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Periarthritis of the shoulder

Trial of treatments investigated by multivariate analysis

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Periarthritis of the shoulder remains one of the commonest rheumatic disorders in general practice. Its pathogenesis is mysterious and its treatment empirical. Suggested treatments have included radiotherapy (Coventry, 1953; Steinbrocker, Neustadt, and Bosch, 1955), ultrasonic therapy (Fransway, 1960), local injections of hydrocortisone (Murnaghan and McIntosh, 1955), heat (Thompson, 1962), short-wave diathermy (Dickson and Crosby, 1932; Levy and Boas, 1938), exercises (Coventry, 1953), gentle traction (Burt, Fletcher, Kininmonth, and Mattingly, 1955), pressure over sensitive points (Levy and Boas, 1938), massage (Thompson, 1962), corticosteroids (Coventry, 1953), ACTH (Solomon, Carp, Berkowitz, Spitzer, Silver, and Steinbrocker, 1951), distension during arthrography (Andren and Lundberg, 1965), injection of trigger point (Travell, Rinzler, and Herman, 1942; Coventry, 1953), and manipulation (Haggart, Dignam, and Sullivan, 1956). The very diversity of these methods casts doubt on the efficacy of any.

The present trial was designed to show whether three treatments for periarthritis of the shoulder (namely hydrocortisone to the joint and exercises, hydrocortisone to the bicipital tendon and exercises, and heat and exercises) were superior to an analgesic control.

The effect of three different methods of treatment on the shoulder movement of such patients was compared with that of analgesics only. Component analysis was used to determine the significance of the changes in movement.

METHODS OF TRIAL

The patients were allotted to one of the four treatment groups, and the following measurements were recorded: active abduction, passive abduction, internal rotation, and external rotation. The detailed description of the exercise regimes and the methods of measurement are given elsewhere (Lee, Haq, Wright, and Longton, 1973). For the treated groups the measurements were taken before treatment, and then at weekly intervals for 6 weeks. For the analgesic group one set of readings was taken at the beginning and another 6 weeks later.

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COMPARABILITY OF GROUPS

Sex Table I gives the observed number of each sex in each group together with those expected on the assumption of no difference between groups in brackets alongside. There was no significant difference between the groups ($\chi^2 = 0{\cdot}81$ on 3 degrees of freedom).

Table I *Sex of patients*

Group	*No. of patients*	*Sex*	
		Male	*Female*
Heat + Exercises	17	7(7·58)	10(9·42)
Analgesics	15	7(6·69)	8(8·31)
Hydrocortisone to the joint + Exercises	15	8(6·69)	7(8·31)
Hydrocortisone to the biceps + Exercises	18	7(8·03)	11(9·97)
Total	65	29	36

Age Table II gives the mean and standard error of age in each group. Analysis of variance showed no difference between the groups ($F = 1{\cdot}49$ on 3·61 degrees of freedom).

Table II *Mean age of patients*

Group	*Age (yrs)*	
	Mean	*Standard error*
Heat + Exercises	61·1	2·7
Analgesics	59·6	2·0
Hydrocortisone to the joint + Exercises	54·0	3·3
Hydrocortisone to the biceps + Exercises	54·7	3·2
Total	57·3	1·5

Duration of condition In view of the occasional patients who had had the condition for 5 years or more and quite a number for less than 3 months, the comparison is presented in groups rather than as mean duration (Table III). Again there was no difference between the groups ($\chi^2 = 5{\cdot}53$ on 6 degrees of freedom).

Table III *Duration of condition*

Group	*Duration (mths)*		
	< 3	*3–< 1 yr*	*1 yr+*
Heat + Exercises	4(5·23)	8(7·58)	5(4·18)
Analgesics	4(4·62)	9(6·69)	2(3·69)
Hydrocortisone to the joint + Exercises	5(4·62)	4(6·69)	6(3·69)
Hydrocortisone to the biceps + Exercises	7(5·54)	8(8·03)	3(4·43)
Total	20	29	16

Table IV *Ranges of variables (equal 5 parts of range found) in degrees*

Movement	*Very low*	*Low*	*Medium*	*High*	*Very high*
Abduction					
Active	30–44	45–59	60–74	75–89	90–104
Passive	30–43	44–58	59–72	73–87	88–102
Rotation					
Internal	15–25	26–36	37–47	48–58	59–70
External	5–16	17–29	30–41	42–54	55–67

