



# Ultra-Reiz Current Appears to be More Effective Modality than Interferential for People with Knee Osteoarthritis: A Randomized Block Clinical Trial

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## ABSTRACT

**Introduction:** Today, increased degenerative disease of the knee, which reduces the efficiency of the activity and quality of life, is one of the most common causes of many population complaints. It is important to properly plan and carry out non-invasive and non-pharmacological therapies to treat the pain and its consequences. The question of which of methods effectively relieves pain, improve function and efficiently increases life quality led to a comparison of two methods, interferential and ultra-reiz (Träbert) currents therapy.

**Methods:** Randomized Block clinical trial carried out at Taleghani general hospital Shahid Beheshti University of Medical Sciences from November 2017 to February 2019. The study included 104 patients of both sexes, aged 38-74 years, with knee osteoarthritis. They were selected based on exclusion and inclusion criteria. The patients were randomly assigned to two groups: A and B. Group A, n: 52 patients, were received ultra-reiz current, and group B, n: 52 patients, were subjected to interferential current. Parameters

assessment were evaluated by the Knee Injury and Osteoarthritis Outcome Score (KOOS) questionnaire with 5 domains: pain, symptoms, ADL, sports/recreational activity, and quality of life. Data were collected at the 1st session and at the end of treatment (at least three times a week). The obtained results were subject to statistical analysis.

**Results:** Data were analyzed in SPSS software by using paired and two independent sample t-test. The mean scores before and after treatment with p-value range 0.002~0.764 showed that there were differences in pain, other symptoms, ADL, sport/recreational activity, and quality of life status between ultra-reiz and IFT groups, but the results were statistically more significant in the ultra-reiz group ( $p < 0.0001$ ).

**Conclusions:** Our study showed that ultra-reiz and IFT were effective for patients with knee OA, but ultra-reiz became a more effective modality than IFT in OA patients.

**Keywords:** ultra-reiz, interferential current, knee osteoarthritis

**Cite this Article:** Ahangari, M., Fashkhami, A.N., Zinalpoor H., Ahangari, H., Sajjadi, M.R.M. 2020. Ultra-Reiz Current Appears to be More Effective Modality than Interferential for People with Knee Osteoarthritis: A Randomized Block Clinical Trial. *Physical Therapy Journal of Indonesia* 1(2): 29-34.

## INTRODUCTION

Osteoarthritis (OA) is one of common degenerative conditions leads to disability, particularly in the older population. In the developed countries it has been taken into account as the most joint problem and a leading cause of chronic pain, mainly owing to knee and/or hip OA.<sup>1</sup> Knee OA represents a significant burden on healthcare provision with remarkable health and welfare costs.<sup>2</sup> Although it may have various and different etiologies but its biologic, morphologic, and clinical findings are similar.<sup>3</sup> The number of patients suffering from OA is likely to increase because of increasing elderly population and the obesity epidemic.<sup>4</sup> The prevalence rates of OA varies in different countries, which possibly contributes by differences in race, culture, lifestyle. According to numerous investigations age, sex, weight, occupation, sports

and recreational activities have significant role as risk factors in the progression of OA.<sup>5</sup> The clinical features for diagnosis of OA includes a number of symptoms and signs, three latent symptoms are knee pain, morning stiffness, and function loss and three latent signs are crepitus, decrease ROM, and bony enlargement.<sup>6</sup> A main risk factor and one of pathogenic forces in OA is mechanical stress which has been detected as a significant factor in causing the inflammatory and catabolic process.<sup>7</sup>

Inflammatory response of joint cartilage is demonstrated as erosion or focal loss of cartilage and activity of osteoblast that is characterized by osteophytosis.<sup>8</sup> In affected population some symptoms of OA namely muscle weakness, joint stiffness, and chronic pain which are serious risk factors for restricted motion and results in impaired quality of life.<sup>9</sup> Treatment plan for knee OA should be based on pain relief, joint mobility improvement

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Received : 2020-07-05

Accepted : 2020-10-27

Published : 2020-12-01

and limit function impairment, and it includes both surgical and conservative options. Surgical methods include various types of arthroscopic interventions, knee arthroplasty, and osteotomy. Non-operative options can be achieved by non-pharmacological and pharmacological methods. Non-operative treatment is usually appropriate for knee OA patients in grades 1-3, which are early stages of OA.<sup>10</sup> To achieving the goals of pain controlling, discomfort, and disability caused by the knee OA condition, through noninvasive and non-pharmacological methods, physical therapy with various techniques is considered as an effective treatment and among the variety of the techniques for pain and its outcomes control, electrotherapy is an effective and appropriate method.<sup>11</sup>

