Elastic Bandages and Intermittent Pneumatic Compression for Treatment of Acute Ankle Sprains

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ABSTRACT. Airaksinen O, Kolari PJ, Miettinen H: Elastic bandages and intermittent pneumatic compression for treatment of acute ankle sprains. Arch Phys Med Rehabil 71:380-383, 1990.

• The efficacy of elastic bandage alone and with intermittent pneumatic compression (IPC) treatments in the rehabilitation of 44 acute ankle sprains \vas studied. Lower-leg dysfunction was assessed by measurements of edema, degree of ankle motion, pain, and limb dysfunction when the patient was first included in the study, after treatment for one week, and after a four-week follow-up. For all the parameters studied, elastic bandage with IPC treatment resulted in highly significantly (p<0.001) faster rehabilitation during the four-week follow-up than did elastic bandage treatment alone. The limb dysfunction improved significantly (/)<0.01) during the follow-up on the study group receiving IPC with elastic bandage compared to elastic bandage alone. The results suggest that IPC treatment is effective in acute posttraumatic therapy.

KEY WORDS: Ankle; Edema; Pain

Inversion ankle sprains are among the most common injuries seen in physically active people, and typically occur when the foot is stressed in a plantar-flexed and inverted position.'"-" Early mobilization is recognized as an effective method of treatment for lateral ankle ligament tears/ " Therapy often includes use of elastic bandages together with early mobilization/-^

Intermittent pneumatic compression (IPC) has been used to treat lymphatic and vascular disorders for more than 40 ycars.^"" In previous studies we have found that IPC was effective in reducing chronic posttraumatic edema and in relieving pain after removal of a cast/'-'- Starkey'^ successfully used IPC and cold packs to treat acute ankle sprains; however, the efficacy of IPC in such therapy has not been well studied.

The aim of this study was to evaluate conservative elastic bandage treatment alone and with IPC therapy for the rehabilitation of acute ankle sprains. A novel pulsatile IPC system was used for therapy.'" Measurements of lower-leg edema, the degree of ankle motion, subjective assessments of pain, and limb function were used as evaluation criteria.

MATERIAL AND METHODS

Ankle sprain was defined as a lesion resulting from an inverting injury, with edema and pain at the lateral ankle joint but with no fractures apart from small avulsions. The patients were examined by a surgeon, and x-ray pictures were taken to evaluate for talar tilt and ligament stability. The criteria for acceptance into the control or study group were (1) injury that had occurred not more than 24 hours earlier; (2) no other acute or chronic immobilizing lesion; (3) no combined clinical adduction instability; (4) age 15 to 50 years; (5) consent to come for the follow-up examination; and (6) no other treatment. All subjects in our study had a stable ankle sprain involving marked edema and dysfunction.

Subjects. The study consisted of 44 patients who were randomized into two groups. The control group consisted of 22 patients (ten female and twelve male), whose mean age was 31.6 (SE ±2.2) years. The study group also had 22 patients (eight female and 14 male), with a mean age of 32.1 (SE ± 1.8) years. The control group wore elastic bandages during the follow-up. Elastoplast[a] bandages were used. The study group received intermittent pulsatile pneumatic compression therapy, and they wore elastic bandages between treatment sessions.

Intermittent compression. The IPC treatment was given with a novel Ventipress device (model 24)[b] daily.[14] This system produces.a proximally moving pressure wave from the toes up to knee level. The pressure first increases rhythmically in the foot and ankle region, simulating the function of the muscle pump. The compression then moves up the limb gradually. The deflation acts in the reverse direction. Compression pressure of 60mmHg for 30 minutes was used. The variable inflation period was set at 30 seconds. The deflation time, too, was set at 30 seconds. During inflation the pressure on the boot was set to reach up to 60mmHg. Immediately after the preset pressure level was obtained, the deflation started and pressure decreased exponentially, being at the end of deflation time zero. During deflation, skin is air ventilated, with an inner disposable hygienic bag, to remove sweat moisture. The ventilation air was not cooled. The IPC treatments were given once per day for five consecutive days.

The lower-leg volume of the affected leg and of the healthy contralatcral leg was measured by water plethysmography." The volume of edema was defined as the difference between the volume of the affected leg and the contralateral leg.

