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EFFECTS OF DICLOFENAC-SODIUM GEL PHONOPHORESIS COMPARERD WITH TRANSCUTANEOUS ELECTRICAL NERVE STIMULATOR (TENS) IN PATIENTS OF KNEE OSTEOARTHRITIS (OA)

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Abstract:

Knee osteoarthritis is deteriorating disease of joint, its cartilage and. Many treatment options are recommended for the treatment of and management of knee osteoarthritis such as; non-pharmacological and pharmacological measures. The aim of this study was to see the effectiveness of tens and diclofenac-sodium phontophoresis for the improvement of pain, stiffness and functional activity of knee in knee osteoarthritic subject.. In this study two modalities of physical therapy i.e. Tens and phontophoresis was compared for knee pain in knee osteoarthritis. The sample size was 40. Total sample was divided in to tens group and phontophoresis group. Both interventions were applied to the subjects for 20 minutes. Half-circle arm universal goniometer was used to check the active range of motion (arom), and numerical pain rating scale was used to determine the intensity of pain. Both treatment protocols were followed twice a week for 6weeks along with their prescribed therapeutic exercises. Treatment evaluation was done on first day,3rd week and last week (6th week) by an independent assessor. Data was analyzed by spss. The main aim of this study was to compare the efficacy of phonophoresis and tens in the treatment of knee osteoarthritis. Current study concluded that in knee osteoarthritis diclofenac-sodium phonophoresis and tens both are significantly effective in reduction of pain and stiffness but phonophoresis is more effective in terms of reduction in difficulty to do work and adls. More over there is a remarkable difference in the overall womac score in phonophoresis group then in tens group ($p<0.05$)

keywords: Diclofenac-sodium, phontophoresis, transcutaneous nerve stimulator, knee pain, knee osteoarthritis

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INTRODUCTION:

Knee osteoarthritis is one of the most common joint diseases in the world. . Most radiological changes in osteoporosis occur at the age of 65, and more than 80% of people over the age of 75 have osteoporosis. The incidence of osteoarthritis is high. Knee osteoarthritis is highly related to disability(felson, 1988). According to the etiology of the disease, knee osteoarthritis is divided into two categories: primary and secondary. Primary oa is idiopathic. Secondary oa is mainly due to the adverse effects on hyaline articular cartilage, 95% of which are composed of extracellular matrix. It is a slow-growing musculoskeletal disease that is characterized by joint inflammation, swelling, pain, joint stiffness, muscle weakness and joint instability, which impairs human mobility and an active lifestyle. (bello & kuwornu, 2014) knee osteoarthritis incidence among adults in pakistan is 25% in rural areas and 28% in urban areas (ghaznavi & sohail, 2016). So our goal is to improve management strategies (fig 1.1)

In general, transcutaneous electrical nerve stimulator (tens), short-wave diathermy, ultrasound, microwave diathermy, iontophorosis, and infrared radiation can be used as supplements to other exercise therapies. However, the choice of these methods depends entirely on the personal priority of the therapist. Physical therapists in pakistan mainly use tens for treatment, and exercises are also used to control the pain of subjects with knee osteoarthritis.

In view of the long-term use of these non-steroidal anti-inflammatory drugs and their adverse effects, these drugs are administered through the skin by iontophorosis, thereby enabling patients to benefit from these drugs and avoiding the development of related conditions. This is a non-invasive method by which a high concentration of transdermal drug, drug or bioactive agent is transdermaly moved by a repulsive electromotive force generated by two electrodes attached to the skin of a part of the human body. (sarzi-puttini et al., 2005).). It has become an alternative to oral and injectable drugs because it is a non-invasive, painless and non-invasive method of administration in humans. Current data supports its effectiveness when combined with therapeutic exercises. (kivitz et al., 2008) (aiyejusunle, kola-korolo, & ajiboye, 2007)

Therefore, we hypothesized that diclofenac sodium iontophorosis can produce better therapeutic effects than tens as an adjuvant therapeutic agent for knee osteoarthritis. Hypothesis

Literature review:

