Original Article

Subjective and Objective Evaluation of Pain for Older Adults with Knee Osteoarthritis in Saudi Arabia: A Reliability Study

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Abstract

Aims: This study establishes the reliability and validity of pain pressure threshold (PPT) in evaluating pain for older adults with knee arthritis, and explores the importance of using a standard tool to measure pain in older adults. **Methods:** The study consisted of a group of 31 older adult patients with bilateral symptomatic knee osteoarthritis, intra- and inter-rater reliability, and concurrent validity that were assessed for PPT and were compared with standard visual analogue scale (VAS). Physical therapy intervention was provided to combat the pain. **Results:** The PPT showed excellent intra-assessor reliability by not only meeting acceptable standards but also representing very high values. The intra-assessor reliability between test sessions was excellent. The inter-assessor agreement was also very high before treatment. The highest ICC showed very good agreement (0.860) during the initial treatment for pain pressure measurement. The study also established concurrent validity of VAS and PPT (before treatment and after treatment), where the rho correlation was high (-0.708 and -0.625) and significant, indicating that PPT is adequately sensitive for detecting changes over time. **Conclusion:** PPT is a reliable and valid tool for measuring pain, and it helps clinicians understand the prognostic effect of the intervention, especially in older adults. The tool is consistent at measuring pain and is a valid tool compared to subjective pain scoring.

Keywords: *Inter assessor reliability, intra assessor reliability, knee osteoarthritis, pain pressure threshold, validity, visual analogue scale*

Introduction

Pain is debilitating; it can occur due to trauma or as a result of pathology to the human body. Knee osteoarthritis (KOA) is the most common form of arthritis, and those suffering from it experience symptoms including pain and muscle weakness, leading to decreased quality of life. KOA is incurable though frequently remedied with surgical and pharmacological treatment procedures. There are a number of nonsurgical clinical procedures that slow down KOA's progression which includes a variety of exercises and physical therapy modalities.[1] In 2012, the American College of Rheumatology published guidelines for managing osteoarthritis without pharmacological means. They also gave a conditional recommendation of interferential current therapy (IFT) to treat KOA.[2] Quantifying pain is imperative for monitoring pain as well as for diagnostic purposes, especially in the case of KOA. Visual analogue scale (VAS) remains the gold standard method for quantifying arthritic pain.[3]

There are varied conclusions about the effectiveness of using a VAS scale for elderly patients. While some researchers have claimed that VAS is a reliable and valid tool for measuring pain intensity, others have concluded that VAS is more difficult to understand since there is a possibility for misinterpretations of zero-value in the

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scale.[4,5] Researchers have investigated the qualitative aspects of osteoarthritis pain and found that content analysis divided the types of pain associated with osteoarthritis into background pain, deep pain, stabbing pain, crushing pain, burning pain, and pricking pain.[6] VAS was originally developed to measure current pain and is a single-item questionnaire but more researchers have been acknowledging the need for a Likert-type scale to measure pain, especially for older patients.[7,8]

Tenderness in the area of pain is the best symptom to measure pain, and in clinical practices, digital pressure palpation is a major component of pain diagnosis. Standardization of such procedures is important because different examiners apply different pressure, creating the possibility for bias in the subjective evaluation of pain among patients.[9] Pain sensitivity also varies in the general population. While some patients exhibit a high pain threshold, others have a low pain threshold.[10] Pain pressure threshold (PPT) is a reliable and routine clinical practice, and pressure algometer is designed to measure deep pressure pain thresholds or tenderness resistance. When a clinician presses a particular site of the body with a probe over an area of 1 cm^2, the device displays the pressure.[11] Fischer (1987) introduced a seminal work that many cite as further evidence of the reliability of the algometer; however, his study collected only one set of measurements for each subject. His results demonstrate reliability on the basis that there was no significant difference detected in the PPT taken from one side of the body compared to the other.[12] Therefore, the present study tries to establish PPT as a reliable tool to measure KOA pain among older adults, and also checks the validity of PPT tool compared to the standard visual analogue scale (VAS), and establishes the treatment effectiveness of physical therapy among older adults above, equal to, and below 60 years of age.

