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Assessment and Comparing of Effectiveness of Over Ground and Treadmill Walking in Chronic Low Back Patients

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Abstract

Positive effect of aerobic exercises in chronic low back patient is shown recent studies. But it is unknown that which type walking pattern is more effective. The aim of this study is to assess effectiveness of over ground and treadmill walking in chronic low back pain patients and compare them. This is a randomized-prospective study. After screening 72 chronic low back pain patients, 18 met qualification criteria for this study. Patients were assessed in terms of physical examination findings, exercise tolerance test parameters. The Visual Analogue Scale (VAS) was used to assess the patients pain. The life quality of patients was assessed by Short Form-36 (SF-36). The mobility of the spine was assessed by single inclinometer measurement, Schober test and fingertip-to-floor test. Patients were randomized to two groups as over ground and treadmill walking. Conventional therapies were applied to both groups in same way. One group has taken treadmill and other has over ground walking exercise for 4 weeks and 3 times a week under supervision. Patients were assessed before and after treatment. As result, in the over ground walking group, there was statistically significant improvement in T12 and real extension values (p=0,005 and p=0,010). The improvement of real extension values were significantly higher in over ground walking group than treadmill walking group (p=0,018). The improvement at the MET levels in treadmill walking group was statistically significant (p=0,004). However, there was no statistically significant difference between two exercise groups. There were statistically significant decreases at the Oswestry disability scores in the over ground walking group before and after therapy (p<0,001). Walking exercise in addition to conservative treatment can improve pain, disability and psychological status in patients with chronic low back pain. In this study we found that over ground walking is more effective than treadmill walking at reducing disability due to low back pain.

Keywords: Chronic low back pain; Over ground walking; Treadmill walking; Aerobic exercise

Introduction

Low back pain is a very common disease all over the world and lifetime prevalence is between 75-85% [1]. The lifetime prevalence in our country is between 33.9 to 51% [2]. 90% of patients get better within 3 months but 10% of patients become chronic low back patients [3]. 80 to 90% of the health and social costs of low back pain is spent on the 10% of patients who have chronic low back pain and as a result, disability. Low back pain is the second most important cause of loss of work in many countries and is considered to be the most important factor affecting decreases in production. Low back pain is a symptom of many diseases, and is affected by various psychosocial factors [4].

Patients and Method

Patients

Patients with chronic low back pain diagnosed by clinical evaluation and imaging techniques were included in the study. 19 patients were randomized into two groups. However, one patient who couldn't tolerate exercise tolerance testing was excluded from the study. This study was designed to be prospective and randomized and the inclusion criteria were low back pain lasting over 3 months, and being between the ages of 20-80. Exclusion criteria were having a disease which is contraindicated for aerobic exercises such as uncontrolled cardiovascular disease, hypertension, cardiac arrhythmia, acute myocardial infarction and unstable angina, patients who had received physical therapy in the last 6 months or lumbar transforaminal injections were also excluded, as were those who had had spinal surgery in the last 1 year, those with acute low back pain signs, neurological disease, symptoms of hip, ankle and foot disease, pregnant patients and those of, poor general health.

Method

After signing an informed consent form, eligible subjects were recruited for the study and were randomly assigned to a treadmill walking group or to an over ground walking group. Both groups had maximal exercise tolerance testing by modified Bruce protocol at the Gülhane Military Medical Academy, Turkish Army Forces Rehabilitation and Care Center performance laboratory. Before testing, all patients had pulmonary function tests to rule out patients with respiratory problems. The exercise tolerance test was used to evaluate the parameters of resting and maximal heart rate, anaerobic threshold, MET value and testing time.

The exercise tolerance test was administered to all patients twice. The purpose of the first test was to determine pre-exercise maximal O2 consumption (ml / kg / min) and the intensity of aerobic exercise.

Both groups had physical therapy for the low back which included TENS, hot packs, ultrasound, abdominal and back muscle strengthening and stretching exercises 5 times a week, and they had pool exercises 2 times a week for 4 weeks.

In both groups walking exercises were performed under the supervision of a physician within a target heart rate range which was calculated by heart rate reserve method ((maximum heart rate-resting heart rate) x 60-80% + resting heart rate).

The first group had walking exercise on an MTC 2000 e- runner treadmill. The time to reach the target heart rate, symptoms such as chest or low back pain, walking time and distances were noted during the exercise. The supervisor physician set the walking speed for all patients and noted them.

The other group had walking exercise using the Polar Team2 system. To achieve the target heart rate during walking, patients were verbally instructed to increase their speeds. At the end of the 4 weeks, both groups had an exercise tolerance test, as they had before exercise.