Tens improves some of the physical parameters. According to a recent metaanalysis study, there is strong evidence to support the view that transcutaneous electrical nerve stimulation (tens) is an effective treatment for managing osteoarthritis (oa) knee pain. However, there is limited evidence showing its effectiveness in improving physical function. This study examined whether tens alone can improve physical function in terms of range of knee motion and the timed-up-and-go test. The decrease in time in performing the timed-up-and-go test was also not significantly different between the 2 groups. A moderate correlation was observed between the reduction in pain scores and the improvement in the timed-up-and-go test. Tens can enhance activity and function in the subjects with knee osteoarthritis. But it requires significant time to do so. Exercise can also be considered as very important adjuvant treatment to tens in improving the functions of knee osteoarthritic subject (law, cheing, & tsui, 2004) .

Pain relief in osteoarthritis and rheumatoid arthritis: tens this study was conducted in 2013. Pain is a common symptom experienced by people with osteoarthritis and rheumatoid arthritis and impacts upon mobility and quality of life. This article reviews the limited evidence relating to tens for pain relief which suggests that it is beneficial for some patients and does no harm. More research is needed to clarify optimal treatments regimes and its cost-effectiveness compared to conventional analgesia (wai ying & while, 2007).

Effect of tens on pain in relation to central sensitization in patients with osteoarthritis of the knee: study protocol of a randomized controlled trial. The purpose of this study is to explore the pain inhibitory effect of burst tens in oak patients and to explore the prognostic value of central sensitization on the pain inhibitory effect of tens in oak patients. Patients with knee pain due to oak will be recruited through advertisements in local media. Temporal summation, before and after a heterotopic noxious conditioning stimulation, will be measured. In addition, pain on a numeric rating score, womac subscores for pain and function and global perceived effect will be assessed. Patients will be randomly allocated to one of two treatment groups (tens, sham tens). Follow-up measurements will be scheduled after a period of 6 and 12 weeks. Tens influences pain through the electrical stimulation of low-threshold a-beta cutaneous fibers. The responsiveness of central pain-signaling neurons of centrally sensitized oak patients may be augmented to the input of these electrical stimuli. This would encompass an adverse therapy effect of tens. To

increase treatment effectiveness it might be interesting to identify a subgroup of symptomatic oak patients, i.e., non-sensitized patients, who are likely to benefit from burst tens(beckwée, de hertogh, lievens, bautmans, & vaes, 2012).

A study conducted in 2000 on "transcutaneous-electrical-nerve stimulation for knee osteoarthritis". To assess the effectiveness of tens in the treatment of knee oa, studies of one year or longer were included in the review. The primary outcomes of interest were those described by the outcome measures in rheumatology clinical trials (omeract 3), which included pain relief, functional status, patient global assessment and change in joint imaging. The secondary objective was to determine the most effective mode of tens application for pain control. This study concludes that the relative effect of placebo and tens showed the effectiveness of tens. Total number of participants in active-tens group and placebo-group are 146 and 148 respectively. Active-tens treatment reliefs the symptoms of pain and the results were remarkably better than placebo treatment. Knee stiffness also surpass at many extents in active tens group as compared with placebo group. Different modes of tens are beneficial in pain relief of knee oa over placebo (osiri et al., 2000).

A rct study conducted in 2012. Transcutaneous electrical nerve stimulation (tens) is commonly used for the management of pain; however, its effects on several pain and function measures are unclear. The purpose of this study was to determine the effects of high-frequency tens (hf-tens) and low-frequency tens (lf-tens) on several outcome measures (pain at rest, movement-evoked pain, and pain sensitivity) in people with knee osteoarthritis. The auther concluded that tens can reduce the pain during movement but not any effect on the pain during rest. Tens also have a significant effect on sensitivity of pain in knee osteoarthritis. Hf-tens and lf-tens both are effective in pain reduction in knee osteoarthritis (vance et al., 2012).