Methodology

This study recruited 31 knees of osteoarthritic older adult patients with bilateral knee osteoarthritis (62 knees; mean age of 60.96 ± 12.25, 48–72 years) who were referred to the physiotherapy clinic of King Khalid University medical department after diagnosis. The referral was specifically for physical therapy treatment. The study excluded patients with any history of chronic pain, fibromyalgia, neurological deficit, or coexisting systemic disorder; history of knee or hip joint replacement surgery of the affected joint; history of any other surgical procedure on the lower limbs in the previous 6 months; or any physical therapy intervention on the lower limbs in the previous 6 months. The clinician palpated the medial part of the affected knee joint line with the tip of his thumb, and then informed the patients to raise the hand and inform the assessor as soon as they felt tenderness; patients who were not able to appreciate pain when palpated manually were excluded from the study, 4 patients were excluded as shown in Figure 1 but were treated for their condition separately. Before the study, the patients completed an informed consent form approved by the university ethics committee. Patients were advised not to use any nonsteroidal anti-inflammatory drugs or analgesics or any other treatment modalities throughout the study.[13]

Fischer described the methodology to perform a subcutaneous PPT measurement: a skinfold is produced between the examiner's thumb and the tip of the algometer which is pressed against the thumb, applying pressure to the subcutaneous tissues within the skinfold. The pressure increased at a continuous rate of 1 kg/s, in a manner similar to the technique used for measurement of deep tissue tenderness which suggested that the criterion of abnormality applied in deep tissues can be utilized for subcutaneous measurements as well.[12]

The present study asked participants to sit with the knee flexed 90° and foot resting on the ground. The clinician asked the patients to relax while palpating the medial part of the affected knee joint line (approximately 1–2 cm) medio-lateral to medial femoral tubercle with the tip of the thumb, then informed the patients to raise the hand and inform the assessor as soon as they felt tenderness. He then marked the area with a marker to ensure he could use the PPT at the exact same tender point in the knee joint. A baseline force gauge algometer; White Plains, New York 10602 USA, device was used for the study as shown in Figure 2. There were two assessors, and the time elapsed between measurements per participant (20 min) was decided with the purpose of properly evaluating the device and evading potential disturbances of any clinical variation of the patient.

One assessor undertook a double repeat clinical assessment for both the knees of the 31 subjects separated by an interval of 1–4 weeks, prior to and after physiotherapy treatment.

The two observers independently measured patients, typically within a 20–min interval between each other's assessment. One observer was an experienced physiotherapist with over 15 years of clinical experience and the other was an advanced musculoskeletal practitioner/researcher with nearly 15 years of experience. The assessors were blinded to each other's assessments, and the examination findings were recorded on different summary sheets and compiled by an assistant observer. During clinical examination, individual clinicians performed each test three times as needed for a consistent recording.

Both construct and concurrent validity were established from the data gathered at baseline as well as in the final week of the study.

The study protocol was performed for 4 weeks. Patients were informed about physiotherapy intervention regarding how they work. The patients (n = 31) attended four treatment sessions 5 per week in the physical therapy clinic and underwent assessments before and after they received treatment. However, 4 patients did not complete the study (equalling a drop-out rate of 12.9%). Clinicians recorded PPT reading as it was measured before and after every treatment, and they recorded VAS scores before and after treatment. The study conducted analysis among two different groups of respondents: those below 60 years of age and those above 60 years of age, to provide a better understanding of the results.

