The Influence of Cycloidal Vibrations on the Knee Joint Mobility of Osteoarthritic Patients

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Key words: knee, joint mobility, active and passive extension and flexion, bi-lateral osteoarthritis

Summary

The paper describes a study conducted on an experimental and control group to show the influence of cycloidal vibrations on the knee joint mobility of osteoarthritis patients. Although the results did not show that one treatment of CVT had an effect on mobility, a significant increase in mobility was shown after ten days.

Introduction

THE aim of this investigation was to measure the influence of cycloidal vibration on the joint mobility of patients with bi-lateral osteoarthritis of the knee.

Wheatly *et al* (1970) stated that an increase in joint mobility can be attained in two ways (not including manipulative or surgical intervention): by using exercises — mostly stretch exercises with or without external help; and by means of physiotherapeutic aids — heat application, vibration, massage and so on. Studies to find out which method is the most efficient have been made with Weber and Kraus (1949) and Fieldman (1968) studying, with good results, the influence of stretching exercises on joint mobility and Kabat *et al* (1958) and Tanigawa (1972) discovering increased mobility in patients treated with PNF techniques. Relaxation and its influence on mobility was studied by Warden (1961).

Massage of the muscles surrounding a hypomobile joint has been found to lead to an increase in the mobility of that joint (Ross, 1966), with vibration too having a similar effect (Bierman, 1970; Chapman *et al*, 1970; Goodwin *et al*, 1972). In addition, local application of heat has had an effect on the relaxation of muscles and in this way on the increase of joint mobility (Ross, 1972; Grobacker and Stull, 1975).

What is CVT?

CVT (cycloidal vibration therapy) is produced by a means of a motor with an eccentric mass which when placed on its axis results in an elliptical movement. As the motor is fixed with 'damping-rings' and because of the gyroscopic effect, this elliptical vibration plane is tilted (fig 1). In this way, a three-dimensional cycloidal movement is produced. It is possible to regulate the frequency of this kind of vibration, but the amplitude is fixed and very small ($\pm 0.5 - 1$ mm). Many studies have been made to endorse this statement (Kolovvsvary. 1960; Bolt *et al*, 1965; Lievens and Kersch, 1979)

Arthrosis Deformans (Osteoarthritis)

Many people suffer from arthrosis deformans, which is also known as hypertrophic arthritis, arthritis senilis or osteoarthrosis, a disease characterised by a degeneration of the articulation cartilage and a hyper-growth of bone tissue around the articulation. In cases of arthrosis, the cartilage as well as the bone is affected but there are no changes in the other periarticular tissues. The cartilage which is normally transparent and smooth loses its elasticity and becomes dead and dull.

Later on, the affected places become rough and uneven and the cartilage becomes frayed and cracked. This degeneration of the cartilage progresses and the bone underneath loses its cartilage. At this stage there is the formation of new bone structure or osteophytosis. These two processes simultaneously developed are typical of the pathology of arthrosis (Green and Martin, 1970).

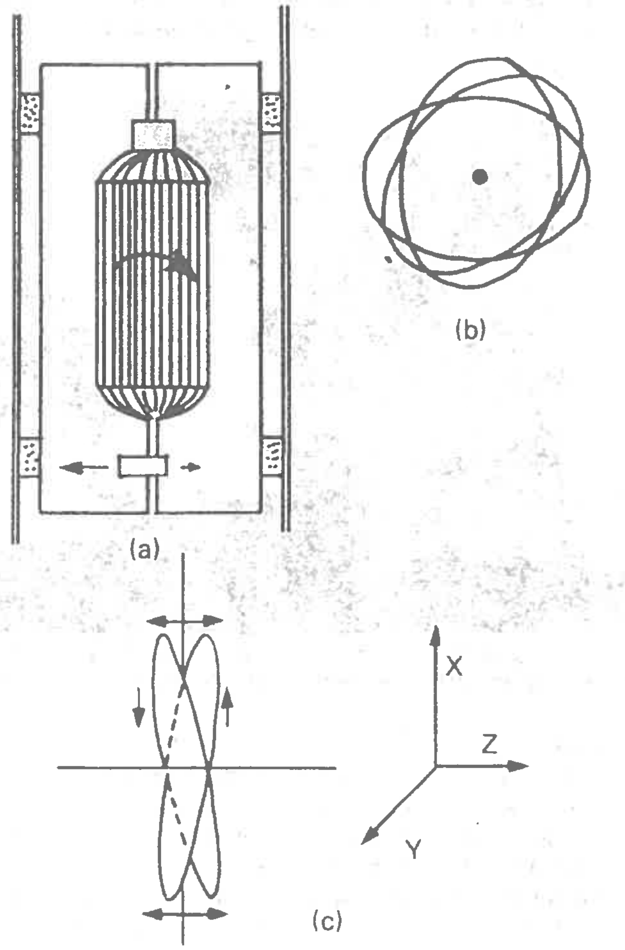


Fig 1: Diagram of (a) motor with eccentric bearings; (b) cycloidal form of vibrations; (c) elliptical form and direction of forces.

