Exercise and Transcutaneous Electrical Nerve Stimulation Treatment in Middle-Aged Patients with Knee Osteoarthritis

Adel Rashad Ahmed
Department of Basic Science, Faculty of Physical Therapy, Cairo University.

ABSTRACT

Background and Purpose: *Knee osteoarthritis(OA) is a major cause of disability among adults peoples. Physiotherapy interventions are recommended as the first line in treatment for knee osteoarthritis. The present study aiming to test whether the addition of transcutaneous electrical nerve stimulation (TENS) to exercise program is more effective than exercise program alone in treating middle-aged patients with knee osteoarthritis.* ***Subjects:*** *Thirty male patients with knee osteoarthritis, their age ranged from 38-58 years, participated in this study.* ***Methods:*** *Patients were randomly assigned into two equal groups. Group A, received exercise program in addition to TENS treatment at each of the treatment sessions. Group B, received exercise program only. The treatment program for both groups include, 5 sessions per week and continue for 6-weeks. Pain measurement and knee function measured by Timed Up-and-Go, and Stair Walking tests have been used to measure knee performance outcomes before and after the treatment program.* ***Results:*** *The results revealed improvement in pain and knee function in both groups after treatment program, but it was highly significant in group A compared to group B.* ***Conclusion:*** *Exercise program and TENS were more effective in pain relief and knee functional improvement than separate exercise program only in treating patients with knee osteoarthritis.*

Key words: *Knee OA, Exercises, TENS, Timed Up and Go Test, Stair Walking Test.*

INTRODUCTION

Knee osteoarthritis (OA) is a major cause of disability among adults peoples[20]. Osteoarthritis is often thought of as a disease of the elderly; however, knee osteoarthritis is evident at younger ages. Approximately 5% of the population age 35 to 54 years has radiographic signs of knee OA, the majority has a previous knee injury[8]. Pain, joint stiffness, loss of function and decreased muscle strength are the major signs and symptoms of knee OA[11,12]. The activities most commonly reported as difficult by people with knee OA include walking, climbing stairs, rising from a chair and transferring, are the most important component of physical rehabilitation for people with knee OA[5].

Physiotherapy can play an important role in the management of patients with knee OA. One aim of the physical therapy treatment for patients with knee OA is to decrease joint pain and increase strength of the musculature surrounding the knee joint. An overview of systematic reviews covering physiotherapy interventions for patients with osteoarthritis of the knee demonstrates that exercise, low-level laser, transcutaneous electrical nerve stimulation and acupuncture can reduce pain and improve function in patients with knee OA[14].

There is strong evidence that TENS is effective in managing OA knee pain; however, there is limited evidence to support its effectiveness in improving physical function It is unclear if transcutaneous electrical nerve stimulation (TENS) produces an improvement in physical function parallel to pain reduction[17]. TENS has the advantage of being effective, inexpensive, simple and essentially free from side effects[13].

Exercise is considered to be one of the most important treatment for patients with mild to moderate knee OA[23]. Combined non-pharmacological approaches such as exercise combined with modalities to reduce pain and swelling will result in the most beneficial effects[21]. It is not clear whether TENS and exercise have a similar effect on pain and function in middle-aged patients compared with elderly patients.

The present study aims to examine whether the addition of (TENS) to exercise training would produce better physical function than exercise alone in treating middle-aged patients with knee osteoarthritis.

MATERIALS AND METHODS

Thirty male patients with knee OA, their age ranged from 38-58 years, were recruited from outpatient clinic of physiotherapy at King Saud Medical Complex, Riyadh, Saudi Arabia. All patients were referred after confirmed clinically and radiologically diagnosed of knee OA by orthopedic surgeon.

The inclusion criteria included:

knee pain lasting for six months or longer.

1- subjects with knee OA based on clinical criteria developed by Altman[1].
2- no radiation of knee pain.
3- normal neurological function of lumbosacral region.