The purpose of physical therapy is to reduce pain, maintaining joint mobility, and improving muscle strength. In a meta-analysis, Page et al.<sup>12</sup> declared that in individuals affected with knee OA, there is strong evidence to indicate that physical therapy interventions can improve the knee's pain and functions. Electrotherapy involves a variety of modalities to treat various diseases. Ultra-reiz is a low frequency rectangular galvanic type of current that has been used for improving knee's pain and functions in knee osteoarthritis patients, lateral humeral epicondylitis, and whiplash injury.<sup>13-15</sup> The current leads to a rise of temperature both locally and segmentally in the stimulation site, which thermal reactions depends on the distance from the treated area.<sup>16</sup>

Interferential therapy (IFT) is a common physiotherapeutic treatment modality used in physical therapy clinics. IFT effectively reduces pain and improves physical function<sup>17</sup> and when it combined with exercise demonstrated a positive interaction effect in pain reduction, decreased medication intake, and improve knee functions in patients with knee OA.<sup>18</sup>

This study aimed to gather evidence of noninvasive methods and evaluate the effects of ultra-reiz and IFT currents and the comparison of them on pain and function in patients with knee OA. We combined an exercise program with these two modalities to maximize any effect on pain and joint stiffness and disability and function.

## METHODS

### Participants and data collection

This randomized block clinical trial was carried out at the physical therapy department, Taleghani General Hospital, Shahid Beheshti University of Medical Sciences Tehran, Iran from November 2017 to February 2019. The study included 104

Subjects of 37 men and 67 women, aged 38-78 years with knee osteoarthritis.

Participants were selected based on exclusion and inclusion criteria. The inclusion criteria were patients with chronic pain at least for three months, limited in ADL and functional ability, being at stages 2 and 3 of knee osteoarthritis (mild to moderate knee osteoarthritis, based on American College of Rheumatology criteria), experience frequent pain during movement, and without anti-inflammation medication intake. The exclusion criteria were neuropathic disorder, nerve injury, rheumatologic disease, autoimmune disease, history of knee fracture and surgery, intra-articular corticosteroid injection, structural giving way, contraindications for electrotherapy, heart disease or having electrical implants such as a pacemaker, malignancies, and epilepsy.

The study protocol has been approved by the ethics committee of Shahid Beheshti University of Medical Sciences, and participants' consent was taken before the study. Before starting treatment, skin evaluation is considered to be healthy, and no scratches on it. All patients were randomly assigned to ultra-reiz (n = 52) and IFT (n = 52) groups. Study outcomes were evaluated by the KOOS questionnaire, which was collected before the 1st session and the end of the 10th session treatment at least three times a week. When the patients reported that the pain was reduced, they underwent an exercise program for the rest of duration of treatment, every day for 3sets and 10 repetitions.

## Interventions

### Ultra-reiz

Ultra-reiz (Enraf-Nonius is made in the Netherlands) is rectangular impulses lasting 2 ms include a 5 ms pause between single impulses, causing to approximately 143 Hz from the mathematical calculations. The intensity of the current depends on the patient's tolerance. Ultra-reiz currents are mainly for improving pain in the locomotor system area and as a selective stimulation of thick fibers.<sup>19</sup> The increasing amplitude makes it necessary to use thick moist viscose sponges (minimum thickness 1 cm) and medium-sized electrodes. In local treatment, electrodes are placed at a distance of 3 cm between each other. The cathode should be placed at the pain site. Before local treatment, segmental treatment is initially performed on the vertebral column to stimulate the vegetative nervous system. One electrode is placed at the lumbosacral junction and the other on the dorsal of the lumbar vertebra. The current intensity is slowly increased in the first few minutes

as patients get used to the sensation from mild to patient's tolerance level.<sup>13</sup> Treatment time was 10 minutes. After treatment was completed in the lumbar region, electrodes were placed locally on either side of the knee joint, for another 10 minutes.

