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The Effect Of Dynamic Versus Isometric Resistance Training With Swd On Pain And Functioning Among Adults With Osteoarthritis Of The Knee

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Abstract:
In this study we compare 4 weeks of isometric versus dynamic resistance training with SWD ON pain and functioning among adults with osteoarthritis of the knee. A total of 30 volunteer subjects with OA of the knee, Group A: (Dynamic resistance training with shortwave diathermy) -n = 15 (7 males and 8 females) and Group B: (Isometric resistance training with shortwave diathermy) -n = 15 (8 males and 7 females). Strength exercises for the legs, 3 times weekly for 4 weeks. Dynamic group: exercises across a functional range of motion; isometric: exercises at discrete joint angles. The time to descend and ascend a flight of stairs and to get down and up off of the floor. Knee pain was assessed immediately after each functional task. The VAS, WOMAC and Stair Ascending and descending score Index was used to assess perceived pain, stiffness, and functional ability. Measures of pain and functioning were significantly and favourably affected in the training groups. The improvements in the 2 training groups as a result of their respective therapies were not significantly different. Dynamic or isometric resistance training with SWD improves functional ability and reduces knee joint pain of patients with knee OA.

Keywords: Osteoarthritis, Pain, SWD, Isometric training, Dynamic Training

INTRODUCTION

Osteoarthritis (OA) is a chronic degenerative condition that damages the synovia, subchondral bone, joint capsule, and joint cartilage [1]. The most prevalent rheumatological condition that results in physical impairment is osteoarthritis (OA).

It has a complex etiology40, is more common in middle-aged and older age groups, and is more common as you get older. Although it affects both sexes equally before the age of 55, women are more likely to experience it after that point. [2] Both age and repetitive mechanical stresses are factors in the genesis of OA. Three key sub-groups of the etiological factors have been identified in recent studies: sex, anatomy, and body mass.

Clinical symptoms include joint discomfort, stiffness, restricted joint motion, quadriceps muscle weakness, and changes in proprioception. Because it results in a progressive loss of function, decreased strength in the muscle groups involving the joints is important. [3] Because the impact of the diseased processes may be distinguished as characteristics on the X-ray, such as joint space narrowing, subchondral sclerosis, and osteophyte formation, radiographic appearance has historically been the cornerstone of diagnosis. [4] Simple analgesics, NSAIDs, intra-articular injections, physical therapy agents, and therapeutic exercises, usage of assistive equipment, education, weight loss, social support, and surgery are some examples of medicines that may be used as part of a treatment plan. [5]

Isometric or dynamic resistance training interventions have a favourable effect on OA symptoms. The training occurred at distinct joint angles, which is a fundamental limitation of the studies on isometric resistance training and may account for the modest gains in functional capacity. Isometric resistance training increases muscular strength solely at the joint angle at which the training is performed, even if functional ability necessitates movement of the joint over a functional range. The extent to which isometric training can

influence the performance of functional activities that include joint movement beyond the joint angle dictated by isometric training may be constrained by the specificity of the training principle [6]. On the other hand, a benefit of isometric training might be that it does not put the joint under stress over a functioning range of motion (ROM). Less pain during and after resistance exercise may be the result of decreased joint motion. Dynamic resistance training, however, increases the strength of the trained muscle over the whole range of motion (ROM) used for the resistance training in non-OA patients. Dynamic resistance training has been shown to enhance knee strength, neuromuscular performance, and certain functional task performance, but not more than the gains seen in a control group of OA individuals. Dynamic resistance training increases strength and functionality over the training range of motion, but because the joint is loaded as it is moved, OA patients may experience pain. [7]

SWD has mostly been utilised in knee OA to reduce pain, increase knee muscular strength, and enhance functional performance. An increase in vascular circulation, a change in tissue temperature, an increase in pain threshold, a reduction in pain and swelling, and the promotion of healing in tissues with chronic inflammation are all possible effects of applying SWD to the implicated tissues. [8]

Need of the study: The need of the present study was to compare the effect of dynamic versus isometric resistance training with SWD on pain and functional ability in patient with knee OA.