The exclusion criteria included:

1- major trauma to the knee or systemic disease.
2- surgical procedure on lower extremity in the last 6 months, or subjects with cardiac pacemaker.
3- subjects who had received intraarticular corticosteroid within 4 weeks before the study.

Patients were instructed to keep taking any current medications and not to start taking new medications for osteoarthritis during the study period.

Experimental Design

This study was prospective randomized clinical trial with a 6-weeks follow-up.

Procedures

All patients provided informed consent before participation. All baseline information that include history taking (name, age, weight, height, body mass index, and current duration of knee pain), were obtained before randomization.

Evaluation procedures

Pain intensity and functional knee ability using, Timed Up-and-Go test, and Stair Walking test (in seconds, using a digital stopwatch) were the outcome measurements.

Pain intensity: pain and discomfort during rest and various functional activities were recorded on a 10 cm VAS, where 0 indicated no pain and 10 indicated extremely intense pain. The subject was asked to mark the scale at a point where he believed it represent his pain experienced.

Timed-Up and Go Test is a validated and reliable test for physical function of knee mobility[24]. The subjects were seated in an standard armchair and instructed on the word "Go" to stood up, without using his arms, walk at a comfortable speed three meters, turned around, returned to the chair, and sit down. The task was timed by a stop watch.

Stair Walking test: is a validated and reliable test[22], the time required to ascend a small wooden stairs consisting of three steps of 20 cm up and three steps of 15 cm down. Subjects were instructed on the word "Go" to walk up and down the stairs at a comfortable pace, can use only one handrail during the test as support.

Treatment procedures

After the baseline assessments, subjects were randomly assigned into two groups of equal number:

Group (A) were subjected to exercise program in addition to TENS treatment and group (B) were subjected to exercise program only.

Group (A): subjects in this group received an exercise program combined with TENS treatment at each of the treatment sessions. TENS treatment was applied at the affected knee for 30 minutes from a single-channel, TENS unit, (Model Combi 200, Gymna Uniphy N.V- Bilzen Belgium). The stimulator delivered a current at 120 Hz with a pulse width of 200μs. Two different pairs of surface rubber electrodes were placed on the site with the most tenderness point and the opposite side to it. The smaller electrode was placed on the site of tenderness. The intensity of TENS stimulation was adjusted so that a tingling sensation was felt by the patient at the sensory level.

Exercise program consists of active range of motion exercises for the knee, muscle strengthening exercises for the hip and knee, muscle stretching for the lower limbs, and riding a stationary bike[6]. The number of strengthening exercise bouts and the stationary bike riding time can be increased on the basis of patient tolerance. Patients exercised in a painless or minimally painful manner, otherwise, the regimen was decreased accordingly for that patient.

Group (B): Subjects in this group received the same exercise program as in group (A).
The treatment program for both groups include, 5- sessions per week and continue for 6-weeks.

Data Analysis

All dependent variable are described and presented as mean ± SD. The effects of treatment were evaluated separately in both groups before and after treatment using student t-test. The level of significance was set at 0.05 for all tests.

RESULTS

Thirty patients with knee OA classified randomly into two equal groups. At initial assessment, statistical analysis did not reveal any significant differences between the two groups regarding the demographic characteristics of the subjects as shown in table 1.

Table (1): Description of the Subjects.

	Group A no= 15 Mean ±SD	Group B no= 15 Mean ±SD	Significance
Age (year)	47.2±4.4	47.7±4.5	N.S
Height (m)	1.71±.07	1.7±.09	N.S
Weight (Kg)	79.3±7.3	79.8 ±7.7	N.S
BMI (Kg/m2)	27.11±4.3	26.91± 4.1	N.S
Onset of knee OA duration (y)	5.3±2.8	5.6±2.2	N.S

N.S: non-significant

Results of Pain intensity

There were significant improvements in pain intensity in both groups after treatment. The mean values of VAS in group (A) were decreased from (8.73±1.12) to (2.14±0.91) with a mean difference 6.59±0.21 which was highly significant (P<0.001). In group B, the mean values of VAS were significantly decreased from (8.92±1.38) to (3.61±1.08) with a mean difference 5.31±0.3 which was significant (P<0.005), as shown in table (2) and figure (1).