A pilot study on using acupuncture and transcutaneous electrical nerve stimulation (tens) to treat knee osteoarthritis (oa). This study tests whether a combined treatment of acupuncture and transcutaneous electrical nerve stimulation (tens) is more effective than acupuncture or tens alone for treating knee osteoarthritis (oa). Thirty-two patients with knee oa were randomly allocated to four groups. The acupuncture group (acp) received only acupuncture treatment at selected acupoints for knee pain; the tens group (tens) received only tens treatment at pain areas; the acupuncture and tens group (a&t) received both acupuncture and tens treatments; the control group (ct) received topical poultice (only when necessary). Each group received specific weekly treatment five times during the study. Outcome measures were pain intensity in a visual analogue scale (vas) and knee function in terms of the western ontario and mcmaster universities osteoarthritis index (womac). Combined acupuncture and tens treatment was effective in pain relief and knee function improvement for the sampled patients suffering from knee oa(itoh et al., 2008). A study conducted in ghana in 2014 on 5% ibuprofen iontophorosis compare with tens in knee osteoarthritis pain the study compared the inclusions of 5% ibuprofen iontophoresis and transcutaneous electrical nerve stimulation (tens) in the management of osteoarthritis (oa) of the knee joint. Subjects and methods: patients diagnosed with knee oa and referred for physiotherapy at a tertiary health facility in accra, ghana participated in the study. This suggests that these both iontophorosis with 5% ibuprofen and tens is very beneficial for the treatment of patients with knee oa. So they both are better than other conventional treatment and can be added in the treatment of knee osteoarthritic patient (bello & kuwornu, 2014).

A study on effects of phonophoresis of piroxicam and ultrasound on symptomatic knee osteoarthritis conducted in 2012. Thw main objective of this study is to compare the effects of phonophoresis of piroxicam (php) and ultrasound therapy (ut) in patients with mild to moderate, symptomatic knee osteoarthritis (oa). This is a randomized, double-blind, controlled trial. Both the php and ut groups were treated with an ultrasound program using the stroking technique, continuous mode, 1.0w/cm2, 10 minutes per session, and 5 times per week for 2 weeks. Four grams of 0.5% piroxicam gel (20mg of piroxicam drug) was used in the php group, while the nondrug coupling gel was used in the ut group. The results indicated that php was significantly more effective than ut in reducing pain and tended to improve knee functioning in kellgren-lawrence grades i to iii knee oa. Php is suggested as a new, effective method for treatment of symptomatic knee oa(luksurapan & boonhong, 2013).

In 2019 study conducted on diclofenac sodium phonophoresis versus conventional therapeutic ultrasound in knee osteoarthritis.purpose of this study is to compare the effect of diclofenac sodium phonophoresis (dsph) with conventional therapeutic ultrasound (tus) on knee oa. This study conclude that dsph had improvement but not significant in pain

intensity level, physical function, and knee flexion rom posttreatment but it had no superior effect on tus. Knee flexion rom improved significantly posttreatment in both groups, but only in ph the improvement sustained for one month after treatment. Ph had long term effect than tus (aboelkhair, elsayed, mohammad, & hassan, 2019).

A study was conducted in 2018 on ultrasound combined transcutaneous electrical nerve stimulation (ultratens) versus phonophoresis of piroxicam (php) in symptomatic knee osteoarthritis it is a randomized double-blind, controlled trial.ultrasound combined with transcutaneous electrical nerve stimulation (ultratens) and phonophoresis of piroxicam (php) are combined modality therapy that frequently used in musculoskeletal pain including knee osteoarthritis (oa). But it is lack of a good clinical trial to prove and compare their effects. Sixty-one patients (55 women), mean age of 63.4 ± 8.1 y, 50–90 mm vas of knee pain and kellgren-lawrence score of grade i–iii were randomly allocated into ultratens and php .the ultratens group received a combined ultrasound with tens program and a non-drug gel, whereas the php group got an ultrasound program with piroxicam gel and sham tens. All patients were treated for a total of 10 sessions, consisting of five times per week and 10 min per session. Before and after treatment, patients were evaluated knee pain by using the 100-mm vas and functional performance by western ontario and mcmaster universities osteoarthritis (womac) index. The results show that ultratens and php were effective for relieving pain and improve functionality knee oa without significant differences between their effects(boonhong, suntornpiyapan, & piriyajarukul, 2018).

Null-hypothesis :(ho)
both tens and diclofenac-sodium phontophoresis are effective for the patients of knee osteoarthritis in terms of pain, stiffness and functional activity.
Alternative hypothesis :(ha)
diclofenac-sodium phontophoresis is more effective for the patients of knee osteoarthritis in terms of pain, stiffness and functional activity.
tens is more effective for the patients of knee osteoarthritis in terms of pain, stiffness and functional activity.