Experimental Study

Patients

Out of a group of 200 old people, 16 people with bi-lateral osteoarthritis of the knee which had been clinically and radiologically confirmed were selected. Their ages ranged between 70 and 90 years old and they were all females. For the purposes of the study, these patients were divided into two groups — an experimental group and a control group.

Method

The patients in the experimental group were placed on a massage table in a half-lying position and four parameters were measured: active and passive extension; and active and passive flexion. The osteological points of reference were the most lateral point of the greater trochanter; the lateral part of the joint line of the knee joint; and the most lateral part of the lateral malleolus. The different parameters were measured at the level of these marks (see table 1).

As a result of their age and because the patients often had coxarthrosis as well, it was not possible to measure these parameters using the normal biometrical procedure, but during the measurements the patients remained in the half-lying position. Care was taken to ensure that no compensating movements were involved. In that way, it was possible to compare the degree of mobility between the first and the tenth day of treatment.

After these measurements had been taken, the patients were treated with cycloidal vibration therapy for 20 minutes — a vibration cushion was placed under the thigh with the motor in the popliteal fossa and local vibration with a hand unit was applied on the knee (fig 2). During this treatment, the lymphatic drainage pathways were followed — the inside of the thigh along the great saphenous vein. After each treatment, the four parameters were again measured on both knees. The control group was not treated with this vibration therapy but the four parameters were measured on a daily basis.

Fig 2: The patient sits with a vibration cushion under her thigh while local vibration is applied to her knee with a hand unit

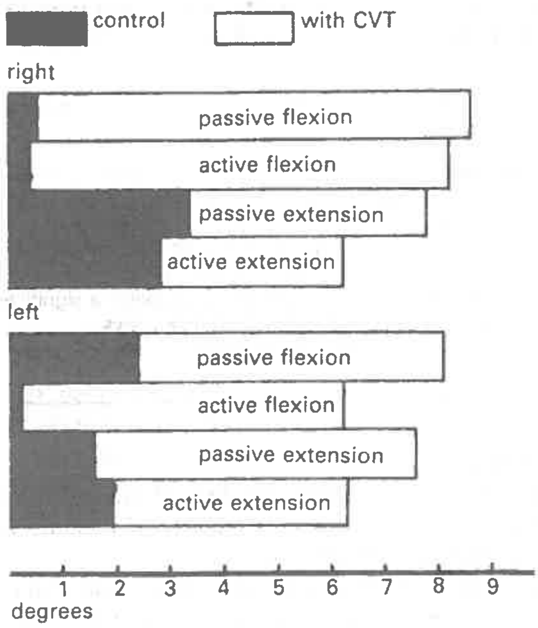
Results

So as to be able to give a statistical interpretation of the results the student-t test was used. The results of the experimental group and the control group were submitted to an unpaired t-test to detect if there was a significant difference between the measured parameters — in other words, to see if the CVT had a significant influence on the knee joint mobility. The results were as follows: active extension: t = 1.834; passive extension: t = 2.683; and active flexion: t = 1.658.

Table 1: The mean values of the four parameters before treatment and after ten days

	Experimental group	*Control group*
Active extension		
Before treatment	149.5	152.4
After ten days' treatment	155.7	155.3
Passive extension		
Before treatment	158.0	157.7
After ten days' treatment	165.6	160.5
Active flexion		
Before treatment	70.8	61.7
After ten days' treatment	62.8	61.4
Passive flexion		
Before treatment	56.4	52.7
After ten days' treatment	47.8	51.9

Table 2: Increase in mobility after ten days of treatment



For the last parameter, namely the passive flexion, another statistical method, the Kolmogorov-Smirnov test, had to be used because the distribution of this parameter was not normal. (Details of these statistical methods will not be expanded here in the interests of simplicity and readability.)

For all four different movements (parameters) a statistically significant difference (in the 5% ratio) was found between the experimental group and the control group after ten days of treatment (table 2).

Discussion

In this study we examined the influence of CVT on the mobility of the knee joint in the case of elderly women suffering from osteoarthritis. It was not possible, however, to prove that one treatment of CVT had an effect on the mobility although other authors, like Bierman (1970) and Atha (1975) have been able to show that CVT has a direct effect on muscle relaxation. On the other hand, we can conclude that there exists a significant increase in joint mobility after ten days' treatment in all movements that we measured (active and passive extension, active and passive flexion).