Table (2). The mean and standard deviations values for pain measurement pre and post treatment in both groups.

	Group A		Group B	
	Pretreatment	Post treatment	Pretreatment	Post treatment
Mean ± SD	8.73 ±1.12	2.14 ±0.91	8.92±1.38	3.61 ±1.08
Mean difference	6.59±0.21		5.31±0.3	
P .Value	P<0.001*		P<0.005*	

*= Significant

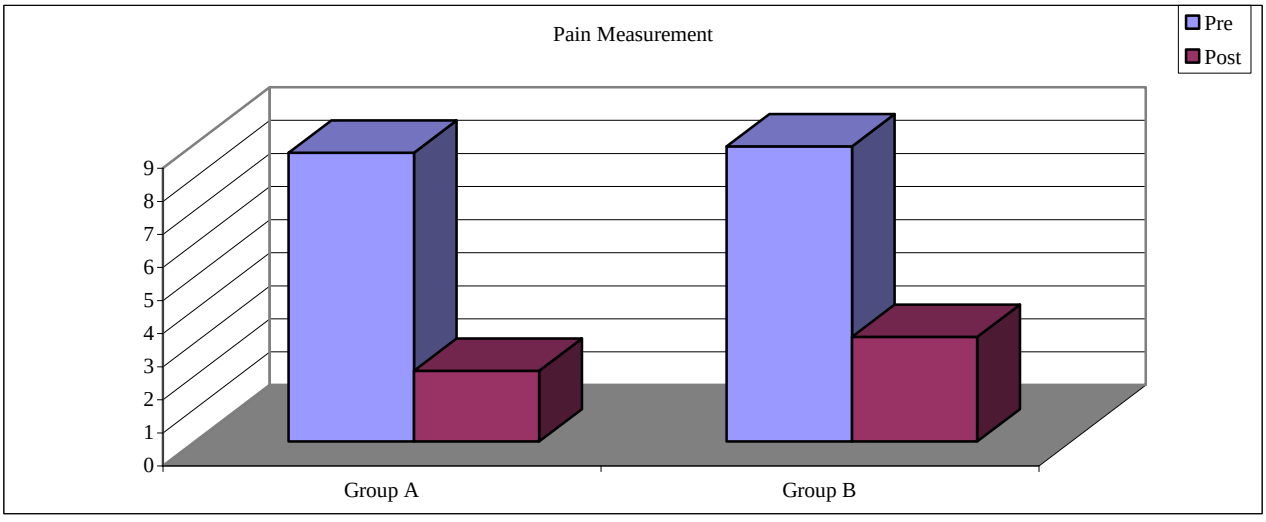

Fig. (1): The mean and standard deviations values for pain intensity pre and post treatment in both groups.

Results of Timed Up-and Go Test

There were significant improvements in Timed Up-and Go Test in both groups after treatment. The mean values in the group A were decreased from (18.12±3.6) to (11.67±3.92) with a mean difference 6.45±1.48 which was significant (P<0.001). In group B, the mean values were significantly decreased from (18.95±4.09) to (14.02±4.10) with a mean difference 4.93±1.99 which was significant (P<0.005), as shown in table (3) and figure (2).

Table (3). The mean and standard deviations values for Timed Up and Go test (sec) pre and post treatment in both groups.