MATERIAL AND METHOD:

The study consist of the patients (males as well as females) who came to opd of allied and dhq hospital faisalabad between october 2019-december 2019 (fig1). The inclusion criteria were as following: age 45 years and greater than 45 years. Those who have morning stiffness for <30minutes and bones producing crepitus sound while knee bending. Along with all these factors recent x-ray showing reduced joint spacing or osteophytes will also be considered as a inclusion criteria. Diagnosed patients of knee oa either unilateral or bilateral knee oa. Patients were excluded from the study for the following reasons: the presence of wounds, lacerations, inflammation or scar tissue in the soft tissue around the knee joint; the presence of metabolic, inflammatory or infectious diseases; malignant, pacemakers, who are unable to communicate and sensory disorders. Inform consent form was signed first by patients.

The participants were randomized in to two groups by lottery method. Group 1 (n=20) receives phonophoresis with diclofenac sodium gel, group 2 (n=20) receives tens. These therapies began with twenty minutes of hot pack application. Patients were not allowed to use analgesic medication or nsaid. Each of these two modalities were applied twice a week for 6 weeks.

Effectiveness of treatment was measured by pre- and post-treatment numerical analogue pain rating scale pain scores at rest, and the western ontario and mcmaster universities arthritis index (womac, turkish version) scores. The womac index included 24 questions for the evaluation of pain, stiffness, and functional status, which is a condition-specific health status questionnaire. The first 5 questions are about pain during walking, using stairs, in bed, sitting or lying and standing, followed by 2 questions on stiffness after first getting up and later in the day, with the staying 17 questions concerned with the limit physical function using stairs, rising from sitting, getting on/off toilet, heavy house tasks, and light house tasks. Each question had a response on a scale of 0–4 with 0 representing none, 1 slight, 2 moderate, 3 severe, and 4 extreme, and these scores are combined to form a womac score ranging from 0 to 96.
Phonophoresis

A 10 cm long strip (four grams) of cream containing diclofenac gel (100 mg of diclofenac gel) was applied to each knee of each patient. Ph was performed using an applicator 5 cm in diameter, at a frequency of 1 mhz, with a power of 1.5 w/cm2, for 8 min for each knee, and for a total of 12 sessions. The transducer was applied in the mediolateral direction to the joint spaces of both knees by moving in small circular motions. The us device used in the treatment was business line us 50.

Tens

A comfy stim was use for this purpose the 4 electrodes are applied in cross 2 on either side (medial and lateral) on pulsative mode.

Table 4.5
Severity of pain on numeric pain rating scale in phonophoresis group

Pain by NPRS	**Mean ±SD**	**F(df_1,df_2)**	**p-value**
Pre treatment	7.25 ±1.25	55.27(2,3)	0.00
Post treatment 1 at week 3	6.30 ±1.59		
Post treatment 2 at week 6	5.40±1.35		

Table 4.5: showed that one way ANOVA was conducted to compare the severity of pain on numerical pain rating scale in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in severity of pain on numerical pain rating scale before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). the pain is significantly reduced after 6 weeks of treatment in phonophoresis group.

Table 4.6
Severity of pain on numeric pain rating scale in phonophoresis group:

Pain by NPRS	**Mean ±SD**	**F(df1,df2)**	**p-value**
Pretreatment pain	6.35±1.81	44.78(2,38)	0.00
Post treatment 1 at week 3	5.20±1.70		
Post treatment2 at week 6	4.55±1.66		

Table 4.6: showed that one way ANOVA was conducted to compare the severity of pain on numerical pain rating scale in TENS group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in severity of pain on numerical pain rating scale before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). the pain is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.7
Severity of pain on WOMAC questionnaire in phonophoresis group

Pain WOMAC	**Mean ± SD**	**F(df1,df2)**	**p-value**
WOMAC pre-pain score	13.05±3.57	48.43(2,38)	0.00
WOMAC post treatment pain score at 3rd week	11.15±3.19		
WOMAC post treatment score pain at 6th week	9.10±2.59		

Table 4.7: showed that one way ANOVA was conducted to compare the score of pain on WOMAC questionnaire in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in severity of pain on WOMAC questionnaire

before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). the pain is significantly reduced after 6 weeks of treatment in phonophoresis group.