In a study that developed a robust mathematical approach for estimating the required number of patients for reliability studies, a sample of 27 patients provides 80% statistical power with 95% confidence ($P < 0.05$).[14] Hence, this study had selected a sample size of 31 bilateral knee osteoarthritis patients (total 62 knees) to assess the reliability of PPT. In another study checking the interobserver and intraobserver reliability of clinical assessments in knee osteoarthritis, only 25 subjects were chosen.[15] In yet another study, measuring the reliability of algometry in healthy humans, only 13 respondents were chosen for the study.[16] Figure 1 represents the sampling structure.

This study used descriptive statistics to profile demographic data. Prior to determining statistical associations, the study performed the Kolmogorov-Smirnov test to assess the data distribution which showed that all data were normally distributed. Later, the study assessed the intra and interclass coefficient correlation (ICC) values. The study classified the ICC values as follows: <0.4 indicated poor agreement, 0.4–0.75 indicated moderate agreement, and >0.75 meant excellent agreement.[17] There were also measurements of standard error of mean (SEM), smallest real difference (SRD), and systematic error of evaluation. The study established concurrent validity as well as construct validity of PPT, and it used a scatter plot to show correlation direction. Statistical analysis were performed in SPSS-22 while a paired t-test was employed to identify treatment effectiveness.

The study calculated the SEM from the square root of the mean square of error derived from the analysis of variance, where SEM=SD × √(1-r) r was the reliability coefficient in the form of the ICC for intra-assessor reliability.[18] The MDC was calculated at 90%, an appropriate level for assessing change during routine clinical use. The smallest real difference (SRD) with 95% confidence was calculated as 1.96 × √2 × SEM.[19] SRD represents the smallest change of a real outcome measure. The percentages for SEM and SRD were calculated to represent measurement error in relative terms. The current study also measured agreement between the measurements across the two sessions using Bland-Altman plots to identify the mean the difference between ratings and the 95% confidence interval for the limits of agreement using MedCalc version 13.2. As a measure of responsiveness, there was the calculation for the effect size to obtain the results of the evaluations at baseline and after treatment sessions.

Concurrent validity between the PPT and VAS was calculated using the spearman's rho since PPT is an ordinal scale. PPT comprises an ordered structure but lacks metric properties while VAS, on the other hand, acts as a psychometric response scale. The correlation determined the strength of the relationship between pain and the lowest PPT.

The study establishes construct validity using repeated-measures ANOVA with a Bonferroni test for intergroup measurements for validation. Repeated measures ANOVA were selected because the dependent variable (an integrated measure of error and time) was measured on the same group of people using different independent variables (before and after intervention).

Results

The process shows that PPT measurements were normally distributed (Shapiro-Wilk normality test). The mean age of patients in the study is 60 ± 12 years, with 15 respondents below 60 years of age and 16 respondents above 60 years of age. The respondents had mean symptom duration of 8 months and a mean

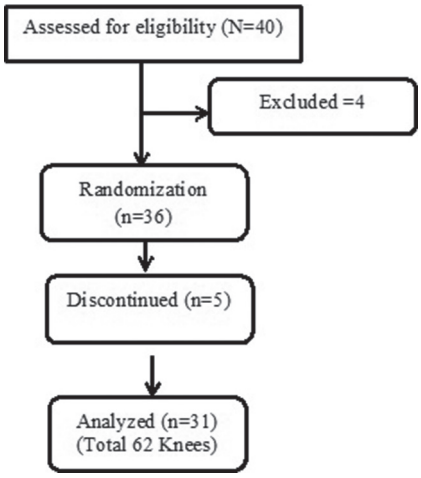


Figure 1: Represents the sampling structure

BMI of 32.30. Table 1 represents how pain levels fell significantly after treatment.