	Group A		Group B	
	Pretest	Posttest	Pretest	Posttest
Mean ± SD	18.12±3.6	11.67±3.92	18.95±4.09	14.02±4.10
Mean difference	6.45±1.48		4.93±1.99	
P .Value	p<0.001*		p<0.005*	

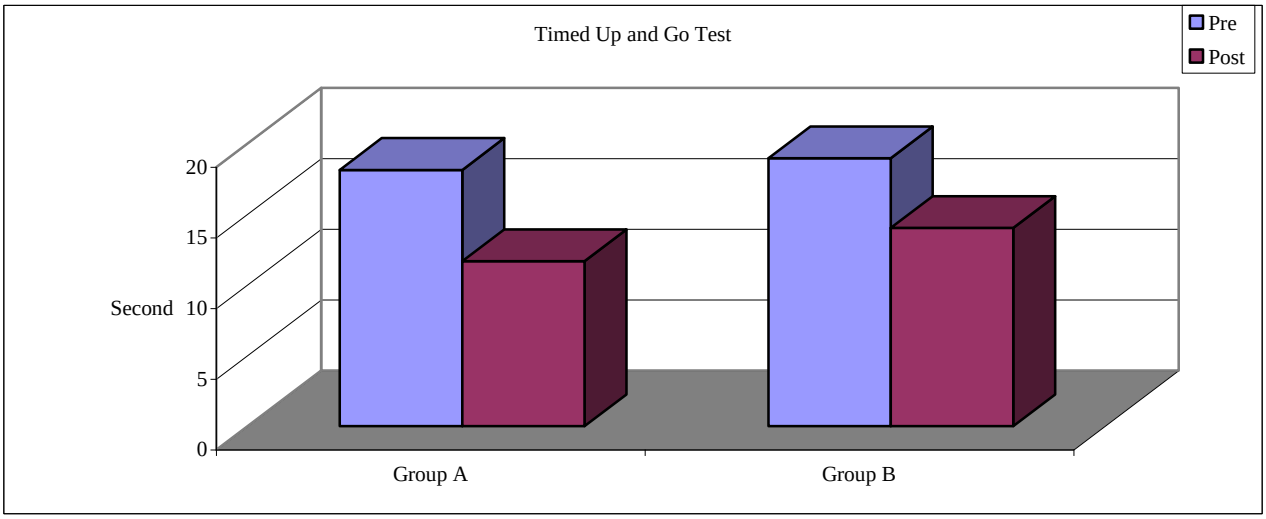

Fig. (2): The mean and standard deviations values for Timed Up and Go test (sec) pre and post treatment in both groups.

Results of Stair Walking test

There were significant improvements in Stair Walking test in both groups after treatment. The mean values in the group A were significantly decreased from (14.2±3.4) to (8.1±3.1) with a mean difference 6.1±2.7 which was significant (P<0.001). In group B, the mean values were significantly decreased from (14.6±3.6) to (9.8±3.9) with a mean difference 4.8±3.2which was significant (P<0.005), as shown in table (4) and figure (3).

Table (4). The mean and standard deviations values for stair walking test (seconds) pre and post treatment in both groups.

	Group A		Group B	
	Pretest	Posttest	Pretest	Posttest
Mean ± SD	14.2±3.4	8.1±3.1	14.6±3.6	9.8±3.9
Mean difference	6.1±2.7		4.8±3.2	
P .Value	P<0.001*		P<0.005*	