The degree of ankle motion was measured in the flexion-extension direction using an OB "Myrin'"[c] goniometer.[t] Sub-

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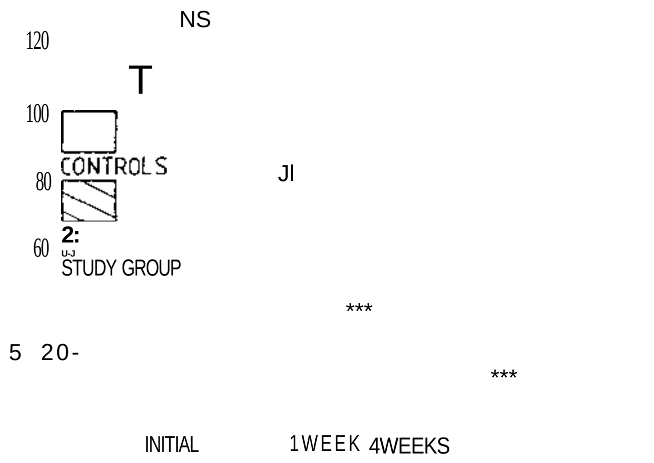

Fig 1 —Changes in lower-leg edema in the control group treated with elastic bandage and in the study group treated with elastic bandage and pulsatile intermittent pneumatic compression therapy (*/?<0.001).**

jective experience of pain and subjective discomfort were measured using the 100mm Visual Analogue Scale (VAS).[15] Ankle joint mobility, pain, and subjective discomfort were evaluated as the differences in mobility, pain, and subjective discomfort before and after the treatment sessions. The patients were also asked to record limb function using the 100mm VAS scale with full function equal to zero and complete dysfunction equal to 100. The control patients were followed for the same period as those receiving the IPC therapy.

For reliability of the measurements of the leg volume and the ankle joint mobility, 20 healthy subjects (ten male and ten

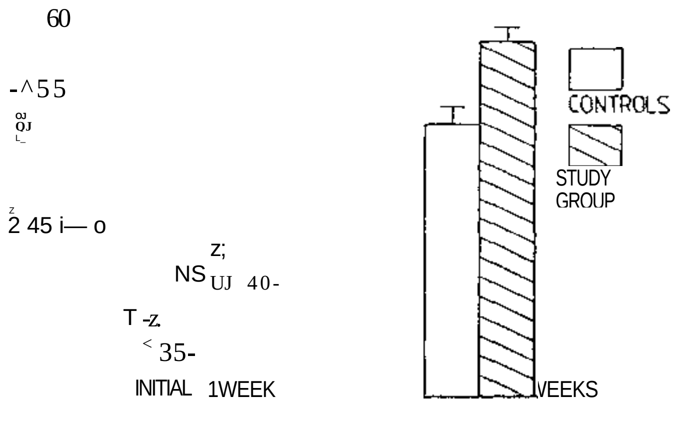

Fig 2—Posttraumatic degree of ankle motion in the control group treated with elastic bandage and in the study group treated with elastic bandage and intermittent compression *(*p<* 0.001).**

female, mean age 30.1 SE ±1.2 years) were studied ind pcndently by two different persons. The measurements we made exactly the same way as described above.

The results are expressed as the mean ± standard err (SE). Statistical analysis was performed using the student test for group comparisons and for paired observations. Chans in pain scores were tested using the nonparametric Krusk; Wallis test." Variances were tested using the F-test.[16] Stat tical significance was set at a two-tailed level of p<O.C Results not significant have been denoted as NS.

RESULTS

In the measurements of the healthy persons the volumes the two measurements by different testers were 1546 mL (SE 15) and 1543mL(SE ±16). The degrees of ankle motion we 63.5° (SE ±1.2 and 63.2° (SE ±1.4). Neither differen was statistically significant, and the coefficient of variance v, very good for both measurements. [Also, no differences we 'found between right and left sides.]

The lower-leg volume of the affected leg was 1645n (SE ± 17) and that of the contralateral healthy leg was 1540n (SE ± 17) in the control group. In the study group the volur of the affected leg was 1646mL (SE ±20), that of the healt leg 1535mL (SE ±22). The volume of edema was defined the difference between the affected leg and the contralatei leg. Thus, the initial volumes of edema were 105mL (SE ± and 109mL (SE ±11) in the control and study groups, r spectively (fig 1). In the control group, the decrease in eden was highly significantly exponential with time during the foi week follow-up ($r = 0.997$, $p<0.001$). In the study group, eden decreased markedly faster. After five IPC treatment session the volume of edema was only 33mL (SE ±6) in the stuc group, as compared to 80mL (SE ±7) among the contra ($p<0.001$). Also, after the four-week follow-up, the stuc group had highly significantly less edema than did the contr group (;;<0.00f). " •

Initial posttraumatic range of ankle motion was 36° (S ± 1.3) in the control group, and 39° (SE ±1.8) in the stuc group. Ankle motion improved markedly more in the stuc group given the IPC treatment than in the control group (fi 2). The difference between the two groups was highly signi icant after one week of treatment ($p<0.001$). In addition, tr degree of the ankle motion was still highly significantly bettt in the study group after the four-week follow-up (fig . p< 0.001). '

Pain was assessed as being equally severe when the patieni entered the control or the study group (fig 3). After one wee of IPC therapy, pain was markedly milder in the study grou than in the control group receiving only bandage treatmet ($p<0.001$). At four-week follow-up, the patients of the stud group experienced only a minor residual pain of 2mm (SE : 1). This was significantly less than the pain still experience by the patients of the control group (p<0.001).

