

Benefits of an exercise class for elderly women following hip surgery

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SUMMARY

A prospective cohort study of a twice weekly exercise programme for six months was undertaken to determine the benefits of an exercise class for 28 elderly women following hip surgery. The effects of the exercise programme were monitored using cycle ergometry. Walking speed was measured on entry and at 3, 6 and 12 months. Twenty-six subjects completed the programme with an overall attendance rate of 88%. Measures of fitness, calculated from cycle ergometry, did not improve significantly apart from test duration. In contrast there was a significant improvement in mean walking speed, with a 50% increase between 0 and 3 months and a further 21% increase between 3 and 6 months. This improvement was maintained at 12 months.

INTRODUCTION

Elderly women with osteoporotic fractures of the hip or primary osteoarthritis requiring total hip replacement form the majority of orthopaedic patients requiring hip surgery. Their numbers are increasing as the proportion of elderly in the population increases.¹ They are considerable consumers of rehabilitation services both in hospital and in the community.

The quality of life for elderly women following hip surgery is largely dependent upon their ability to pursue a variety of physical activities. Reduction in levels of normal physical activity with age and following hip surgery leads to a deterioration in both exercise capacity and physical condition, setting up a vicious circle which

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may eventually jeopardise their capacity for independent living.² These functional consequences of this decline in physical activity are an important public health issue.³

Regular exercise in the elderly has beneficial effects on cardiovascular fitness,^{4,5} skeletal muscle strength,⁶ bone mass,^{7,8} glucose tolerance, flexibility and general wellbeing.⁹ Most of these studies have been carried out with elderly subjects who are in good health, but similar improvements in elderly individuals with chronic disease have also been demonstrated.⁴

The ability to produce improvements in fitness and activity levels in elderly patients following hip surgery using an exercise programme would be of major significance, especially if it resulted in prolonged independence and an improved quality of life. A study was therefore undertaken to monitor the effects of an exercise programme in elderly women following hip surgery to ascertain if beneficial improvements in fitness and functional capacity occurred. In addition, a submaximal cycle ergometer test and a self-selected walking speed test were compared as methods of assessing the fitness of this group.

METHODS

Elderly female subjects who had previously undergone surgery for osteoporotic hip fracture or hip replacement for primary osteoarthritis and who were living independently in the community were recruited from hospital orthopaedic clinics. Subjects were excluded if there was severe pre-existing illness. After informed consent subjects were enrolled in a twice-weekly exercise programme for six months.

Exercise programme

The exercise programme was developed by chartered physiotherapists skilled in the care of the elderly and took place in the physiotherapy department of the geriatric day hospital, Royal Victoria Hospital. The emphasis was on weight-bearing activities. After an initial warm-up period of supervised walking, stair climbing, flexibility and active weight-bearing activities, the intensity of exercise increased and subjects took part in aerobic type dance routines accompanied by music. This was followed by a cool-down period which involved stretching and balance exercises. Between each routine a short relaxation period was permitted, the duration of which decreased as fitness improved. The length of the exercise class increased from 25 minutes to 45 minutes during the six months of the study.

Fitness tests

A modified physical work capacity test was undertaken by all subjects at the commencement and completion of the six-month exercise training period on an electronically braked cycle ergometer (Seca, Germany). Heart rate was measured by telemetry (Polar Electro, Finland) with the heart rate of the last 10 seconds in each workload taken as the steady state. Skinfold thickness was measured at four sites using Harpenden calipers, and percentage body fat and lean body mass calculated.¹⁰ Following an habituation period subjects rested for 10 minutes before commencing the test. To allow for the effect of the decline in maximal heart rate with increasing age¹¹ and to adhere to safe guidelines for submaximal

exercise, physical work capacity was calculated at 85% of the age-related maximal heart rate (PWC 85%).¹² The initial workload in watts was determined at 75% of lean body mass¹³ and set to the nearest 5 watts. Subsequent workloads were set as described elsewhere¹² and estimated maximum oxygen uptake (VO₂ max) calculated.¹⁴

Walking speed was measured at 0, 3, 6 and 12 months on a standard flat 64 metre carpet and vinyl course. Patients were instructed to complete the distance at a comfortable walking speed and timed using a hand held stop-watch. All walking speed measurements were undertaken prior to the group exercises. Results were analysed using analysis of variance techniques and paired t-tests.

RESULTS

A total of 28 elderly female subjects were enrolled, 26 completed the 6 month exercise programme and 22 attended the 12 month assessment of walking speed. During the study period one subject withdrew because of intercurrent illness and a second because of the onset of hip pain in the unoperated side. Three subjects were unable to complete the 12 month assessment because of illness and a fourth declined. At initial attendance four subjects employed walking sticks for indoor and outdoor mobility, and at completion all subjects were able to walk without aids.