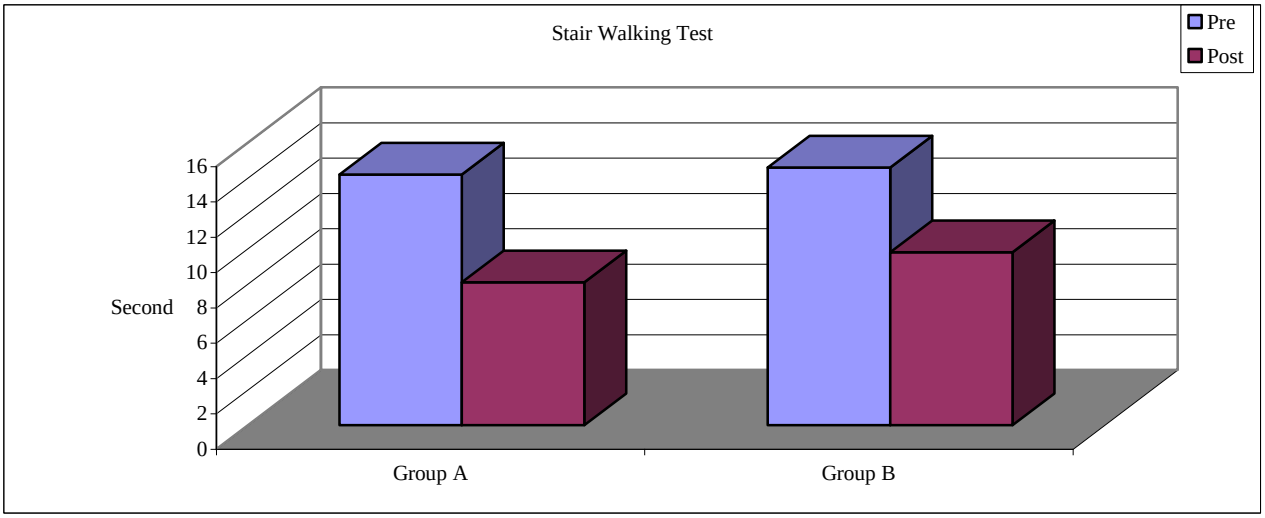

Fig. (3): The mean and standard deviations values for stair walking test (seconds) pre and post treatment in both groups.

Comparison between both groups post-treatment, revealed a statistically significant improvements in pain measurement, Timed-Up and Go test and stair walking test in group (A) compared to group (B), $P<0.05$.

DISCUSSION

The objectives of management of OA of the knee are to relieve pain, maintain or improve mobility, and minimize disability. Different modalities in physiotherapy have been shown to help improve clinical symptoms and function of knee OA[15].

As pain is one of the major factors restricting physical function. There is strong evidence that TENS was effective for immediate relief of pain, as well as improving physical function in patients with knee OA[13]. Pain may discourage people with knee OA from performing exercise, which may result in a reduction in joint mobility over time. So, application of TENS before exercise could control knee pain, which can let patient with knee OA to tolerate more knee exercise in a grater knee range of motion[16].

The finding of the this study showed a positive effects on pain reduction and improvement in knee physical function measured by Timed Up and Go Test and Stair walking Test after treatment. TENS is a common effective modality for treating musculoskeletal pain[18]. TENS may stimulate the large-diameter fibers, which may reduce the transmission of pain signals through the smaller Nociceptive afferent fibers, that inhibiting pain perception[3,4]. As pain, swelling and stiffness are common signs and symptoms of knee OA. High frequency TENS is believed to increase the local blood supply, which in turn may decreased the swelling around the joint, thus improving the freedom of movement within the joint[10].

Exercise is the most common in almost all treatment sessions and this is supported by high quality evidence in the management of knee OA[14]. In osteoarthritis, exercise therapy aims in reducing pain and disability by improving muscle strength and range of motion[7]. Improvement in knee pain measured by VAS in this study may be due to the effect of the comprehensive exercise program that may have addressed more of the impairment found in patients with knee OA[6].

The finding of this study agreed with the previous studies[9] which concluded that therapeutic exercise, and progressive resistance training can increase muscle strength in patients with knee OA. Lower limb muscle strengthening has recently received increased interest as an inexpensive treatment for knee OA due to its ability to reduce knee pain and improve physical function, and also because of its potential ability to reduce knee joint load[19].