ICC determined the intra-assessor reliability to be at 95% confidence intervals (CI). Table 2 displays the measurement data from the intra-assessor reliability analysis, including the ICC. The PPT showed excellent intra-assessor reliability, not only meeting acceptable standards but also representing very high values. The intra-assessor reliability between test sessions 1 and 2 (before and after treatment on the knee) was excellent. Assessor 1 indicated very well to the excellent agreement, while assessor 2 indicated excellent agreement. The intra-assessor reliability for PPT was very good to excellent for all 4 weeks, both before

Table 1: Demographic data of the sample

Demographics	Mean±SD	Before Treatment Mean±SD	After Treatment Mean±SD
Age (Years)	60.96±12.25	-	-
BMI	31.21±6.79		
Duration of Symptoms	8.1±2.4		
VAS	-	6.43±0.1.9	4.22±1.14

Data are mean±SD. BMI: body mass index; VAS: visual analogue scale

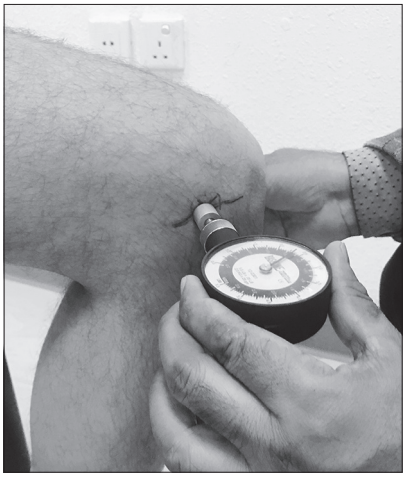


Figure 2: Measurement of pain using Pressure Algometer

Table 2: Measures and intra-assessor reliability (ICC) of pressure testing using pain pressure threshold

	Assessor	Week 1	Week 2	Week 3	Week 4
Intra Assessor Reliability - Before Treatment					
ICC (before)	A1	0.923	0.836	0.904	0.889
	A2	0.924	0.877	0.934	0.941
Confidence Interval	A1	0.866-0.959	0.727-0.911	0.835-0.949	0.810-0.941
	A2	0.867-0.960	0.791-0.934	0.884-0.965	0.896-0.969
Mean	A1	4.11	5.47	6.15	5.92
	A2	4.45	5.37	5.97	6.34
SD	A1	1.52	1.37	1.49	1.28
	A2	1.53	1.54	1.54	1.41
LOA	A1	1.13-7.08	2.78-8.15	3.22-9.07	3.41-8.42
	A2	1.74-7.15	2.35-8.38	2.95-8.98	3.57-9.10
SEM	A1	0.42	0.55	0.46	0.42
	A2	0.38	0.54	0.39	0.34
MDC	A1	1.16	1.52	1.27	1.16
	A2	1.05	1.49	1.08	0.94
Intra assessor reliability - After Treatment					
ICC (after)	A1	0.917	0.905	0.952	0.947
	A2	0.887	0.838	0.941	0.765
Confidence Interval	A1	0.856-0.956	0.835-0.949	0.915-0.975	0.906-0.972
	A2	0.807-0.940	0.730-0.912	0.896-0.969	0.622-.869
Mean	A1	5.19	5.71	6.33	6.33
	A2	5.05	5.79	6.34	6.16
SD	A1	1.43	1.44	1.52	1.46
	A2	1.50	1.52	1.41	1.36
LOA	A1	2.38-7.99	2.88-8.53	3.35-9.30	3.46-9.19
	A2	2.11-7.99	2.81-8.76	3.57-9.10	3.49-8.82
SEM	A1	0.41	0.44	0.33	0.33
	A2	0.50	0.61	0.34	0.65
MDC	A1	1.13	1.21	0.91	0.91
	A2	1.38	1.69	0.94	1.80

ICC: SD: Standard Deviation; LOA: Limit of Agreement; SEM: Standard Error of Mean; MDC: Minimum Detectable change