Each session had a warm-up period for 5-10 minutes of low-intensity walking (heart rate under 40% heart rate reserve formula), 20-60 minutes of walking exercise at the target heart rate and then a cooling down period of 5-10 minutes of walking at low intensity. Each week, according to the condition of the patients, the exercise time increased 5 minutes. Treatment was applied to both groups 3 times per week for 4 weeks.

The patients were assessed before and after treatment by physical examination, exercise tolerance test parameters (VO2max max, maximal heart rate, anaerobic threshold (AT), MET), pain, quality of life and functional disability.

We used the Turkish version of the Oswestry scale to assess low back pain-related disability. The questionnaire has 10 questions and there are 6 options for each question. Patients were instructed to choose the option that best defined their disability. The maximum score is 50 points. Higher scores mean greater disability.

The Visual Analogue Scale (VAS) was used to assess the patients' pain. Patients were instructed to mark their level of pain on a10 cm horizontal line (0-no pain, 10-the most severe pain encountered in life). The VAS score was assessed for daily activities, resting and night pain.

The life quality of patients was assessed by Short Form-36 (SF-36). This scale has 36 questions about 8 health-related parameters: physical function, social function, physical role, emotional role, mental health, vitality, bodily pain, general health. Each parameter is scored from 0 to 100. Higher scores mean a better quality of life.

The mobility of the spine was assessed by single inclinometer measurement, Schober test and fingertip-to-floor test.

The upper end of the sacrum and T12 vertebrae spinous process were palpated in a standing position and then maximal flexion and extension were measured with these marks. To get the true flexion and extension, the readings of the sacrum measurements were subtracted from those of the upper measurements. Left and right lateral flexions were measured at the T12 vertebrae.

Statistical analyses

The data from the outcome measures were entered into the SPSS for Windows 11.5 software package program. The distribution of the continuous variables was investigated by Shapiro-Wilk test with regards to whether they were close to normal. Descriptive statistics for the continuous variables mean ± standard deviation, median (width between quarters) or median (minimum-maximum) were used, and the number of cases and (%) was used for the categorical variables. The significance of the difference between the groups in terms of mean values was investigated by Student's t-test, and the significance of the difference between the groups in terms of median values was investigated by Mann Whitney U test. Nominal variables were evaluated by Fisher's Exact Chi-Square test. P<0.05 was considered statistically significant. The significance of the averages of input and output measurements within the groups was evaluated by dependent t-test with Bonferroni correction. The significance of the median values of input and output measurements within the groups was evaluated by Bonferroni correction Wilcoxon signed test.

Results

In this study, 18 patients (8 male, 10 female) who had chronic low back pain without radicular back pain and neurological deficits were included. The average age of the patients was 53.0 ± 15.9 in Group I, and 59.8 ± 7.9 years in Group II, and the average duration of low back pain was 24 months in Group I, and 60 months in Group II. No statistically significant differences were observed in the mean age, gender, disease duration, concomitant disease and drug therapy of Group I and Group II (p>0.05) (Table 1).

Variables	Group I	Group II	p-value
Age	53.0 ± 15.9	59.8 ± 7.9	0.275
Gender			0.153
Male	6 (66.7%)	2 (22.2%)	
Female	3 (33.3%)	7 (77.8%)	
Disease duration	24 (6-96)	60 (5-120)	0.297
Concomitant disease	5 (55.6%)	6 (66.7%)	1.000
Drug therapy	2 (22.2%)	1 (11.1%)	1.000

Table 1: Demographic Characteristics of the patients according to Groups

The mean body weight and body mass index showed a statistically significant reduction in Group I and Group II before treatment and after treatment (p<0.001). Between the two groups the change in body weight and body mass index after treatment compared to the baseline did not show a significant difference (p=0.483 and p=0.722).

There were no significant difference in both groups after Bonferroni correction before and after treatment measurements of T12 flexion, S1flexion, S1 extension, real-flexion, right and left lateral flexion (p<0.025). In Group I the change in the before and after treatment measurements of T12 extension and real extension was not statistically significant (p=0.062 and p=0.402) but in Group II it was (p=0.005 and p=0.010). The only significant difference between the groups was in the real extension. Group II had a greater increase than Group I (p=0.018) (Figure 1).

There were no statistically significant changes in both groups before or after the treatment in terms of Schober measurements (p>0.05). In

Group II there was no significant decrease before and after the treatment in terms of finger-to-tip measurements but there was in Group II.