Table 4.8
Severity of pain on WOMAC questionnaire in TENS group:

Pain WOMAC	Mean±SD	F(df1,df2)	p-value
WOMAC pre-pain score	10.70±4.24	37.16(2,38)	0.00
WOMAC post treatment pain score at 3rd week	8.90±3.52		
WOMAC post treatment score pain at 6th week	8.35±3.89		

Table 4.8: showed that one way ANOVA was conducted to compare the score of pain on WOMAC questionnaire in group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in severity of pain on WOMAC questionnaire before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). the pain is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.9
Score of stiffness on WOMAC questionnaire in phonophoresis group:

Stiffness score	Mean±SD	F(df1,df2)	p-value
WOMAC pre-stiffness score	4.95±2.06	22.82(2,38)	0.00
WOMAC post-treatment stiffness score at 3rd week	4.30±1.55		
WOMAC post-treatment stiffness score at 6th week	3.50±1.35		

Table 4.9: showed that one way ANOVA was conducted to compare the score of stiffness on WOMAC questionnaire in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in score of stiffness on WOMAC questionnaire before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The stiffness is significantly reduced after 6 weeks of treatment in phonophoresis group.

Table 4.10
Score of stiffness on WOMAC questionnaire in TENS group

Stiffness score	Mean±SD	F(df1,df2)	p-value
WOMAC pre-stiffness score	4.50±1.90	16.42(2,38)	0.00
WOMAC post-treatment stiffness score at 3rd week	3.55±1.60		
WOMAC post-treatment stiffness score at 6th week	3.60±1.63		

Table 4.10: showed that one way ANOVA was conducted to compare the score of stiffness on WOMAC questionnaire in group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in score of stiffness on WOMAC questionnaire before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The stiffness is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.11

Score of difficulty on WOMAC questionnaire in phonophoresis group:

Difficulty score	Mean±SD	F(df1,df2)	p-value
WOMAC pre-difficulty score	46.20±10.13	55.31(2,38)	0.00
WOMAC post-treatment difficulty score at 3rd week	41.45±8.84		
WOMAC post treatment difficulty score at 6th week	36.05±8.22		

Table 4.11: showed that one way ANOVA was conducted to compare the score of difficulty on WOMAC questionnaire in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in score of difficulty on WOMAC questionnaire before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The difficulty is significantly reduced after 6 weeks of treatment in phonophoresis group.

Table 4.12

Score of stiffness on WOMAC questionnaire in TENS group:

Difficulty score	Mean±SD	F(df1,df2)	p-value
WOMAC pre-difficulty score	42.20±14.34	6.50(2,38)	0.004
WOMAC post-treatment difficulty score at 3rd week	38.05±12.16		
WOMAC post treatment difficulty score at 6th week	33.25±12.89		

Table 4.12: showed that one way ANOVA was conducted to compare the score of difficulty on WOMAC questionnaire in group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in score of difficulty on WOMAC questionnaire before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The difficulty is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.13

Total score of WOMAC questionnaire in phonophoresis group:

Total score	Mean±SD	F(df1,df2)	p-value
total score recoded by WOMAC questionnare before the treatment	64.10±14.44	54.33(2,38)	0.00
total score recoded by WOMAC questionnare in 3rrd week of treatment	56.95±12.17		
total score recorded by WOMAC questionnare in 6th week of treatment	49.20±10.47		

Table 4.13: showed that one way ANOVA was conducted to compare theTotal score of WOMAC questionnaire in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in Total score of WOMAC questionnaire before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The WOMAC Total score is significantly reduced after 6 weeks of treatment in phonophoresis group.