MATERIALS AND METHODS:

Subjects: Total no. of 30 patients was selected after meeting the inclusion and exclusion criteria.

Number and Source

- 30 patients
- Orthopaedic Physiotherapy Outpatient Department of Prakash Hospital Noida

Inclusion Criteria:

- Subject having age between 40 to 60 years both male and female.
- Pain on most days in one or both knee.
- Grade 2 of knee OA
- Self - reported disability due to knee pain for at least 3 of the following descending or ascending stairs, walking, kneeling, or performing daily activity.

Exclusion Criteria

- Physiotherapy and knee surgery in previous 12 months.
- Intra - articular steroid injection
- Lower limb arthroplasty
- A sever medical condition
- A systemic arthritic condition

Sampling:

According to the inclusion criteria, 30 subjects were selected from Prakash Hospital, Noida and randomly divided in to two groups through lottery method.

- **Group A:** (Dynamic resistance training with shortwave diathermy) -n = 15 (7 males and 8 females)
- **Group B:** (Isometric resistance training with shortwave diathermy) -n = 15 (8 males and 7 females)

METHODOLOGY

All subjects were asked to come for the study wearing loose clothes so that the knee joint to be tested could be exposed properly. [9, 10]

Pre-tests: The subjects were screened first according to the inclusion and exclusion criteria. Those who met the inclusion criteria were approached with the proposal of the study. The participants underwent a general assessment procedure. The procedures were clearly explained to the subjects of all the two groups respectively. Written informed consent was taken from the subjects who agreed to participate. The baseline measurement at 0 day for pain and functional disability status were taken through VAS which deals with pain, WOMAC pain and physical function subscale scores and stair ascending and descending time.

Group A- (Dynamic Resistant Training and SWD Group)

SWD Treatment: Subjects received twenty minutes of SWD applied by electrodes arranged by the contra planer method on the anterior and posterior aspects of the affected knee. The dosage of SWD was based on each subject's tolerance but all subjects were generally advice that they should feel just comfortable warmth.

Exercise protocol: A session of dynamic resistant training included a five minute warm up, 30 minute dynamic resistant training, and 5 minute cool down. The warm up consisted of mild unweighted leg movements to increase blood flow to the leg muscles. After the warm up subjects completed the six dynamic resistance training exercises, which were designed to develop the ankle dorsi and plantar flexors, knee flexors and extensors, and hip flexors and extensors.

During training week 1st each subject perform one set of 8 repetitions of each exercise using the yellow theraband. Subject increase the number of repetitions or sets of repetitions in second and third week using red tharadand in second week and green tharaband in third week, each subject performed to set often repetitions of each exercise. Progression of training continue until during forth week, each subject perform three set of 14 repetitions of each exercise with black theraband. The cool down consist of five minute of stretching exercises.

Group B- (Isometric Resistance Training and SWD Group)

SWD Treatment: Subjects received twenty minutes of SWD applied by electrodes arranged by the contra planer method on the anterior and posterior aspects of the affected knee.

The dosage of SWD was based on each subject's tolerance but all subjects were generally advice that they should feel just comfortable warmth.

Exercise protocol: Subject perform the six isometric resistant training exercises by using standard isometric training technique. These techniques required the individuals to generate tension in the muscle without changing the joint angle. Subjects generated this muscle tension by using the black theraband, which they were unable to stretch during exercise. After positioning the joint to the prescribe angle the subject generate tension against the theraband in the muscle group for 3 to 5 seconds without moving the joint angle. Training joint angles include 0 degree of dorsi and plantar flexion when performing ankle dorsi and planter flexion of the ankle, ten degree of knee flexion when performing knee flexion and extension, and ten degree of hip flexion and ten degree of hip extension when performing the two hip resistance training exercise.