The results of the study showed that TENS and exercise treatments have better effects in pain relief and knee function in patients with knee OA. These results came in consistence of previous study[3], showed that

the addition of TENS to exercise training would produce better physical outcomes in people with knee osteoarthritis. If TENS could reduce knee pain, theoretically, it could improve walking performance. There is a good correlation between the VAS score and the Timed-Up-and-Go Test[16]. Non-pharmacological approaches such as exercise combined with modalities to reduce pain and swelling will result in most beneficial effects[21]. Combined exercise therapy with physical agents (TENS) increases performance and compliance of exercise[2].

Because TENS unit is economic and safe modality that patient can use it at home, it is considered as a good choice of treatment in the management of knee OA. Therefore, it is indicated that an effective rehabilitation program should consists of both TENS and an adjunct exercise program. It could be conclude that exercise and TENS can reduce pain and improve function in patients with knee OA.

REFERENCES

1- Altman, R.D.: Criteria for classification of clinical osteoarthritis. J Rheumatol; 27: 10-12, 1991.

2- Cetin, N., Aytar, A., Atalay, A. and Akman, M.N.: 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; 87: 443-451, 2008.

3- Cheing, G.L. and Hui-Chan, C.W.: Does four weeks of TENS and/or isometric exercise produce cumulative reduction of osteoarthritic knee pain?. Clin Rehabil; 16: 749-760, 2002.

4- Cheing, G.L.Y., Tsui, A.Y., Lo, S.K., Hui-Chan, C.W.: Optimal stimulation duration of TENS in the management of osteoarthritic knee pain. J Rehabil Med; 35: 62-68, 2003.

5- Creamer, P., Lethbridge-Cejku, M. and Hochberg, M.: Factors associated with functional impairment in symptomatic knee osteoarthritis. Rheumatology; 39: 490-496, 2000.

6- Deyle, G.D., Henderson, N.E., Matekel, R.L., Ryder, M.G., Garber, M.B. and Allison, C.: Effectiveness of Manual Physical Therapy and Exercise in Osteoarthritis of the Knee A Randomized, Controlled Trial. Ann Intern Med; 132: 173-181, 2000.

7- Doi, T., Akai, M., Fujino, K., Iwaya, T., Kurosawa, H., Hayashi, K. and Marui, E.: Effect of home exercise of quadriceps on knee osteoarthritis compared with non-steroidal anti inflammatory drugs: a randomized controlled trial. Am J Phys Med Rehabil; 87: 258-269, 2008.

8- Ewa, M.R.: Joint injury causes knee osteoarthritis in young adults. Curr Opin Rheumato; Lippincort Williams and Wilkins., l 17:195-200, 2005.

9- Fransen, M., McConnell, S. and Bell, M.: Exercise for osteoarthritis of the hip or knee. Cochrane Database Syst Rev; (3): CD004286, 2003.

10- Grimmer, K.: A controlled double-blind study comparing the effects of strong burst mode TENS and high rate TENS on painful osteoarthritic knees. Aust J Physiother; 38: 49-56, 1992.

11- Harrison, A.L.: The influence of pathology, pain, balance, and self-efficacy on function in women with osteoarthritis of the knee. Phys Ther; 84: 822-831, 2004.

12- Hinman, R.S., Heywood, S.E. and Day, A.R.: Aquatic physical therapy for hip and knee osteoarthritis: results of a single-blind randomized controlled trial. Phys Ther.; 87: 32-43, 2007.

13- Itoh, K., Hirota, S., Katsumi, Y., Ochi1, H. and Kitakoji, H.: A pilot study on using acupuncture and transcutaneous electrical nerve stimulation (TENS) to treat knee osteoarthritis (OA). Chinese Medicine; 3: 2, 2008. http://cmjournal .org/content/3/1/2.

14- Jamtvedt, G., Dahm, K.T., Christie, A., Moe, R., Haavardsholm, E. and Holm, I.: Physical therapy for patients with osteoarthritis of the knee, an overview of systematic reviews. Phys Ther; 88: 123-136, 2008.