Table 4.14

Total score of WOMAC questionnaire in phonophoresis group:

Total score	**Mean±SD**	**F(df1,df2)**	**p-value**
total score recoded by WOMAC questionnaire before the treatment	56.00±18.61	35.25(2,36)	0.00
total score recoded by WOMAC questionnaire in 3rrd week of treatment	49.47±16.04		
total score recorded by WOMAC questionnaire in 6th week of treatment	47.36±15.80		

Table 4.14: showed that one way ANOVA was conducted to compare the Total score of WOMAC questionnaire in group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in Total score of WOMAC questionnaire before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The WOMAC Total score is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.15

Pain reduction in NPRS

	Group	**mean±SD**	**t(df)**	**p-value**
Pain reduction in NPRS	**phonophoresis**	1.85±0.87	168(38)	0.86
	TENS	1.80±1.00		

Table 4.15: showed the independent sample t-test was conducted to compare the reduction in pain in 6weeks follow up between phonophoresis and TENS group. The reduction in pain of phonophoresis group was significantly more than the TENS group ($p<0.05$).

Table 14.16

Pain reduction by WOMAC score:

	Group	**mean±SD**	**t(df)**	**p-value**
Pain reduction by WOMAC score	**Phonophoresis**	3.95±2.25	2.70(38)	0.10
	TENS	2.35±1.34		

Table 4.16: showed the independent sample t-test was conducted to compare the reduction in pain in 6weeks follow up between phonophoresis and TENS group. The reduction in pain of phonophoresis group was significantly more than the TENS group ($p<0.05$).

Table 4.17
Reduction in stiffness by WOMAC scores:

Stiffness reduction by WOMAC score	**Group**	**mean±SD**	**t(df)**	**p-value**
	Phonophoresis	1.45±0.99	1.87(38)	0.069
	TENS	0.90±0.85		

Table 4.17: showed the independent sample t-test was conducted to compare the reduction in stiffness in 6weeks follow up between phonophoresis and TENS group. The reduction in stiffness of phonophoresis group was significantly more than the TENS group ($p<0.05$).

Table 4.18:
Reduction in difficulty by WOMAC scores:

Difficulty reduction by WOMAC score	**Group**	**mean±SD**	**t(df)**	**p-value**
	Phonophoresis	10.15±4.54	390(38)	0.699
	TENS	8.95±13.00		

Table 4.18: showed the independent sample t-test was conducted to compare the reduction in difficulty in 6weeks follow up between phonophoresis and TENS group. The reduction in difficulty of phonophoresis group was significantly more than the TENS group ($p<0.05$).

Table 4.19
Reduction in Total WOMAC score

WOMAC Total score reduction	**Group**	**mean±SD**	**t(df)**	**p-value**
	Phonophoresis	14.90±7.73	2.95(37)	0.005
	TENS	8.63±5.18		

Table 4.19: showed the independent sample t-test was conducted to compare the reduction Total WOMAC score in 6weeks follow up between phonophoresis and TENS group. The reduction in Total WOMAC score of phonophoresis group was significantly more than the TENS group ($p<0.05$).

Findings

Table 4.5: showed that one way ANOVA was conducted to compare the severity of pain on numerical pain rating scale in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in severity of pain on numerical pain rating scale before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). the pain is significantly reduced after 6 weeks of treatment in phonophoresis group. Table 4.6: showed that one way ANOVA was conducted to compare the severity of pain on numerical pain rating scale in TENS group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in severity of pain on numerical pain rating scale before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). the pain is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.7: showed that one way ANOVA was conducted to compare the score of pain on WOMAC questionnaire in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in severity of pain on WOMAC questionnaire before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). the pain is significantly reduced after 6 weeks of treatment in phonophoresis group.