During training 1st week each subject perform one set of 8 repetitions while producing mild or sub maximum muscle tension during the exercise. After 1st week each subject was told to complete each isometric repetition while producing maximum muscle tension for 3 to 5 second. Subjects increase the number of repetitions or sets of repetitions in second and third week. Progressions of training continue until during fourth week, each subject performs three sets of 14 repetitions of each exercise with a two minute rest between sets. The cool down consist of five minutes of stretching exercises. [11, 12]

OUTCOME MEASURES

Measurement of

- Pain
- Functional status
- Ascending and descending stairs

On 0 day, 2nd week and 4th week

WOMAC was used to evaluate both functional ability and perceived discomfort. For patients with hip and knee OA, the WOMAC is a multimodal, disease-specific, self-administered health status assessment. [13]

From the initial evaluation to the 4-week follow-up exam, pain was measured at weekly intervals. For this assessment, a 10 cm Visual Analog Scale (VAS) with "no pain" and "worst agony imaginable" anchors on the left and right sides, respectively, was employed.

For three trials, each individual was required to climb and descend five steps. The individuals also described knee and quadriceps involvement as causing physical discomfort.

Statistical Analysis: Data were summarized as Mean± SD. Groups were compared by repeated measures analysis of variance (RM ANOVA) and the significance of mean difference within and between the groups was done by Newman - Keuls post hoc test. A two - tailed (α - 2) probability $p<0.05$ was considered to be statistically significant. All analyses were performed on SPSS (version 15.0).

For each group (treatment) and outcome measure (VAS, WOMAC osteoarthritis index and Stair ascending and descending test), a relative percent mean change (from 0 wk to 4 wk) was also evaluated as % change = MEAN o wk - MEAN 4 wk / MEAN o wk x 100

RESULTS AND OBSERVATIONS:

1. Visual Analogue Scale: The visual analogue scale (VAS) scores of two groups (Group A: Dynamic resistance training with SWD and Group B: Isometric resistance training with SWD) at three different periods (0 wk , 2 wk and 4 wk) were summarized in Table 1. Table 1 showed that the mean VAS scores in both groups (treatments) decreases after the treatment and the decrease was evident 1.2 times higher in Group A (79,8 %) than Group B (69.7 %) .

Table 1: Visual analogue scale summary (Mean ± SD, n = 15) of two groups at three different periods

Groups	Periods			% mean change (0 wk - 4 wk)	Mean fold change (Group A / Group B)
	0 wk	2 wk	4 wk		
Group A	8.60 ±0.51 (8-9)	5.87 ±0.74 (5-7)	1.73 ±0.59 (1-3)	79.8 %	1.2
Group B	8.80 ±0.56 (8-10)	5.93 ±0.80 (5-7)	2.67± 0.82 (1-4)	69.7 %	

Numbers in parenthesis represents data range (min - max)

On comparing the mean VAS within the groups (Table 2), the VAS in both group decreases significantly ($p<0.001$) at 2 wk and 4 wk (post treatment) as compared to 0 wk (pre-treatment). Further, the VAS in both the groups also decreases significantly ($p<0.001$) compared to 2 wk.

Table 2: For each group, significance (p-value) of mean difference in VAS between the periods within groups

Comparisons	Group A (p value)	Group B (p-value)
0 wk vs. 2 wk	0.00012	0.00012
0 wk vs. 4 wk	0.00013	0.00013
2 wk vs. 4 wk	0.00012	0.00012

Similarly, comparing the mean VAS between the groups (Table 3), the VAS did not differed significantly ($p>0.05$) at 0 wk ($p=0.42455$) and 2 wk ($p=0.78967$) between the two groups i.e. found to be statistically the same while at 4 wk ($p=0.00052$) a decreased significantly ($p<0.001$) more in Group A as compared to Group B.

Table 3: For each period, significance (p value) of mean difference in VAS between the groups

Comparisons	Group A vs. Group B (p value)
0 wk	0.42465
2 wk	0.78967
4 wk	0.00052

2. WOMAC OSTEOARTHRITIS INDEX:

The WOMAC osteoarthritis index scores of two groups (Group A: Dynamic resistance training with SWD and Group B : Isometric resistance training with SWD) at three different periods (0 wk , 2 wk and 4 wk) were summarized in Table 4. Table 4 showed that the mean WOMAC osteoarthritis index scores in both groups (treatments) decreases after the treatment and the decrease was evident 1.4 times higher in Group A (70.7 %) than Group B (49.5 %).