Table V *Comparison of variables in shoulder movement*

Comparison	*Degrees of movement*						
		Very low	*Low*	*Medium*	*High*	*Very high*	*Total*
Active abduction *v.* Passive abduction	Very low	2	2	0	0	0	4
	Low	3	10	2	1	0	16
	Medium	1	6	7	3	0	17
	High	1	1	10	3	1	16
	Very high	0	1	2	3	6	12
	Total	7	20	21	10	7	65
v. Internal rotation	Very low	3	11	3	2	1	20
	Low	3	8	4	2	1	18
	Medium	1	1	7	3	3	15
	High	0	0	5	0	1	6
	Very high	0	0	2	3	1	6
	Total	7	20	21	10	7	65
v. External rotation	Very low	1	6	2	0	0	9
	Low	3	8	8	2	2	23
	Medium	2	3	6	6	2	19
	High	1	3	1	2	2	9
	Very high	0	0	4	0	1	5
	Total	7	20	21	10	7	65
Passive abduction *v.* Internal rotation	Very low	3	8	4	3	2	20
	Low	1	6	8	1	2	18
	Medium	0	2	2	8	3	15
	High	0	0	2	2	2	6
	Very high	0	0	1	2	3	6
	Total	4	16	17	16	12	65
v. External rotation	Very low	2	3	3	0	1	9
	Low	0	9	6	5	3	23
	Medium	1	1	6	8	3	19
	High	1	3	1	0	4	9
	Very high	0	0	1	3	1	5
	Total	4	16	17	16	12	65
Internal rotation *v.* External rotation	Very low	6	3	0	0	0	9
	Low	7	10	3	2	1	23
	Medium	6	2	8	1	2	19
	High	1	3	2	1	2	9
	Very high	0	0	2	2	1	5
	Total	20	18	15	6	6	65

METHOD OF ANALYSIS

Before considering the effect of the treatments on the four measurements individually, the relationship between the measurements themselves was investigated for all the patients at the beginning of the test period. The four variables were all significantly positively correlated, especially the two abductions ($r = 0{\cdot}82$) and the two rotations ($r = 0{\cdot}64$). These correlations are illustrated in Tables IV and V. The range found for each measurement is split into five equal categories (range, active abduction 30°–104°, passive abduction 30°–108°, internal rotation 15°–70°, external rotation 5°–67°), and for each pair of measurements the number of patients in each combination of categories is given.

In these circumstances it was clear that one was not measuring four independent variables and that each variable, to some extent, measured the same thing. In this situation component analysis (Kendall, 1957) was indicated in order to calculate the linear multiple of the variables which accounted for the greatest part of the variation between the patients. This was done and a principal component (C) was computed which had 66 per cent. of the total variation. This was equal to:

$$C = (0.40 \times \text{Active abduction}) + (0.39 \times \text{Passive abduction}) + (0.53 \times \text{Internal rotation}) + (0.63 \times \text{External rotation}) - 96.98$$

As a low value of any of these four measurements meant a poor condition and a higher value an improvement, it was clear that the component had the same qualities. The component was calculated at each time for each patient.

As occasional patients were absent for some readings, it was not possible to compare directly the component at different times by averaging all the values of patients at one time with the average at another time as this would have led to a biased result. Instead the average change in the value of the component for each treatment between successive pairs of times was calculated. The cumulative effect of these changes are shown in Fig. 1. In the graph the initial average was set at zero and, *e.g.* for heat and exercise, since the average change from Time 0 to 1 was 9·6 and from Time 1 to 2 was 3.0, the reading at Time 2 is given as 12·6. Similar graphs (Figs 2 to 5) were plotted for the four individual measurements separately. Analyses of variance for overall change and individual changes were also carried out for the component only as this would show up differences more easily.

Results and conclusions

From the graphs (especially Fig. 1), it would seem that, in general, from the point of view of movement, the analgesic group fared worse than any of the others,