Table 4.8: showed that one way ANOVA was conducted to compare the score of pain on WOMAC questionnaire in group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in severity of pain on WOMAC questionnaire before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). the pain is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.9: showed that one way ANOVA was conducted to compare the score of stiffness on WOMAC questionnaire in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in score of stiffness on WOMAC questionnaire before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The stiffness is significantly reduced after 6 weeks of treatment in phonophoresis group. Table 4.10: showed that one way ANOVA was conducted to compare the score of stiffness on WOMAC questionnaire in group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in score of stiffness on WOMAC questionnaire before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The stiffness is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.11: showed that one way ANOVA was conducted to compare the score of difficulty on WOMAC questionnaire in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in score of difficulty on WOMAC questionnaire before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The difficulty is significantly reduced after 6 weeks of treatment in phonophoresis group. Table 4.12: showed that one way ANOVA was conducted to compare the score of difficulty on WOMAC questionnaire in group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in score of difficulty on WOMAC questionnaire before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The difficulty is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.13: showed that one way ANOVA was conducted to compare theTotal score of WOMAC questionnaire in phonophoresis group before phonophoresis, after phonophoresis on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in Total score of WOMAC questionnaire before the phonophoresis treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The WOMAC Total score is significantly reduced after 6 weeks of treatment in phonophoresis group. Table 4.14: showed that one way ANOVA was conducted to compare the Total score of WOMAC questionnaire in group before TENS, after TENS on 3rd week and at the last of the sessions on 6th week. The results revealed that there is standard significant difference in Total score of WOMAC questionnaire before the TENS treatment on 3rd week of treatment and on the 6th week of treatment ($p<0.05$). The WOMAC Total score is significantly reduced after 6 weeks of treatment in TENS group.

Table 4.15: showed the independent sample t-test was conducted to compare the reduction in pain in 6weeks follow up between phonophoresis and TENS group. The reduction in pain of phonophoresis group was significantly more than the TENS group ($p<0.05$). Table 4.16: showed the independent sample t-test was conducted to compare the reduction in pain in 6weeks follow up between phonophoresis and TENS group. The reduction in pain of phonophoresis group was significantly more than the TENS group ($p<0.05$).

Table 4.17: showed the independent sample t-test was conducted to compare the reduction in stiffness in 6weeks follow up between phonophoresis and TENS group. The reduction in stiffness of phonophoresis group was significantly more than the TENS group ($p<0.05$). Table 4.18: showed the independent sample t-test was conducted to compare the reduction in difficulty in 6weeks follow up between phonophoresis and TENS group. The reduction in difficulty of phonophoresis group was significantly more than the TENS group ($p<0.05$).

Table 4.19: showed the independent sample t-test was conducted to compare the reduction Total WOMAC score in 6weeks follow up between phonophoresis and TENS group. The reduction in Total WOMAC score of phonophoresis group was significantly more than the TENS group ($p<0.05$)

CONCLUSION:

Current study found that in knee osteoarthritis Diclofenac-sodium phonophoresis and TENS both are significantly effective in reduction of pain and stiffness but phonophoresis is more effective in terms of reduction in difficulty to do work and ADLs. More over there is a remarkable difference in the overall WOMAC score in phonophoresis group then in TENS group ($p<0.05$)

DISCUSSION:

The main aim of this study was to compare the efficacy of phonophoresis and TENS in the treatment of knee osteoarthritis. The results of this study reveals that there was a improvement in terms of pain and stiffness by WOMAC score and in Numeric pain rating scale in both groups(phonophoresis and TENS). However in terms of difficulty and Total WOMAC score phonophoresis group show more improvement then TENS group.

In literature some studies compare the effect of phonophoresis with different type of gel and analgesic creams. But no one compare the diclofenac-sodium phonophoresis with that of TENS.

LIMITATIONS:

The present study has the following limitations

- Firstly there was a limited time span available for the study. For example we conducted this study and measure the outcomes if we have further time we are able to find weather the improvement sustain for long time or are temporarily and which modality give the long time effects.
- Secondly, the population of our study was only from Faisalabad if we collect data from more than 1 city the result may be changed.
- Thirdly, the sample size of our study was 40 if we collect more data from larger population the results may be more précised and more supportive.
- Last but not the least some patients are unable to exactly describe the pain difficulty and stiffness some may tell us the condition in exaggerated form so the biasness come in the study. Some people hesitate to give their data so we can't include them in study.
- Some are uneducated so they can't understand the instructions properly.
- Furthermore funds are not given for the research, the transport and other miscellaneous expenditures were also caused difficulty in data collection.

RECOMMENDATIONS:

The limitations of the study were discussed in the previous section. These limitations recommended further research to extend and enhance what couldn't be grasped in this research.

- The time duration will be more to record the long term and temporary effects of these modalities.
- The study can be conducted in different cities of Pakistan to check the efficacy of the interventions use.
- Increase the sample size to get more accurate results.
- Generate funds for the research purpose.

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