of effective pain removal. Mobility of joints was not so improved in spite of satisfactory pain removal in many cases (Figure 7).

(6) Patients successively treated with the system were followed.

Case 1—a woman with rheumatoid arthritis of 64 years old and had pain and limited motion of the right knee joint. Laser irradiation for 15 s was carried out at three tender points for five successive weeks. The motion range of the knee joint recovered to 130° with improvement of the pain score to 2 marks in week 5 (Figure 8).

(7) The therapeutic effect was maintained for longer periods of 6 h to 3 days in more cases and for 7 or more days in 38% of the cases with mean duration of 4.5 days (Figure 9).

(8) Differences in therapeutic effect between oper-
atigators are shown in Figure 10. Pain scores were 8 for the right and left knees and the left elbow and 4 for the right elbow of an RA patient of 46 years after treatment by operator A whereas they were 1 for the left knee, 2 for the right knee and elbow, and 5 for the left elbow of the same patient after treatment by operator B. There were differences in therapeutic effect between the operators with different level of clinical experience. Similar differences were found in mean score in 18 joints of eight patients between them (Figure 11).

Overall effective rate of the placebo probe was 78.7% (Figure 12) with significant difference from that shown in Figure 3. The effect of placebo was maintained for 2.9 days, on the average, in contrast with 4.5 days with the normal probe (Figure 13).
Discussion

Treatment of pain, a main complaint of RA patients, forms a large part of daily care of rheumatoid arthritis characterized mainly by painful multiple arthritis. From the orthopaedic viewpoint, maintenance of patient’s motility and articular function and restoration from functional disturbance are also an important issue in clinical treatment. Therefore, we used a diode laser system regarded as effective for removal of pain caused by various factors in an attempt to accelerate rehabilitation. The 830 nm beam ensures deep penetration into affected tissue. The treatment with the system immediately removes pains and allows patients to realize mobility of their affected joints. Thus the treatment is expected to encourage patients and to exert good mental influence on them because they may confirm possibility to recover by rehabilitation.

However, it was found that there was marked discrepancy between incidence of therapeutic effect and improvement of articular mobility. These results were obtained in the present study although cases of bony ankylosis at stage IV were excluded. The fact suggested that organic contracture was already present at the time of treatment. Therefore, the present method can be used to evaluate severity of organic contraction.

Precise location of tender points and exact irradiation at the points are important technical problems because a probe focusing the laser beam on a smaller point is used to irradiate a broader region of a joint. In the present study, significant difference was found in therapeutic effect of treatment with the laser system for the same patient between operators of poor and considerable orthopaedic experience. Difference in skill of locating tender points seemed to contribute to the difference in the therapeutic effect. In this connection, doctors having considerable experience tended to obtain results as they were more familiar with the laser treatment.

The sound indicating emission of laser may have mentally influenced patients. In addition, we checked tender points by pressing with the tip of the probe and the pressure may have finger-pressure therapeutic effect. So, placebo effects of the sound and pressure were examined as mentioned above. Although the placebo effects were found in pain score and duration of therapeutic effect, they clearly differed from the effects obtained by actual emission of laser (Figures 12 and 13).

Conclusion

The diode laser system has been commonly accepted as an excellent treatment device because of its excellent effect of removing pains, simple operation, and safety. The authors have used the system to treat arthralgia in outpatients with rheumatoid arthritis and to secure and improve articular mobility as a part of daily rehabilitation, and described results of the treatment with the system.

The treatment was effective in 90% of the cases, based on pain scoring, whereas it improved articular mobility only in 59.7% of them.

Pain was removed by the treatment for 2 to 3 and 7 or more days in many cases.

Therapeutic effects by clinical experience of operators were investigated to find technical problems in clinical treatment. Precise location of tendon points was important to improve clinical results.

Finally, study of placebo effects indicated usefulness of the treatment.

References