Table 4: WOMAC osteoarthritis index score summary (Meana SD, a - 15) of two groups at three different periods

Groups	Periods			% mean change (0 wk - 4 wk)	Mean fold change (Group A/ Group B)
	0 wk	2 wk	4 wk		
Group A	75.60 ±5.95 (65-85)	46.67± 2.79 (41- 51)	22.13±3.60 (16-30)	70.7%	1.4
Group B	77.40 ±5.60 (68-85)	55.13±4.66 (47-61)	39.07 ±2.37 (36-43)	49.5%	

Numbers in parenthesis represents data range (min - max)

On comparing the mean WOMAC osteoarthritis index score within the groups (Table 5), the WOMAC osteoarthritis index score in both groups decreases significantly ($p<0.001$) at 2 wk and 4 wk (post treatment) as compared to 0 wk (pre-treatment). Further, WOMAC osteoarthritis index scores in both groups also decreases significantly ($p<0.001$) at 4 wk as compared to 2 wk.

Table 5: For each group, significance (p-value) of mean difference in WOMAC osteoarthritis index score between the periods- within groups

Comparisons	Group A (p value)	Group B (p-value)
0 wk vs. 2 wk	0.00012	0.00012
0 wk vs. 4 wk	0.00013	0.00013
2 wk vs. 4 wk	0.00012	0.00012

Similarly, comparing the mean WOMAC osteoarthritis index score between the groups (Table 6) , the WOMAC osteoarthritis index score did not differed significantly ($p>0.05$) between the two groups at 0 wk ($p=0.26412$) while differed significantly ($p<0.001$) at both 2 wk ($p= 0.00011$) and 4 wk (p - 0.00011). In other words WOMAC osteoarthritis index scores improved (decreased) at 2 wk and 4 wk more significantly ($p<0.001$) in Group A than Group B.

Table 6: For each group, significance (p-value) of mean difference in WOMAC osteoarthritis index scores between the groups

Periods	Group A vs. Group B (p value)

0 wk	0.26412
2 wk	0.00011
4 wk	0.00011

3. STAIRS ASCENDING AND DESCENDING TEST

The stairs ascending and descending test scores of two groups (Group A: Dynamic training with SWD and Group B: Isometric resistance training wide SWD) at three different periods (0 wk, 2 wk and 4 wk) were summarized in Table 7. Table 7 showed that the mean stairs ascending and descending test scores in both groups (treatments) decreases after the treatment and the decrease was evident 1.1 times in higher in Group A (76.4 %) than Group B (68.7 %)

Table 7: Stairs ascending and descending test score summary (Mean± SD, n=15) of two groups at three different periods

Groups	Periods			% mean change	Mean fold change
	0 wk	2 wk	4 wk	(0 wk - 4 wk)	(Group A / Group B)
Group A	8.20 ±1.08 (6-10)	4.53 ± 1.06 (3- 6)	1.93±1.03 (1-4)	76.4%	1.1
Group B	8.73 ±0.96 (7-10)	5.47 ±0.99 (4-7)	2.73 ±0.59 (2-4)	68.7%	

Numbers in parenthesis represents data range (min - max)

On comparing the mean stair ascending and descending test score within the groups (Table 8), the stair ascending and descending test score in both groups decreases significantly ($p<0.001$) at 2 wk and 4 wk (post treatment) as compared to 0 wk (pre=treatment). Further, stair ascending and descending test score in both groups also decreases significantly ($p<0.001$) at 4 wk as compared to 2 wk.

Table 8: For each group, significance (p-value) of mean difference in stair ascending and descending test score between the periods- within groups

Comparisons	Group A (p value)	Group B (p-value)
0 wk vs. 2 wk	0.00012	0.00012
0 wk vs. 4 wk	0.00013	0.00013
2 wk vs. 4 wk	0.00012	0.00012

Similarly, comparing the mean stairs ascending and descending test score between the groups (Table 9), the stairs ascending and descending test score did not differed significantly ($p>0.05$) between the two groups at 0 wk (p - 0.13773) while differed significantly ($p<0.05$) at both 2 wk (p - 0.01116) and 4 wk (p - 0.02813). In other words stairs ascending and descending test scores improved (decreased) at 2 wk and 4 wk more significantly ($p< 0.05$) in Group A than Group B.