### IFT

IFT (Enraf-Nonius is made in the Netherlands) predominately excites large-diameter nerve fibers and reduces the transmission of nociceptive signals through small-diameter nerve fibers to the spinal dorsal horn by presynaptic inhibition, thus achieving pain modulation in the higher center.<sup>20</sup> IFT is associated with lower skin resistance, comfortable & tolerance, and deep penetration. Two medium frequency currents can be given out of phase; these currents interrupt with each other inside tissues when the currents cross. The resultant amplitude-modulated interference that have been reported to stimulate analgesic effect produce in beat frequencies of between 1 and 250 Hz.<sup>21</sup> The patients were treated with quadripolar vector scan electrode technique, covering quadriceps muscle and knee joint using the beat frequency of 100 Hz and carrier frequency of 4000 Hz. The intensity was adjusted according to patients' tolerance, strong but comfortable. Treatment time was 20 minutes, and electrodes were placed locally on both sides of the knee joint.

### Exercises

Patients reported that the pain was reduced from the

third session, then after the last treatment session, all individuals in the two groups, underwent in an exercise program that include isometric exercise, terminal extension in close chain, and straight leg raise of 10 repetitions for 3 sets.

### Statistical analysis

Continuous data of KOOS's pain, symptoms, ADL, sports/recreational activity, and quality of life were entered into SPSS software, version 25 (IBM Corporation, Armonk, NY) for statistical analysis. The paired T-test was used to examine whether data between the pre-test and post-test were statistically significant difference in the two groups. The independent T-test was performed to evaluate mean changes of ultra-reiz and IFT groups whether they were significantly difference. A *p*-value of <0.05 in the results was considered statistically significant.

### RESULTS

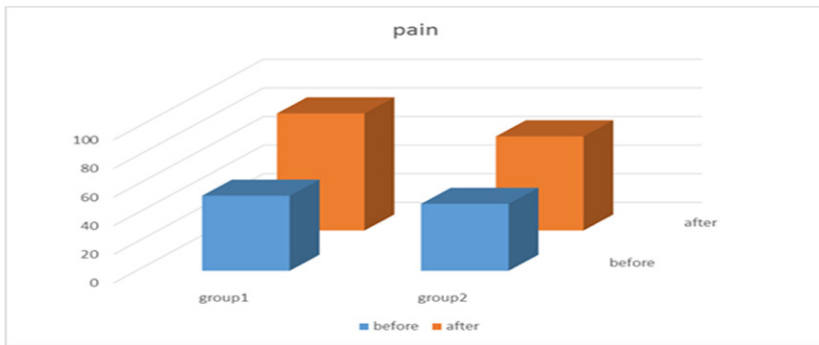
To achieve the goal of study, the mean variables of both groups should not be significantly different before intervention, which assumed the intervention groups have equal baseline characteristics. Based on the findings no significant difference was found in the mean of variables between ultra-reiz and IFT groups before the intervention.

The KOOS scores in the ultra-reiz group before treatment were 22.8~61.5 and after treatment ranged were 51.4~86.3, whereas in the IFT group before treatment were 22.3~55.0 and after treatment

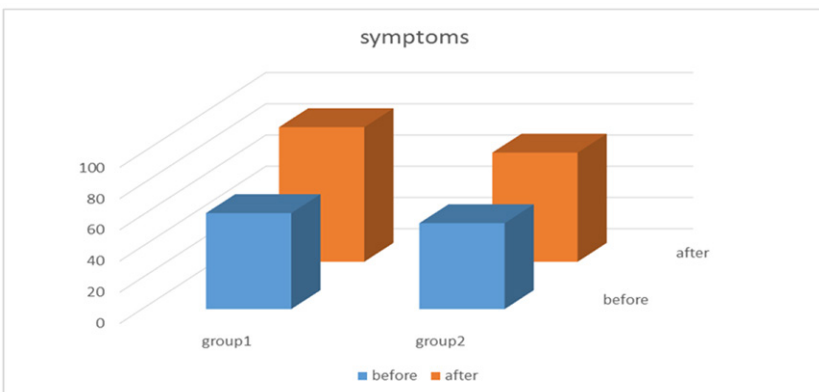
**Table 1.** Comparisons of the Knee Injury and Osteoarthritis Outcome Score (KOOS) domains at the baseline and their changes over the 10-times interventions among the ultra-reiz and interferential therapy (IFT) groups

