

WALKING TIME MEASURES FOR EVALUATING OA OF THE KNEE

RELIABILITY AND SENSITIVITY OF SELF-PACED WALKING TIME FOR ASSESSING FUNCTIONAL CAPACITY IN PERSONS WITH OSTEOARTHRITIS OF THE KNEE

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INTRODUCTION

Although kinematic measures of walking time continue to be used for judging the efficacy of treatments for osteoarthritis (OA) of the Knee¹⁻⁷, no study to date has specifically investigated whether these measurements are reliable and sensitive to change in this patient population. Given the constantly fluctuating symptomatology of OA⁸, it is of utmost importance to ensure that interval changes in walking time can be confidently attributed to a true change in clinical status of the patient⁹. It is equally important to ensure that walking time measurements designed to evaluate the efficacy of treatments for this condition are sensitive indicators of a change in functional status.

The purpose of this study was to examine the reliability of measurements of walking time for persons with stable knee OA over a six week period. A second purpose was to aid the clinician and/or investigator in determining whether measurements of walking time would be sufficiently sensitive for determining the efficacy of treatments other than surgery for patients with knee OA.

PATIENTS AND METHODS

Patients

The patients in this prospective study were 10 women aged 54-76 years (mean 65.90 approx 8.34), height 155-167 cm (mean 161.9 approx 3.31) and weight 63-113 kg (mean 76.01 approx 15.28) who fulfilled the clinical and radiological criteria of the American College of Rheumatology (ARA) for the diagnosis of OA of the knee¹¹. In addition, three patients, age range 53-62 years, who fulfilled the ARA

criteria were studied before and after completion of a six week isometric quadriceps strength training program. At study entry all participants complained of pain on walking. Fifty per cent were receiving non-steroidal anti-inflammatory drugs for their arthritis and none used walking aids. As indicated by an average score of 12.80 approx 3.11 on The Lequesne Index of Disease Severity of Knee OA or ISK¹², the cohorts studied were severely handicapped. The protocol was approved by a University Ethics Committee and all participants provided informed consent.

Procedures

The walking time measurements were carried out indoors on level ground using a stop watch. To allow a subject to walk at constant speed on the walkway and to control for the effects of acceleration and deceleration, subjects were instructed to walk with ordinary shoes at their normal comfortable walking pace for a distance of 3 m before walking time was recorded. The standardised procedures were carried out by the same observer six weeks later under the same theoretical no change conditions for the control group and after the six weeks of exercises for the experimental group.

Statistical methods

The statistics used to describe the data were the mean and standard deviation (SD). Reliability (R) was computed with intraclass correlation coefficients (ICCs) (1,1)¹⁴. In addition, the standard error of the mean or SEM which represents the 68 percent confidence interval about the mean was computed from the reliability data as suggested by Hayes¹⁵. To assess the statistical significance of learning on the repeated measurements, a dependent t-test was used.

Differences in walking time, maximal isometric quadriceps torque and ISK scores at baseline and after six weeks of quadriceps strength training were expressed as a percentage of the baseline scores (see Table I). Pre- and post-exercise data were also compared using paired t-tests and Pearson correlations.

The level of significance for the analyses was set at P.

ABSTRACT

This study assessed the test-retest reliability and the sensitivity of self-paced walking time measurements for evaluating the functional performance of persons with knee osteoarthritis (OA). The 13 m timed walking tests were carried out on two separate occasions over a six week period for 10 patients using a standardised protocol. The same measurements were recorded also for three additional patients before and after a six week quadriceps strength training regimen. As indicated by an intraclass correlation coefficient of 0.83 with no significant intersession test differences for the group ($P=0.98$), the gait measurements were reliable. However, despite marked increase in knee extensor strength and significant subjective improvements in walking time for the three experimental subjects were smaller than the error of measurement. The findings suggest that regardless of reliability, measurements of self-paced level walking time might not be sufficiently sensitive for evaluating longitudinal changes in functional performance in this patient population.

RESULTS

Reliability

The means, standard deviations and the 95 percent confidence intervals about the mean calculated for the walking tests are reported in Table II (page 7). As shown, the ICC or R statistic for the tests was 0.83 with a SEM of 1.50 seconds. As indicated by a Student's t-test there was no systematic learning effect with repeated testing.

Sensitivity

Although accompanied by a 4-8 percent improvement in walking time after exercise which correlated positively with individual increases of quadriceps strength ($r=0.90$), this improvement was not significant ($t=2.05$, $p=0.17$) and remained within the possible error of measurement of 1.50 seconds (see Table I page 7). The ISK scores which were also positively correlated with the walking time scores post-intervention ($r=0.86$) were, however, significantly improved ($t=8.66$, $p=0.01$).