The 26 subjects had a mean age of 71.5 (range 63 – 82) years, mean height 159 cm (range 147 – 170), mean weight 64.15 kg (range 45 – 91) and mean body fat of 28.2% (range 23 – 37). No significant change in body fat or body weight occurred between enrolment and completion of the exercise programme. Thirteen of the subjects had received total hip replacement (mean 12.5 months previously) and 13 internal fixation of the femoral neck (mean 12.2 months previously). There were no significant differences in the above variables between the two groups. Compliance with the study was excellent with an overall attendance rate of 88%.

The mean walking speed on entry to the study for all 26 subjects was 0.82 m/sec, after three months 1.23 m/sec and after six months 1.49 m/sec (Figure). At 12 months the mean walking speed for the 22 subjects was 1.31 m/sec. There was thus a 50% increase in mean walking speed between entry and three months and a further 21% increase between three and six months. The increase in walking speed at three, six and 12 months in comparison to that on entry was significant ($p < 0.0001$).

The total hip replacement subjects had a higher walking speed on entry to the study than the fracture group ($p < 0.05$). Both groups had a significant increase in walking speed during the first three months and the difference between the groups was maintained. By six months a further increase in walking speed had occurred but there was no longer a significant difference between the groups. The improvement in walking speed in both groups was maintained at twelve months.

Heart rate was monitored for each subject during a typical exercise session. On average 88.7% of total exercise time was spent at heart rates equivalent to greater than 50% of maximum heart rate (220 beats/min minus age in years), and 26.4% of time at greater than 70% of maximum heart rate.

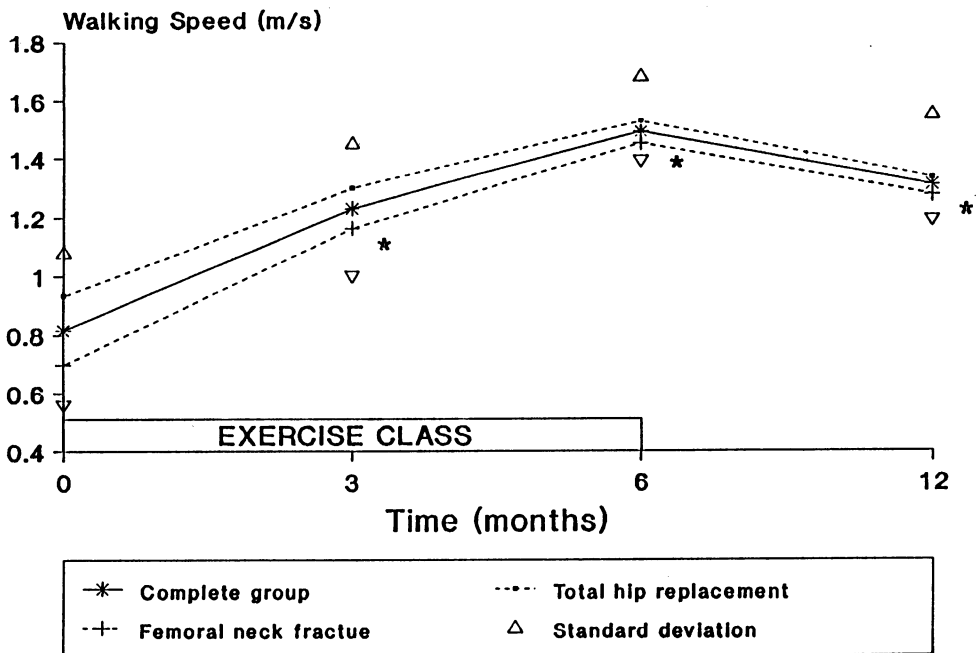


Figure. Walking speed and exercise * $p < 0.001$ in comparison to walking speed at entry.

Three parameters of fitness were determined from the bicycle ergometer test, namely physical working capacity equivalent to 85% of age related maximum heart rate (PWC 85%), estimated VO_2 max (mls/kg/minute) and exercise duration (mins). The results of the pre and post-training tests are given (Table). Due to hip pain and abnormal heart rate responses, only half of the subjects completed the cycle ergometry workloads satisfactorily. There was no significant difference in physical working capacity or estimated maximum oxygen uptake between pre and post-training tests. There was, however, a significant increase in test duration from pre to post-training ($p = 0.001$). A total of 46% of subjects completed three workloads at the pre-training test, which increased to 89% at the post-training test.