KOOS	At baseline Mean±SD	After interventions Mean±SD	p-value	Changes Mean±SD	p-value
Pain					
Ultra-reiz	52.5±19.5	81.8±9.4	0.045	29.41±0.1	
IFT	46.8±14.5	65.8±10.7	0.314	19.0±3.8	<0.000
Symptoms					
Ultra-reiz	61.5±18.0	86.2±10.1	0.403	24.7±7.9	
IFT	55.0±19.4	69.9±16.4	0.000	14.9±3.0	<0.000
ADL					
Ultra-reiz	56.6±19.5	86.3±8.3	0.181	29.7±11.2	
IFT	51.8±17.2	67.5±13.3	0.002	15.7±3.9	<0.000
Sport/Rec					
Ultra-reiz	24.3±23.7	59.3±15.5	0.074	35.0±8.2	
IFT	22.3±20.0	30.5±21.9	0.150	8.1±1.9	<0.000
QOL					
Ultra-reiz	22.8±12.3	51.4±18.7	0.764	28.6±6.8	
IFT	26.0±12.2	38.6±12.7	0.210	12.6±0.0	<0.000

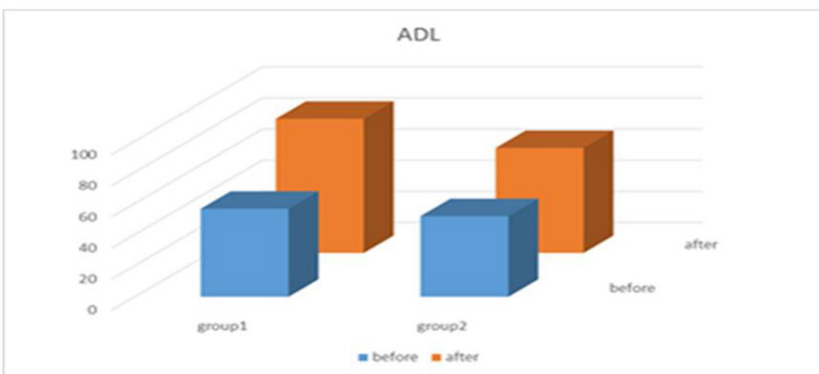
SD, standard deviation



**Figure 1.** Mean pain variable in groups 1 and 2 before and after treatment



**Figure 2.** Mean symptoms variable in groups 1 and 2 before and after treatment



**Figure 3.** Mean ADL variable in groups 1 and 2 before and after treatment

were 30.5~69.9. There were differences between pre-test and post-test scores in both intervention groups (p-value: ultra-reiz= 0.045~0.764, IFT= <0.0001~0.314) (Table 1). Figures 1-5 showed means of variables in the ultra-reiz and IFT before and after interventions.

There were significant differences in mean changes of KOOS's domains between ultra-reiz and IFT groups, whereas the ultra-reiz intervention had bigger changes than the IFT intervention.

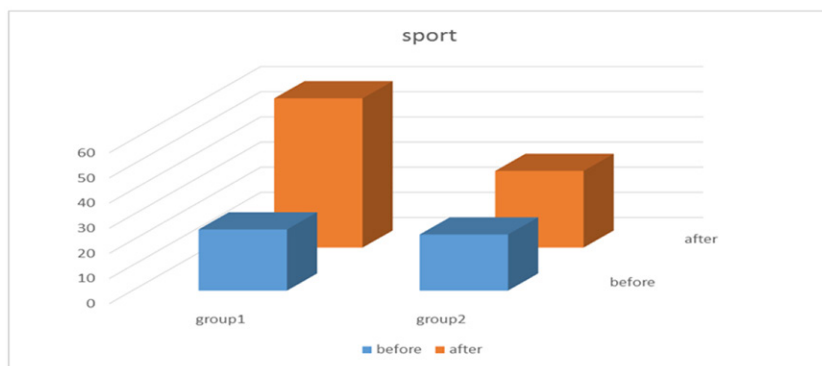
## DISCUSSION

The goal of knee OA intervention is to improve the patients' pain, functions, and quality of life.<sup>6</sup> Physical therapy is one of the reliable method in conservative interventions for pain control and functional improvement.<sup>22</sup> This was a randomized block clinical trial, which aimed to evaluate the efficacy of ultra-reiz and IFT as electrotherapeutic modalities in patients with knee OA and parameters measured by the KOOS questionnaire.