Table 9: For each group, significance (p-value) of mean difference in stair ascending and descending test scores between the groups

Periods	Group A vs. Group B (p value)
0 wk	0.13773
2 wk	0.01116
4 wk	0.02813

DISCUSSION

In this study, 50 patients with knee OA were randomly assigned to one of two groups: group A (dynamic resistance training with SWD), which included 30 patients who met the inclusion criteria (Isometric resistance training with SWD). Physical disabilities from OA of the knee, particularly those related to ambulatory dysfunction and transfer issues, are possible. Functional restrictions become more obvious as the condition progresses. [3, 8]

Treatment for knee OA seeks to manage pain, maintain and improve range of motion and muscular strength, and improve independence in activities of daily living (ADL). In the acute phase, resting, cane or stick walking, applying ice, and TENS are all options. NSAIDs and analgesics can also be given. In the chronic phase, deep and superficial heating can be used in conjunction with medication to lessen pain and muscle spasm. Exercises that are isometric can help maintain muscle strength during the acute phase. Exercises that are isometric, isotonic, and isokinetic are used to build muscle strength and stamina. Exercise can be used in conjunction with physical therapy agents to reduce pain and spasms, boost therapy compliance, and improve overall health.

Prior to participating in the trial, participants were asked about their level of pain. Both groups saw a considerable reduction in pain, although dynamic resistance training was more successful. Dynamic and isometric resistance training, as demonstrated by Robert Top et al., decreased experienced knee joint pain while having no impact on perceived joint stiffness. Perceived functional limits were only lessened by dynamic training. [10, 14]

As determined by the WOMAC, functionality significantly improved in this trial. At first, both groups experienced this improvement, but towards the end of the study, only the members of the dynamic resistance training with SWD group

continued to experience it. Essential daily tasks such as safely climbing and descending stairs might be challenging for a patient with knee osteoarthritis. Physical therapists must regularly assess a patient's preparedness to carry out functional tasks like stair climbing and descending, which carry a substantially higher risk of injury, especially when patients first try to descend stairs. In this study, both groups showed improved stair ascending and descending times. However, the dynamic resistance training group saw greater improvement. [12]

This study shows that both groups help patients with knee OA feel less pain and function better, although dynamic resistance training with SWD is more effective than isometric resistance training with SWD at reducing pain and enhancing function. These findings indicate that dynamic resistance training with SWD is a suitable and effective treatment for patient with OA of knee.

FUTURE RESEARCH:

As we know that osteoarthritis is a very common condition. In the present study we used small sample size and the duration of it is 4 weeks but further we can increase sample size and duration. In this study we have used dynamic and isometric resistance training with SWD but further in this study we can also check BMI of the patients and other interventions can also be used like - ultrasound, TENS, stretching exercise, PNF etc.

CONCLUSION:

This study found both the treatment (Dynamic resistance training with SWD and isometric resistance training with SWD) effective in the management of pain and functioning among adults with osteoarthritis of the knee but dynamic resistance training with SWD was found to be significantly more effective than isometric resistance training with SWD.

REFERENCES:

[1]. Akyol Y, Durmus D, Alayli G, Tander B, Bek Y, Canturk F, Tastan Sakarya S. Does short-wave diathermy increase the effectiveness of isokinetic exercise on pain, function, knee muscle strength, quality of life, and depression in the patients with knee osteoarthritis? A randomized controlled clinical study. Eur J Phys Rehabil Med. 2010 Sep; 46(3):325-36. Epub 2010 Jul 16. PMID: 20926998.

[2]. Chen Y, Yu Y, He CQ. [Correlations between Joint Proprioception, Muscle Strength, and Functional Ability in Patients with Knee Osteoarthritis]. Sichuan Da Xue Xue Bao Yi Xue Ban. 2015 Nov; 46(6):880-4. Chinese. PMID: 26867325.

[3]. Mikesky AE, Mazzuca SA, Brandt KD, Perkins SM, Damush T, Lane KA. Effects of strength training on the incidence and progression of knee osteoarthritis. Arthritis Rheum. 2006 Oct 15; 55(5):690-9. doi: 10.1002/art.22245. PMID: 17013851.