15- Jamtvedt, G., Dahm, K.T., Holm, I. and Flottorp, S.: Measuring physiotherapy performance in patients with osteoarthritis of the knee: A prospective study. BMC Health Services Research; 8: 145-150, 2008.

16- Law, P.W., Cheing, G.L. and Amy, Y.Y.: Does Transcutaneous Electrical Nerve Stimulation Improve the Physical Performance of People With Knee Osteoarthritis. J Clin Rheumatol; 10: 295-299, 2004.

17- Philadelphia Panel Evidence-Based Clinical Practice Guidelines on Selected Rehabilitation Interventions for Shoulder Pain. Phys Ther; 81: 1719-1730, 2001.

18- Robinson, A.J.: Transcutaneous electrical nerve stimulation for the control of pain in musculoskeletal disorders. J Orthop Sports Phys Ther; 24: 208-226, 1996.
19- Roddy, E., Zhang, W. and Doherty, M.: Aerobic walking or strengthening exercise for osteoarthritis of the knee? A systematic review. Ann Rheum Dis; 64: 544-548, 2005.
20- Selfe, Terry Kit and Taylor, Ann Gill: Acupuncture and Osteoarthritis of the Knee A Review of Randomized, Controlled Trials. Family and Community Health; 31(3): 247–254, 2008.
21- Sisto, S.A. and Malanga, G.: Osteoarthritis and therapeutic exercise. Am J Phys Med Rehabil; 85: S69-S78, 2006.
22- Skelton, D.A. and McLaughlin, A.W.: Training functional ability in old age. Physiotherapy; 82: 159-167, 1996.
23- Thorstensson, C.A., Roos, E.M., Petersoon, I.F. and Ekdahl, C.: Six-week high-intensity exercise program for middle-aged patients with knee osteoarthritis: a randomized controlled trial. BMC Musculoskeletal Disorders; 6: 27, 2005.
24- Wall, J.C., Bell, C., Campbell, S. and Davis, J.: The Timed Get-Up and-go Test Revisited: Measurement of the component Tasks. Journal of Rehabilitation Research and Development; 37(1): 109-114, 2000.

الملخص العربي

التمرينات والتنبيه العصبي الكهربائي من خلال الجلد في علاج مرضى خشونة الركبة متوسطي العمر

توصف خشونة الركبة على أنها مرض كبار السن مع أنها يمكن حدوثها في الأعمار الأصغر. تهدف الدراسة الحالية إلى معرفة هل إضافة التنبيه العصبي الكهربائي من خلال الجلد إلى برنامج التمرينات يعتبر أفضل من تطبيق برنامج التمرينات فقط في علاج مرضى خشونة الركبة متوسطي العمر. أشترك في الدراسة ثلاثون مريضا يعانون من خشونة الركبة تتراوح أعمارهم من 38-58 عاما. قسموا عشوائيا إلى مجموعتين : المجموعة (أ) والتي عولجت بالتمرينات بالإضافة إلى التنبيه العصبي الكهربائي من خلال الجلد و المجموعة (ب) والتي عولجت بالتمرينات فقط . تلقى المرضى خمس جلسات أسبوعية لمدة ستة أسابيع. تم قياس شدة الألم ، ووظيفة الركبة من خلال اختبار وقت الوقوف والمشي وصعود السلم قبل وبعد انتهاء البرنامج العلاجي. أظهرت النتائج تحسن ذو دلالة إحصائية في كلتا المجموعتين ولكن التحسن كان كبيرا في المجموعة (أ) والتي عولجت بالتمرينات بالإضافة إلى التنبيه العصبي الكهربائي من خلال الجلد مقارنة بالمجموعة (ب) والتي عولجت بالتمرينات فقط . يمكن استنتاج أن إضافة التنبيه العصبي الكهربائي من خلال الجلد لبرنامج التمرينات تعتبر أكثر فعالية في تخفيف ألم ووظيفة الركبة لعلاج مرضى خشونة الركبة متوسطي العمر .