Limb function as assessed by VAS was markedly improve after the one-week IPC treatment in the study group compare to the controls (fig 4, /?<O.OI). At the four-week follow-up limb dysfunction was minimal in the study group. This wa significantly better than in the control group.

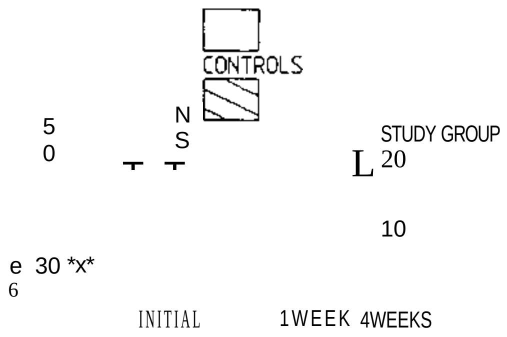

Fig 3 — Pain relief after treatment with elastic bandage and intermittent compression therapy for ankle injuries (*p<0.001).**

DISCUSSION

We compared the efficacy of elastic bandage treatment alone and with pulsatile IPC treatment for rehabilitation of the lower-leg dysfunction caused by acute ankle sprains. The measurements in our study by healthy persons showed that the methods used were valid and reliable for the evaluation of ankle volume and motion. Our results showed that IPC therapy with elastic bandage brought about better improvement in all the parameters studied than did the elastic bandage alone, which is a commonly used method for treating patients with ankle injuries.[2-7]

In conservative treatment of ankle sprains and lateral ligament ruptures, early mobilizing treatment has proved better than plaster treatment.[1-] When early mobilizing treatment is given, attention is paid to treating the inflammatory symptoms, the aim being to reduce pain and regain function as quickly as possible.[7-8] The most common problems in the rehabilitation process are edema, pain, and immobility. These problems often lead to a cycle of limb disuse and dysfunction.[2-7-KS] Earlier studies have evaluated the management of chronic dysfunction.[] Our results suggest that the same cycle may also play a role in acute injuries, although acute cases have a better spontaneous decrease in edema. Also, the type of edema (the fluid consisting of proteins) may be different in acute injuries.

Joint aspiration with the injection of local anesthetic,[21] hyaluronidase or cortisone,[5] locally applied antiinflammatory gel,[22] cooling,[5] and physiotherapy[4] have all been used together with bandage and early mobilization, and have brought about better results than treatment with bandage and early mobilization alone. There was a larger reduction in swelling in bandage-treated patients than in untreated patients, but the difference was not statistically significant.[7] Furthermore, a slightly larger proportion of bandage-treated patients was free of walking pain after four and eight days.'

The mechanism of the IPC is suggested to be multifactorial. The mechanical factor of compression-reducing edema is an important part of the influence.[2] Intermittent pneumatic compression has been shown to have vascular influences that increase venous flow in patients suffering from tibial fractures[19] and that increase tissue oxygen tension.[23] Billion[10] suggested that IPC also has reflexive vascular effects, such as changes in the tone of blood vessels after IPC therapy and similar changes in the contralateral nontreated leg. However, the effects of IPC treatment at the tissue level are poorly understood. The experimental studies of possible influences of IPC treatment in different compartments of tissues (subcutaneous, muscular, and fat) during edematous disorders of limbs are needed for better understanding of the clinical results. If the IPC has effects at the muscular level, it could also influence the metabolism of muscular tissue and washout of waste products from muscles.

Our results suggest that elastic bandage with IPC treatment is effective in decreasing edema, relieving pain, and increasing ankle joint motion after ankle sprains. All these factors improve limb function and lead to good results in the rehabilitation of ankle sprains.

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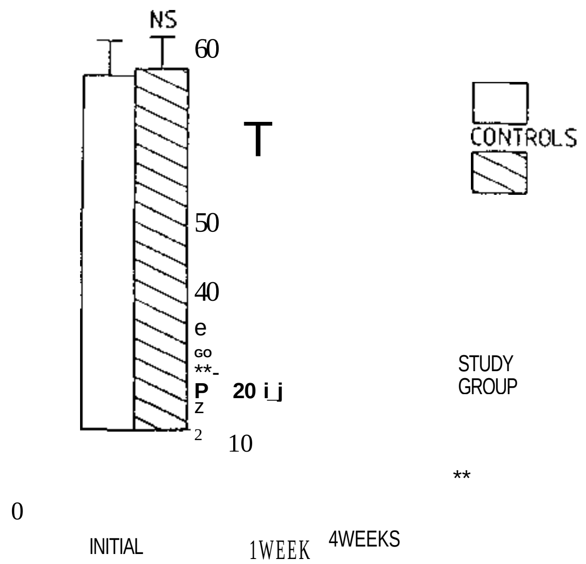

Fig 4—Assessed limb function in elastic bandage treated (controls) and in clastic bandage plus intermittent compression treated (study group) palients with ankle injuries ($p<0.01$).**

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Suppliers

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