[4]. Adegoke, B.O.A* And Gbeminiyi, M.O. Efficacy Of Ice And Shortwave Diathermy In The Management Of Osteoarthritis Of The Knee – A Preliminary Report. African Journal of Biomedical Research, Vol. 7 (2004); 107 – 111.

[5]. Teichtahl A, Wluka A, Cicuttini FM. Abnormal biomechanics: a precursor or result of knee osteoarthritis? Br J Sports Med. 2003 Aug; 37(4):289-90. doi: 10.1136/bjsm.37.4. 289. PMID: 12893709; PMCID: PMC1724 660.

[6]. Lim BW, Hinman RS, Wrigley TV, Sharma L, Bennell KL. Does knee malalignment mediate the effects of quadriceps strengthening on knee adduction moment, pain, and function in medial knee osteoarthritis? A randomized controlled trial. Arthritis Rheum. 2008 Jul 15; 59(7):943-51. doi: 10.1002/art.23823. PMID: 18576289.

[7]. Baker KR, Nelson ME, Felson DT, Layne JE, Sarno R, Rouben off R. The efficacy of home based progressive strength training in older adults with knee osteoarthritis: a randomized controlled trial. J Rheumatol. 2001 Jul; 28(7):1655-65. PMID: 11469475.

[8]. Hassan BS, Mockett S, Doherty M. Influence of elastic bandage on knee pain, proprioception, and postural sway in subjects with knee osteoarthritis. Ann Rheum Dis. 2002 Jan; 61(1):24-8. doi: 10.1136/ard.61.1. 24. PMID: 11779753; PMCID: PMC175388 0.

[9]. Cetin N, Aytar A, Atalay A, Akman MN. Comparing hot pack, short-wave diathermy, ultrasound, and TENS on isokinetic strength, pain, and functional status of women with osteoarthritic knees: a single-blind, randomized, controlled trial. Am J Phys Med Rehabil. 2008 Jun; 87(6):443-51. doi: 10.1097/PHM.0b013e 318174e467. PMID: 18496246.

[10]. Felson DT, Lawrence RC, Dieppe PA, Hirsch R, Helmick CG, Jordan JM, Kington RS, Lane NE, Nevitt MC, Zhang Y, Sowers M, McAlindon T, Spector TD, Poole AR,

Yanovski SZ, Ateshian G, Sharma L, Buckwalter JA, Brandt KD, Fries JF. Osteoarthritis: new insights. Part 1: the disease and its risk factors. Ann Intern Med. 2000 Oct 17; 133(8):635-46. doi: 10.7326/0003-4819-133-8-200010170-00016. PMID: 11033593.

[11]. Roddy E, Zhang W, Doherty M. Aerobic walking or strengthening exercise for osteoarthritis of the knee? A systematic review. Ann Rheum Dis. 2005 Apr; 64(4):544-8. doi: 10.1136/ard.2004.028746. PMID: 15769914; PMCID: PMC1755453.

[12]. Gulsah Sahin, Naciye Fusun Toraman, Yeliz Ozdol, Emel Cetin, Ceylan Ece Top, Sibel Nalbant, Funda Baran. The Effect of Two Different Strength Training Programs on Functional Performance and Pain of Elderly Women with Knee Osteoarthritis. Middle East Journal of Age and Ageing Volume 7, Issue 5, November 2010.

[13]. Jamtvedt G, Dahm KT, Holm I, Flottorp S. Measuring physiotherapy performance in patients with osteoarthritis of the knee: a prospective study. BMC Health Serv Res. 2008 Jul 8; 8:145. doi: 10.1186/1472-6963-8-145. PMID: 18611250; PMCID: PMC2475531.

[14]. Peat G, McCarney R, Croft P. Knee pain and osteoarthritis in older adults: a review of community burden and current use of primary health care. Ann Rheum Dis. 2001 Feb; 60(2):91-7. doi: 10.1136/ard.60.2.91. PMID: 11156538; PMCID: PMC1753462.