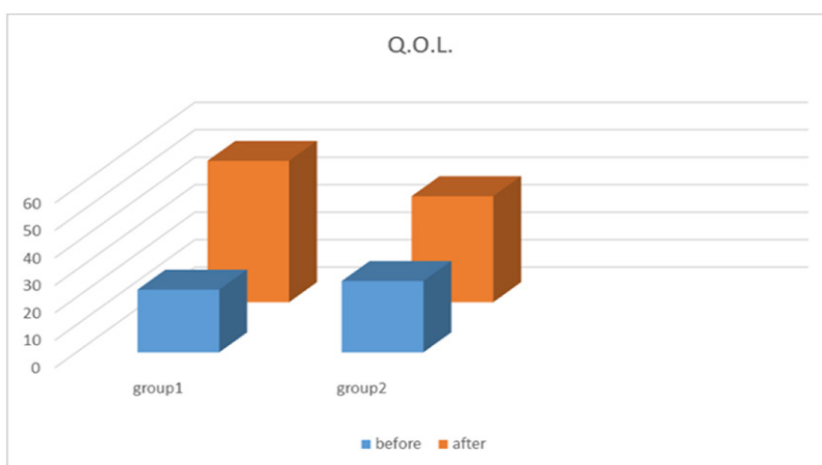
The pathophysiology of pain, symptom, and structural change of cartilage are complex. Elements related to the knee which are rich innervated are subchondral bone, periosteum, ligaments, muscles, synovium, and joint capsule, being the source of nociception in OA. Diagnostic magnetic resonance imaging (MRI) has shown some significant effects in joint structure for instance bone marrow lesions, sub-articular bone erosion, synovitis, and effusion have been associated with the knee pain. Of 351 persons with the knee pain, 272 (77.5%) had bone marrow, but only 15 out of 50 (30%) among persons without no knee pain had bone marrow.<sup>23</sup> Decreased blood flow and elevated interosseous pressure lead to bone angia which along with periostitis related to osteophyte information and subchondral microfractures provide bone-derived pain.

In arthritis, pain-producing biochemical elements such as prostaglandins, histamine, bradykinin, vasoactive intestinal peptide, substance P, lactic acid, and calcitonin gene-related peptide (CGRP) are spread out into the joint. These substances decrease the firing threshold of nociceptors on the knee joint, which induced the noxious- and non-noxious-pain.<sup>24</sup>

Hajizadeh et al.<sup>25</sup> suggested that the skin's electrical stimulation increases local blood flow through two mechanisms, releasing some vasodilator neurotransmitters nerve endings and removing sympathetic tone. Besides, electrical stimulation can alter bone hydrodynamics and subsequently improve venous return, reducing intra-osseous pressure and relieving pain. In this study, ultra-reiz effectively improved patients' pain, function, and quality of life, possibly due to increasing circulation that releases subchondral bone congestion, decreasing the intraosseous pressure, relieving pain, and improved mobility and function.<sup>13,14</sup> It has been demonstrated that improved the circulation to the knee joint washed out the noxious biochemical elements such as prostaglandin and bradykinin.<sup>13</sup> Ultra-reiz intervention improved circulation that released the congestion of subchondral bone, which decreased



**Figure 4.** Mean sport variable in groups 1 and 2 before and after treatment



**Figure 5.** Mean of quality of life variable in groups 1 and 2 before and after treatment

pressures inside intraosseous and nociceptors activity.

Our study findings had shown that IFC improved the patients' pain, functions, and quality of life, which might indicate that local nerve cells were stimulated and have shown analgesic and anesthetic effects owing to blocking pain transmitters signals or stimulating release endorphins which are pain relievers.<sup>26</sup> Previous study<sup>17</sup> not only supported these findings but also found that IFC increased the range of motion and decreased edema. More importantly, when IFC combined with mobilization exercise, the results will be more effective.<sup>27</sup>

There were some limitations of this study we need to explain. Firstly, there was no sham group in this study. Thus, we could not determine if the differences between the pretreatment and post-treatment outcomes were due to a therapeutic or placebo effect. Secondly, there was no group without exercise in this study. Thus, we cannot confirm whether only ultra-reiz or IFT only without exercise have similar effects in improving knee pain, functions, and QOL. We suggested for further study to consider these limitations to achieve more specific results.

## CONCLUSION

According to our findings, it can be concluded that ultra-reiz and IFT have proved to be effective physical modalities in treating patients with knee OA. Comparison between both interventions demonstrated that ultra reiz current therapy was more effective in all domains of the KOOS questionnaire than IFT.

## CONFLICT OF INTEREST

There is no conflict of interest

## FUNDING

N/A

## AUTHOR CONTRIBUTIONS

MA conceived the study design, data collections, data analysis, and drafted the paper, and ANF, HZ, HA, and MRMS conducted data collections, data analysis, and drafted the

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