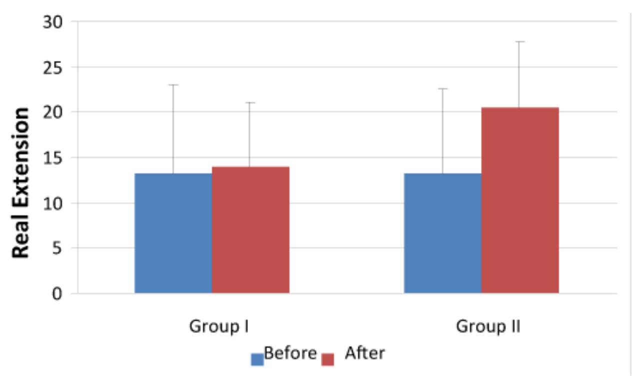

Figure 1: Changes of real extension values

There were no statistically significant changes in both groups before and after the treatment of VO2max in terms of maximal heart rate, anaerobic threshold measures ($p>0.05$). There were statistically significant changes in Group Il before and after treatment in terms of MET measures but no changes in Group I. In terms of the variables mentioned above, the change in post-treatment levels compared to the baseline was similar between the groups ($p>0.05$).

There were changes in both groups before and after the treatment in terms of the duration of the test, walking distance and walking time ($p<0.01$). However, these changes were similar in both groups ($p>0.05$). There was no statistically significant decrease in Group I in terms of the time to reach the target heart rate ($p=0.030$) but in Group II when after the treatment was compared with the baseline, the decrease was statistically significant ($p=0.008$).

There were decreases in Group I's measurements before and after the treatment in terms of VAS scores of activity, night and rest pain and Oswestry scores but they were not statically significant after Bonferroni correction ($p<0.025$). There were statistically significant decreases in Group II in the before and after treatment measurements of VAS scores of activity, night and rest pain and Oswestry scores ($p<0.025$). The changes of the before and after treatment measures of VAS scores of activity, night and rest pain were similar between the two groups ($p>0.05$). However Group II had a significantly greater decrease in Oswetry scores than Group I ($p=0.025$) (Figure 1).

Despite the fact that all SF-36 subscale scores increased in Group I, only the energy component changes of the before and after treatment significantly increased ($p=0.011$). All SF subscale scores except the physical role scores increased but only the bodily pain and mental health scores changes of the before and after treatment had statistically significant increases ($p=0.018$ and $p=0.012$). The degree of change in each the SF-36 subscales before treatment and after treatment were similar in both groups ($p>0.05$)

Discussion

Recently, treatment guidelines have recommended being active and avoiding bed rest for acute and subacute low back pain patients; however exercise should be prescribed for patients with chronic low back pain [5]. Recent studies have shown that exercise and a multidisciplinary approach should be recommended for chronic low back pain [6]. Aerobic exercises are shown to be especially beneficial in back pain as with many diseases [7].

Walking is one type of aerobic exercise which is easy to perform and is a basic human activity. It has been shown to have many benefits and fewer side effects [5].

In our study in addition to the conventional therapy to the low back, one group had walking exercise on flat ground and the other group had walking exercise on the a treadmill for 4 weeks under supervision. Thus, we aimed to compare the effectiveness of the two different types of walking exercise on chronic low back pain.

Liddle et al. pointed out in their review that supervised trunk strengthening or stabilization exercises improve back specific function more than many other modalities, and that supervision increases the effectiveness of exercises. In our study, the exercises were supervised so as to teach the patients the target heart rate speeds and the basics of walking exercise in order to increase the effectiveness of therapy [6].

The weakness of the current study is not having a control group. Therefore, it is unclear if the positive results were due to conventional therapy or aerobic exercises. Although there are studies which show that 4-week aerobic exercise is beneficial, the American College of Sports Medicine Society recommends at least 6 weeks for cardiopulmonary endurance [8,9]. The superiority of exercise to other modalities has been shown in many studies [10,11]. Hayden et al. concluded that trials should investigate specific exercise intervention strategies in well-defined populations of patients with low back pain [12]. Based on this advice, in this study we aimed to compare two different types of walking exercise and this is the first such study in the literature. In addition, the other superiority of our study is that the aerobic exercise program was planned at the maximal heart rate which was measured in the exercise tolerance test and was supervised by a physician. Liddle et al. concluded that supervision enhances exercise compliance and efficacy in chronic low back pain [6].

