Treatment of Soft-tissue Injuries by Pulsed Electrical Energy

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Summary

Twenty pairs of patients matched for sex, age, weight, and degree of trauma were treated either with an active Diapulse machine emitting pulsed, high-frequency electrical energy or with a non-active placebo machine. They were examined for swelling, pain, and disability before treatment and after three days under double-blind conditions. The results show that the pulsed, high-frequency electrical treatment has a definite biological effect on recently injured soft tissues, especially in the reduction of pain and disability.

Introduction

The interrelation of mechanical stress and electrical charges in collagen fibres has been examined in vitro in both tendon and bone (Fukada and Yasuda, 1957, 1964; Bassett and Becker, 1962; Bassett, 1965; Shamos and Levine, 1967) and attempts have been made to use electrical energy to stimulate the repair of collagen fibres in vivo (Ginsberg, 1961). Recently J. M. Fitton and S. Hulman (personal communication, 1971) reported favourably on a subjective trial of pulsed, high-frequency electrical energy in the treatment of soft-tissue injuries. In view of this a double-blind trial was planned to make a statistical assessment of this treatment in patients suffering from a recent sprain of the lateral ligaments of the ankle joint.

Patients and Method

Patients who had sustained an inversion injury of the ankle during the preceding 36 hours were examined physically and radiologically to exclude a bony injury or a ligamentous instability of the ankle. They were then graded for swelling, pain, and disability and paired for age, weight, sex, and degree of injury.

Diapulse machines were used to give the patients pulsed, high-frequency electromagnetic radiation. These machines give a 975-watt emission for 65 microseconds at 27·12 megacycles with a resting interval between successive pulses of 1,600 microseconds. Patients received continuous treatment for one hour and were treated daily for three days. After each treatment crêpe bandages were applied from the toes to the calf and the patients were given walking instruction and exercises by an experienced physiotherapist.

DETAILS OF DOUBLE-BLIND TRIAL

Six Diapulse machines were used, designated by random letters from the alphabet and arranged in three pairs. A fuse was removed from one of each pair of machines so as to have one functional and one placebo machine in each pair. The code indicating which machines were functional was placed in a sealed envelope by the electrician and it was not opened until the trial had been completed. Patients receiving treatment from a Diapulse machine are not aware of any sensation as there is no heating of the tissues. Thus neither the patients nor the clinician who examined them knew which patients had received electrical treatment and which had the placebo.

GRADING OF PATIENTS' SIGNS AND SYMPTOMS

Patients were examined before treatment on the first day and after treatment on the third day, and on each occasion were graded on a 0-4 scale for swelling, pain, and disability (TableI).

TABLE I—*Numerical Grading of Signs and Symptoms*

Signs	Grade	Symptoms
Swelling	0	No increase of ankle circumference compared with uninjured ankle
	1	Increased circumference of 0-½ in (1·3 cm)
	2	Increased circumference of ½-1 in (1·3-2·5 cm)
	3	Increased circumference of 1-1½ in (2·5-3·8 cm)
	4	Increased circumference of over 1½ in (3·8 cm)
Pain	0	No pain
	1	Pain only after walking some distance
	2	Pain on taking even one step
	3	Pain when at rest on couch
	4	Pain severe enough to require analgesics
Disability	0	No disability
	1	Walks with slight limp
	2	Walks with considerable difficulty
	3	Can walk only with help of supporting arm
	4	Cannot walk at all

Results

The scores of the 20 placebo patients (Table II) and the 20 treated patients (Table III) in each of the measured categories of swelling, pain, and disability were added together. In each category the percentage improvement in the treated patients was about twice that of the placebo patients.

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TABLE II—*Total Grades of 20 Placebo Patients*

	Swelling	Pain	Disability	Total
Before treatment first day ..	38	37	41	116
After treatment third day ..	26	25	23	74
Percentage improvement ..	31·6	32·4	43·9	36·2

TABLE III—*Total Grades of 20 Treated Patients*

	Swelling	Pain	Disability	Total
Before treatment first day ..	38	43	46	127
After treatment third day ..	14	11	6	31
Percentage improvement ..	63·2	74·4	86·9	75·6

STATISTICAL ANALYSIS

With a non-sequential method of analysis the Diapulse treatment was found to be significantly preferable to the placebo treatment on all four counts—that is, swelling, disability, pain, and total scores.

A Bross plan B chart for sequential analysis of matched pairs was used and Diapulse was found to be a preferable treatment compared with placebo, statistically speaking, with respect of improvement in disability scores, pain scores, and total scores. No significant difference between the two groups was found as regards improvement in swelling scores, although the trend of results seen looked likely to produce a significant result, given more results.

The outcome of awarding a positive sign when the treated patient's progress was better than his or her matched pair and a negative sign when the placebo patient made more progress is shown in Table IV. No sign was awarded when there was no clear preference between the two patients. The P values in all four categories are less than 0·05.

TABLE IV—*Results of Treatment in 20 Matched Pairs of Patients*

	No. Positive	No. Negative	P Value
Swelling	9	2	0·033
Disability	12	2	0·006
Pain	13	1	0·002
Total Scores	13	2	0·011

Discussion

This investigation shows that so far as sprained ankles are concerned pulsed, high-frequency electrical treatment has a biological effect on recently-injured soft tissues. This is particularly noticeable in the reduction of pain and also disability. The treatment is time consuming, however, both for the patient and for the physiotherapist and it is probably not justified in treating minor sprains where the patient can walk on the ankle after the application of an adhesive bandage, but for the patient who is more severely injured it has been shown to be a valuable method of treatment.

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