TABLE

Fitness changes (cycle ergometry); mean values (\pm SD) before and after completion of exercise programme

	<i>n</i>	<i>At entry</i>	<i>At 6 months</i>
85% physical work capacity (watts)	13	63.23 (\pm 27.7)	50.00 (\pm 17.9)
Estimated maximum oxygen uptake (ml/kg/min)	20	21.28 (\pm 7.1)	19.18 (\pm 5.9)
Exercise duration (mins)	26	4.8 (\pm 2.1)	5.77 (\pm 0.7)*

* $p < 0.0001$ compared with duration at entry.

DISCUSSION

The exercise classes were perceived as enjoyable by the subjects and this was reflected in the excellent compliance rate of 88% attendance overall. Subjects felt fitter, were more able to carry out their normal daily activities and enjoyed the opportunity for social contact.

Objective benefit was demonstrated by the improvement in walking speed, which was sustained six months after completion of the exercise programme. At the entry to the study only three of the 26 subjects were able to achieve the minimum recommended walking speed of 1.07 metres/second required to negotiate a "pelican" road crossing,¹⁵ while on completion of the exercise period 25 of the 26 subjects were able to exceed the requirement. Uncorrected walking speed has been shown to be a reliable clinical method of monitoring gait rehabilitation for hospitalised elderly.¹⁶ On entry to this study the mean walking speed of 0.82 m/sec was lower than the mean speed of 1.16 m/sec of a group of elderly females living independently with a similar mean age of 72 years¹⁷ and also of an older group of 79 year old Swedish women with a mean walking speed of 0.92 m/sec.¹⁸ This low figure and the subsequent substantial improvement in walking speeds of this group who had received hip surgery and conventional rehabilitation over a year prior to entry into the trial demonstrates the failure of present post-operative rehabilitation to achieve maximal recovery. While a small improvement of 8% in walking speed may occur in the second year after hip arthroplasty,¹⁹ the improvement in walking speed of 45% at the end of the six-month exercise period in this study was substantial and too great to be due to natural recovery alone. These surprisingly large improvements in walking speed were achieved with a twice weekly exercise programme with most improvement occurring after three months and sustained at 12 months. The parameters to which these improvements may be attributed are unclear and merit further investigation, as does the duration and frequency of exercise necessary to elicit health and cardiovascular fitness benefits in the elderly.²⁰

It has been calculated that for the average 70–75 year old female, walking at 1.38 m/sec is maximum aerobic exercise,^{3, 21} and it is of interest that the mean walking speed achieved at completion of the study of 1.49 m/sec exceeded this. Although the exercise involvement in this study falls short of the recommended guidelines for developing and maintaining cardio-respiratory fitness in healthy adults (of at least 20 minutes training, three days per week at 60 to 90% of maximum heart rate), our regimen may be an appropriate and achievable exercise protocol for elderly people.

In contrast to the walking speed results we were unable to demonstrate a significant improvement in physical work capacity or oxygen uptake. This reflects methodological problems including hip pain associated with the cycling action, and erratic heart rate response to exercise contributing to reduced sensitivity of cycle ergometry as an accurate measure of fitness changes in the elderly. There was, however, a significant increase in the exercise duration undertaken on the cycle ergometry testing on comparing the initial and post-training measurements. The correlation between self-selected walking pace and maximum oxygen uptake has been found to be not significant in elderly subjects.²² It has also been stated that exercise training in the elderly will increase submaximal performance to a

greater degree than any changes in maximum oxygen uptake,²³ which may explain the improvements in cycling duration and walking speed without corresponding improvements in physical work capacity. Other studies have shown that training reduces the stress imposed by submaximal exercise.²⁴ Such improvements are highly relevant to everyday life for an elderly population as most activities of daily living require submaximal response. Observed improvements in submaximal function may have been due to improvements in flexibility and muscle strength which reportedly occur with exercise.^{24, 25, 26, 27} Similarly, exercise programmes have been reported to result in improved muscle strength and mobility even in the very elderly and may in part be due to muscle hypertrophy as well as improved neural recruitment patterns.⁶ These parameters were not assessed in this study and we were unable to identify the physiological changes contributing to improvements in walking speed and submaximal performance.

The bicycle ergometer test was found to be an insensitive measure of improved submaximal function in this group of elderly subjects. Given its substantial cost in terms of time and equipment, the simpler measurement of walking speed is preferable.

This study indicates the major benefits which a wider provision of resources for promotion of exercise in the elderly with musculo-skeletal problems could provide. These improvements were particularly noteworthy as the seventh decade is thought to be the critical age for accelerated decline in function.²³ Many elderly women are not achieving their full potential following hip surgery for osteoporotic fracture or osteoarthritis and would benefit from further rehabilitation.

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