Table 3: Inter Assessor Reliability - ICC, SEM and MDC values

	Week 1	Week 2	Week 3	Week 4
Inter Assessor - Before Treatment				
ICC	0.911	0.860	0.917	0.916
Confidence Interval	0.823-0.956	0.730-0.930	0.835-0.959	0.832-0.958
Mean	2.89	2.84	3.91	3.92
SD	1.02	0.97	1.04	1.03
Mean Difference (SD)	-0.37 (0.22)	0.32 (0.27)	-0.17 (0.21)	0.17 (0.21)
LOA	0.89-4.88	0.93-4.74	1.87-5.94	1.90-5.93
SEM	0.30	0.36	0.29	0.29
MDC	0.83	0.99	0.80	0.88
Inter Assessor - After Treatment				
ICC (after)	0.793	0.870	0.909	0.920
Confidence Interval	0.613-0.894	0.747-0.935	0.820-0.955	0.841-0.961
Mean	3.40	3.38	4.29	4.29
SD	0.99	0.96	0.95	0.97
Mean Difference	-0.33 (0.30)	-0.29 (0.16)	-0.19 (0.20)	0.18 (0.19)
LOA	1.45-5.34	1.49-5.26	2.42-6.15	2.38-6.19
SEM	0.45	0.34	0.29	0.27
MDC	1.24	0.94	0.80	0.74

ICC: SD: Standard Deviation; LOA: Limit of Agreement; SEM: Standard Error of Mean; MDC: Minimum Detectable change

Table 4: Construct validity between VAS and PPT

Measure		Time	Wilks Lambda	F	df	sig	Sphericity Assumed
VAS	Pre	6.35	0.508	28.074	1.00	0.000	67.204
	Post	4.23					
PPT	Pre	1.35	0.203	113.915	1.00	0.000	8.495
	Post	2.10					

VAS: Visual Analogue Scale; PPT: Pain Pressure Threshold

Table 5: Before and After Physical therapy treatment

Treatment	Below 60 Individual Mean	Paired Mean (SD)	Above 60 Individual Mean	Paired Mean (SD)	*P*	Effect Size
VAS	8.0	6.26 (1.82)	7.56	5.56 (1.41)	0.000	0.92
	1.73		2.0			
PPT	1.14	0.78 (0.72)	1.01	0.94 (0.58)	0.000	1.735
	1.92		1.95			

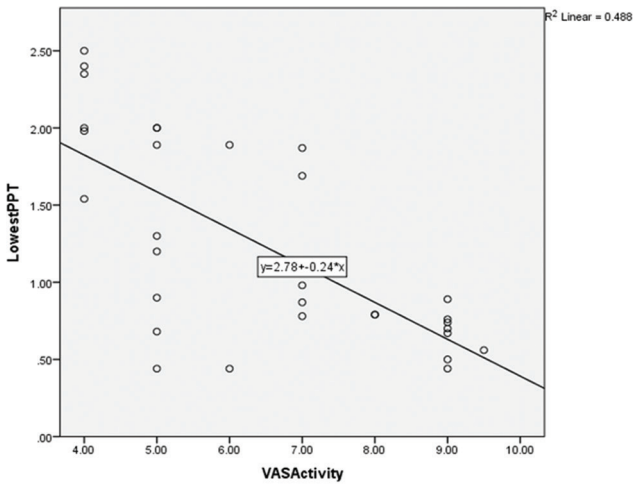
and after treatment. The MDC ranged from 0.94–1.52 before treatment and 0.91–1.80 for after treatment. SEM ranged from 0.34 kg/cm2 (before treatment) and from 0.33 kg/cm2 (after treatment) for intra assessor reliability.