To explain this increased mobility we can offer some hypotheses:

1. There is a proven influence of CVT on muscle relaxation. Contracted muscles are a secondary problem in people suffering from osteoarthritis.
2. There is probably a relaxing of the joint capsule and an increase in the synovial activity.

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EQUIPMENT NOTE

Framing up to Stroke Rehabilitation

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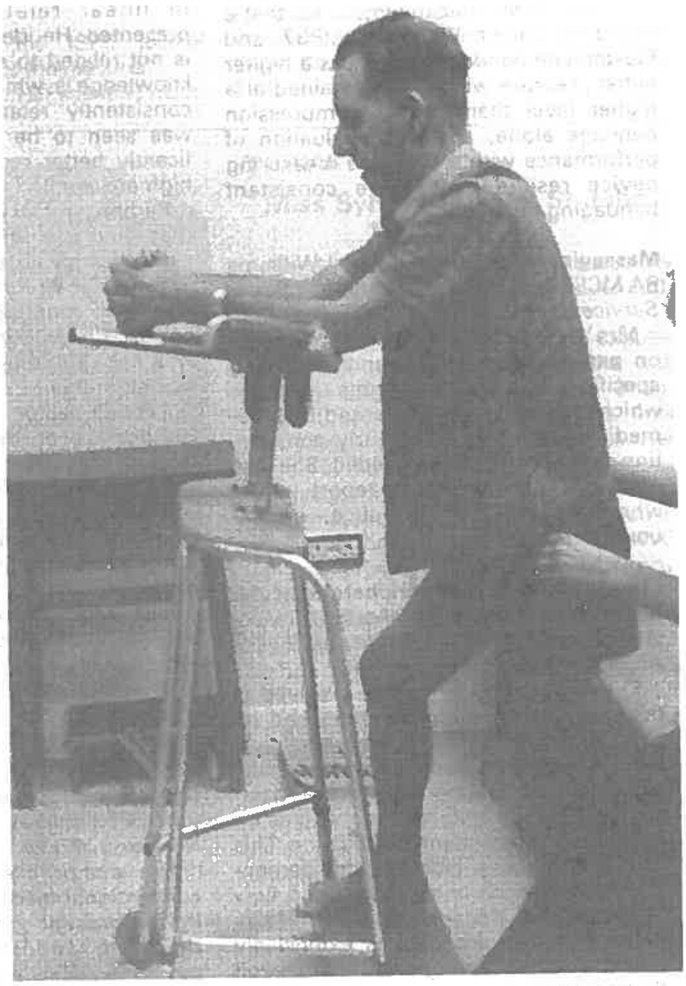
AS physiotherapists concerned with rehabilitation, our main aim is to return the patient to as near normal a state as possible. Gaining independence, however, is often a prolonged exercise, and aids may have to be used to assist in treatment programmes. One such, described here, has been adapted to help with both upper and lower limb rehabilitation following stroke.

The frame has manoeuvrable gutter arm rests which can be adjusted forwards and backwards to allow for differing arm lengths and moved to the correct height. As a result, correct weight-bearing can be achieved, that is weight from the shoulder to the elbow to the forearm, and this can be further maintained by the use of Velcro grips over the forearm (see figure). It also has adjustable legs and its easily fitted wheels permit mobility.

The patient interlocks the fingers of his affected hand with those of his unaffected hand and places them over a vertical grip, ensuring that a well positioned wrist extension and thumb abduction of the affected hand are achieved. A mirror should be placed in front of the patient during treatment with the frame so that he can see the position of his head, shoulders, torso and lower limbs. Once the position of the upper limbs has been maintained, the therapist is free to work on the lower limb.

The frame allows good all-round vision for both the therapist and the patient when practising rehabilitation exercises. The frame's easy manoeuvrability means that it can be used as a progressive aid to assist with a correct walking pattern for although the frame is light, it is very dependable. We have found that the patients who have used it, even those who are very heavy and tall, have had total confidence in it.

One other point in its favour is that it can easily be used in the ward. This is not only beneficial for the patient, but



has also proved a useful means of helping to educate nursing staff with regard to proper positioning and weight bearing of hemiplegic limbs.

Any inquiries regarding the supply or provision of sample stroke frames (this photograph depicts the prototype version) should be made to Ellis Son and Paramore Ltd, Spring Street Works, Sheffield S3 8PB while any interested physiotherapists who sample the frame are asked to submit resulting inquiries or recommendations for refining the design to Miss J Bond MCSP, Senior Physiotherapist, Northern General Hospital, Herries Road, Sheffield S5 7AU.