In the current study, the pain and disability scores decreased in both groups. There were more statistically significant decreases in the disability scores of the over ground walking group than in the treadmill walking group. Murtezani et al. concluded that pain reduction will also decrease the disability score in their study which compared passive modalities and high-intensity aerobic exercise for chronic low back pain in workers [7]. We had similar results in our study. Also, the exercise tolerance test parameters were evaluated in our study before and after treatment. MET scores increased in both groups but it was only statistically significant in the treadmill group. These results can be due to increased patient endurance and/or familiarity with the test because the test was performed on a treadmill. In addition, VO2max and anaerobic threshold values increased in the treadmill group, but they were not statistically significant. This can be a result of not performing the exercise for enough time to increase aerobic capacity. These results are similar to the study performed by Doğan et al. which compared three modalities (aerobic exercise, physical therapy and physical therapy + a home exercise program) in chronic low back pain [13]. Finger-to-tip and Schober measurement scores increased in the treadmill group but only the finger-to-tip score was statistically significant. All low back ROM measurements scores increased more in the over ground walking group than in the treadmill group. However, only the increase in extension scores was statistically significant for the two groups. These results can be due to having more lumbar spinal stenosis patients with significant extension limitation in the over ground walking group and the small numbers in the study. We think that in treadmill walking, patients hold the bars to keep their balance and this disturbs the spinal oscillation of walking, but over ground walking is a more physiological type of walking which enables rhythmic muscle activation and increases the aerobic capacity of the extensor low back muscles. However, not measuring the postures of patients at the beginning of study made it impossible to determine the effect of extension limitation on patients' posture. For this reason future studies must have the same population of low back pain patients. Instead of chronic low back pain patients, choosing patients with specific diagnoses such as lumbar spinal stenosis with extension limitation and lumbar discopathy with flexion limitation is more useful.

Mannion et al. concluded that low intensity aerobic exercises can reduce excess healthcare costs in chronic low back pain patients [14]. In their study they prescribed exercise without an exercise tolerance test, unlike in our study. We consider that walking exercise is a cheap and simple method and a basic human activity which can be beneficial and should be applied at every stage of low back pain treatment. Many studies have shown that aerobic exercises have a positive effect on psychological state and functionality in cases of chronic low back pain [15-18]. In their study Hurwitz et al. concluded that instead of specific low back exercises, non-specific exercise with walking was more effective on the psychological condition in chronic low back pain. It was also shown that physical activity was restricted due to fear of pain [19]. In our study, there were statistically significant increases in the mental health and bodily pain scores of the over ground walking group. Although there was no statistically significant difference between the groups, it can be said the patients felt more comfortable and thus, more active when walking over ground.

No statistically significant changes could be found in studies which researching the difference between over ground and treadmill walking parameters [20-22]. In their study which compared the energy consumption of over ground and treadmill walking in older adults, Berryman et al. found that treadmill walking required more energy [23].

In the treadmill walking group patients reached the target heart rate because the physician who was supervising the exercise altered the speed and tilt. The real problem is walking at the target heart rate in a natural environment. Due to pain, fatigue and personal factors, walking speed can reduce and patients cannot reach the target heart rate. In our study when walking over ground, the patients were monitored by polar system and they were encouraged verbally to reach the target heart rate. There was no statistically significant difference between the two groups in terms of reaching the target heart rate time. However, patients cannot determine their walking speed to do aerobic exercise in the natural environment without a system such as polar which shows the heart rate. Therefore, we think that instead of high cost treadmill walking programs, people of all ages and education levels can do aerobic exercises in the natural environment with just polar heart rate monitoring systems with two-week exercise training.

Chronic low back patients avoid physical activity because of their fear of pain. This results in decreasing muscle strength and cardiac capacity, and predisposition to muscle spasms. This situation causes deconditioning which is an important factor that makes pain chronic. There are studies which have shown that with the increase in aerobic capacity, pain and disability scores decrease [13,15]. Several studies have shown that there is a greater loss of strength in the extensor muscle group than in the flexor muscles in patients with chronic low back pain [6,10,24]. Therefore, many studies in the literature have assessed the effect of extensor muscle strengthening exercise programs. Also, in these studies the strengthening of abdominal muscles was added to the exercise program. In our study, abdominal and back muscle strengthening exercises were added to both groups. Studies have shown that while walking, the back extensor and rectus abdominal muscles contract to stabilize the body on the pelvis. When the walking speed increases, the activation of these muscles also increases [25,26]. In our study dynamometric measurements of muscle strength were not applied due to the pain of the patients. However in studies like this one, at least the measurement of the endurance of flexor and extensor group muscles in seconds may be beneficial as a follow up.

Conclusion

In our study, we concluded that over ground walking is more effective in terms of reducing disability due to low back pain than treadmill walking. We couldn't evaluate the long-term results of this effectiveness due to the short follow-up period. Future studies evaluating and comparing the effectiveness of two different walking exercises for chronic low back pain should have higher numbers of patients, long term follow up periods and they should be well-designed, randomized and controlled.

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