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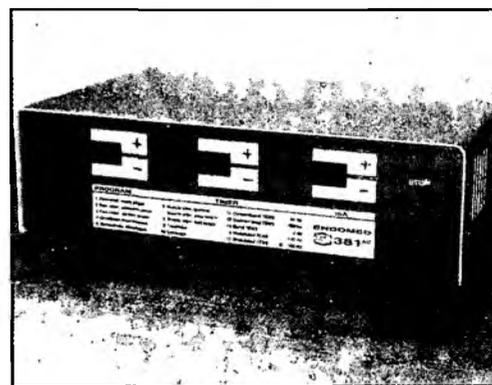
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DISCUSSION

Table I: Summary of post-exercise improvements in walking time

Subject	Walking time (secs)	Quadriceps torque at 60° Flexion (Nm)	ISK scores*
1	0.6 (8%)	31 (75%)	6 (66%)
2	1.0 (7.6%)	85 (60%)	4 (56%)
3	0.4 (4%)	22 (30%)	5 (29%)

Abbreviations:
Nm = Newton Metres
ISK = Index of knee severity
* Significantly improved

Table II: Mean, standard deviation, 95% confidence limit about the mean, and intraclass correlation coefficient

	Week 1		Week 6
Mean	12.33		12.35
SD	3.37		2.85
95% CL	12.33±1.50		12.35±1.50
ICC		0.83	
p		0.98	

Statistical test: Dependent t-test

Free walking velocity, which is often subnormal in persons with OA of the knee^{10,13,18,19} is frequently used for the objective evaluation of therapeutic regimes for this condition^{1,2,5,19} or for identifying problems during ambulation^{6,7,10,13,18}. However, despite the widespread and continued use of this measurement for objectively assessing functional capacity, there are no studies concerning possible changes in measurements of self-paced walking time due to the repetition of the test nor any estimates of the measurement error associated with such tests. Equally important in evaluative research is the criterion of instrument responsiveness or sensitivity to change²⁰ and this aspect has not been the subject of any previous study of this measurement for this group.

In accordance with the high intra-observer reliability reported for the 50-foot walking test in patients with rheumatoid arthritis^{16,17}, the present measurements of self-paced walking time were performed with high reliability across sessions (see Table II). The reliability of the tests was supported also by the finding of no significant measurement differences across sessions and a low SEM.

The high inter-day reliability of the measurements contrasted with those obtained from other commonly used outcome measures for evaluating treatment effects in this population, such as radiographic and laboratory measures. The

measurements were also easy to perform, required no special setting other than an illuminated walkway and were obtained with minimal time commitment on the part of the researcher. It is also expected that since the measurements are easily standardised that different observers would achieve a similar result.

However, in spite of significant measurement reliability and statistically significant improvements on a validated subjective index in three cases undergoing exercise therapy, the trend towards improvement in walking time in this subgroup of patients ($t=2.05$, $n=3$, $p=0.17$) fell within the limits of normal variability of the measurement, suggesting poor measurement sensitivity. Although this has been implied for rheumatoid arthritic trials¹⁶, a small sample with limited power might reduce the ability to detect statistically significant differences in walking time before and after treatment, even if these actually exist, resulting in a beta error. In addition, the duration or intensity of the current strengthening program might have been insufficient.

Improvements in walking speed might also be expected to be more evident following the effects of treatments such as unicompartmental prosthetic knee replacements as suggested by the findings of Mattsson *et al*⁶ for 19 of 20 patients with moderate knee OA. They not only found an individual change in the parameters of self-selected walking speed for these patients postsurgery, confirming the sensitivity of the measurements, but also reported that the improvements in walking time were correlated with favourable changes in single limb support time, indicating measurement validity. This was in line with the findings of Stauffer *et al*¹³ who reported significant correlations between the variable of gait velocity and those of pain, range of motion, walking distance, sitting and rising from a chair and instability in 65 patients with degenerative joint disease examined preoperatively. Based on a study of patients with OA of the knee who underwent total knee arthroplasty, Collopy *et al*²⁵ postulated that strength of the knee extensor muscles was related to free walking velocity which they reported was a sensitive indicator of functional performance.

However, the usefulness of walking time measurements for measuring clinical improvements in knee function was not supported for persons with knee OA following drug therapy despite clinical improvements in rest pain, knee range of motion and stiffness. Lack of measurement sensitivity might also serve to explain the outcome of a controlled study of fenoprofen therapy in geriatric patients with knee OA in which the time required to walk 50 feet was the only parameter demonstrat-

ing insignificant improvement¹. This was also the finding with post-test baseline comparisons in free velocity reported by Peterson *et al*¹⁹ which failed to achieve significance when intervention ($n=47$) and control groups ($n=44$) of patients with knee OA were compared after an eight-week program of physical exercise, which included strengthening. Thus, while walking tests appear useful for assessing the locomotor handicap occurring in OA of the knee postsurgery^{3,6,7} doubt arises as to their utility for assessing the efficacy of more conservative therapies such as drugs and exercise for the treatment of this condition. This was also the conclusion reached by Grace *et al*¹⁶ for persons with rheumatoid arthritis.

These data suggest that inasmuch as the goal of physiotherapy for knee OA is to improve function, that due to their poor responsiveness, measurements of self-paced walking may prove inaccurate for monitoring longitudinal changes in functional ability in this group of patients, despite their reliability, practicality and cost-effectiveness. Pending further research using a larger sample, it is therefore recommended that to ensure important therapeutic changes are not overlooked in trials designed to evaluate efficacy for individuals with knee OA, validated tools such as the ISK be used concurrently for measuring functional capacity.

ACKNOWLEDGEMENTS

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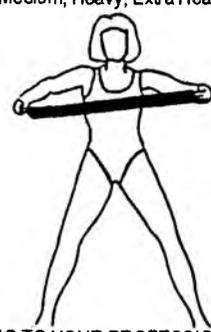
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