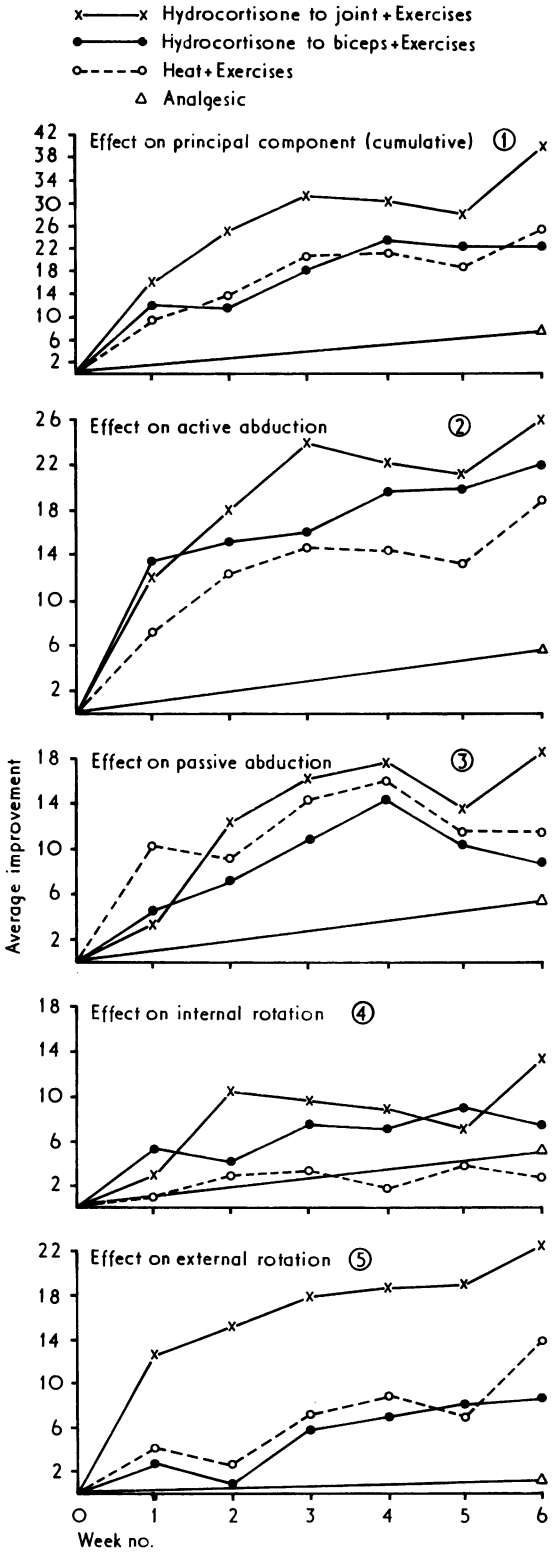

FIG. 1 *Effect on principal component of three forms of treatment compared with analgesics only*

FIG. 2 *Effect on active abduction of the shoulder of three forms of treatment compared with analgesics only*

FIG. 3 *Effect on passive abduction of the shoulder of three forms of treatment compared with analgesics only*

FIG. 4 *Effect on internal rotation of the shoulder of three forms of treatment compared with analgesics only*

FIG. 5 *Effect on external rotation of the shoulder of three forms of treatment compared with analgesics only*

and that hydrocortisone to the joint and exercise was the best of the treatments given. Analyses of variance showed that the three treatments gave significantly better results than the analgesic ($P < 0.01$), but that there was no significant difference between the three treatments. Further analyses of variance of the individual time differences for the three treatments gave only one significant result. This was a superiority of hydrocortisone to the joint between Time 1 and Time 2. This could be the point at which this treatment gains any advantage it may have over the others. It would be necessary to test more patients to ascertain with confidence whether this indication that hydrocortisone to the joint is the best treatment is real or due to chance. In any case the difference was small. A further point that emerged from the trial was that there was much less improvement during the last 3 weeks than during the first 3 weeks for all the treatments tried.

It should be noted that, though component analysis has assisted in simplifying the effects of the treatment into the consideration of one criterion, Table V indicates that this is to some extent an over-simplification. For instance, in the internal rotation *v.* passiev abduction Table, there are eight patients with high abduction and low rotation, but none with low abduction and high rotation. This, however, is not important, as the relative merits of the treatments when based on any one measurement could not be shown to be different from the relative merits based on any other measurement in this trial.

Summary

The effect of three forms of treatment (heat and exercises, hydrocortisone to the shoulder joint and exercises, and hydrocortisone around the biceps tendon in the bicipital groove of the shoulder and exercises) on movement of the shoulder in cases of periarthritis of the shoulder was compared over a 6-week period with the effect of treatment with analgesics only. The four groups comprising 65 patients did not differ in sex, age, or duration of the condition.

Active abduction, passive abduction, internal rotation, and external rotation were measured at weekly intervals in the three treatment groups and at the beginning and end of the 6-week period in the analgesic group; these measurements correlated closely and a principal component was computed. The analgesic group fared worse than any of the others, but there was no significant difference between the three treatment groups. The greatest degree of improvement occurred during the first 3 weeks of treatment in all cases.

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