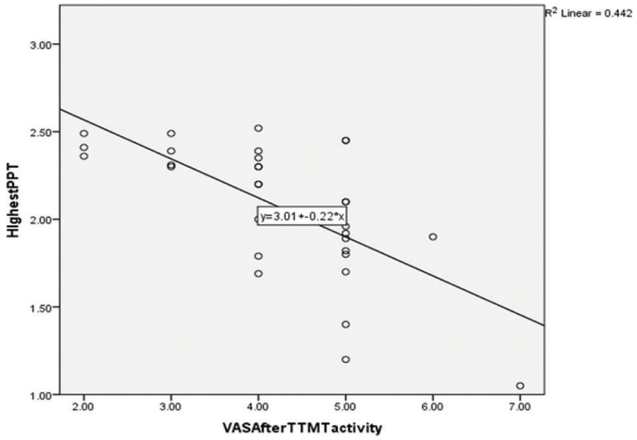
The ICC acted as the tool to establish inter-assessor reliability. The inter-assessor agreement is also very high before treatment. The highest ICC was for week 1, 3, and 4. Week 2 showed very good agreement (0.860) during the before treatment algometry measurement. The ICC values showed good to excellent reliability in the after-treatment measure. Week 1's ICC value showed good agreement (0.793) whereas the rest of the ICCs were all excellent. Table 3 exhibits the SEM, MDC, and ICC values of inter-assessor reliability.

The study also established the concurrent validity of VAS and PPT (before treatment and after treatment), where the rho correlation was high (-0.708) and significant before treatment. The rho correlation was medium (-0.625) and significant between the two measures VAS and PPT after treatment, which Figure 3 clarifies. The scatter plot shows the direction of the relation. The present study also established construct validity while Table 4 shows that the mean difference of PPT is higher than the VAS score.

The mean VAS (before and after treatment) was 6.26 ± 1.82 for the group below 60 years of age and 5.56 ± 1.41 for the group above 61. The values of PPT before and after treatment showed a mean value of -0.98 for IFT and -0.98 for SWD. Table 5 provides the mean values and effect size in this process.

Before Treatment	Mean±SD	Rho	*P*	Scatter Plot
VAS	6.4±1.9	**-0.708**	**0.000**	
Lowest PPT	**1.24**±0.66			
After treatment				
VAS	4.2±1.14	**-0.625**	**0.00**	
Highest PPT	**2.07 (0.38)**			





PPT: Pain Pressure Threshold; VAS: Visual Analogue Scale

Figure 3: Concurrent validity- comparison between PPT and VAS

Discussion

This study's purpose was two-fold. The first objective of the study was to establish PPT as a reliable tool to measure KOA. Indeed, there are surprisingly few studies that report information on intra-class correlation coefficient (ICC) confidence intervals, statistical power, standard error of the measurement, or minimal detectable change, to establish intra-assessor and inter-assessor reliability for PPT among KOA patients.[20-22] Prior studies have tested intra-assessor reliability with three consecutive PPT measurements of the tibialis anterior with a pressure algometer and reported excellent ICC values of 0.97.[22] A comparison between two consecutive assessments is common in studies dealing with PPT but questions the rationale that three PPT values are often recorded.[23] This study, therefore, used the three values of PPT to assess intra-assessor reliability.

It is important to note that this study observed no significant difference for PPT measurements between weeks 1, 2, 3, and 4. Intra-assessor reliability showed a slight decrease in the second-week session. The ICCs values both before and after treatment sessions were also almost perfect, confirming excellent reliability and agreeing with previous studies.

Studies have found that patients with OA present lower pain sensitivity and therefore a lower PPT,[24,25] the results of the study also concurs with this finding. Prior studies have concluded that there is good agreement between observers while using PPT across different parts of the body.[22,26] The literature also dictates that healthy participants, and especially athletes, show excellent inter-assessor reliability and moderate intra-assessor reliability.[27] The reliability of PPT varies from 0.61–0.91 between repeated measurements in KOA

in previous studies[28] but this study exhibits very high ICC for intra-assessor and inter-assessor reliability. ICC should be considered along with the SEM as a means to estimate measurement precision. Absolute error, confirmed by the SEM and MDC, signifies the measurement properties of the PPT evaluated by PPT. A prior study's SEM values obtained using an electronic PPT had an SEM range from 18.2–73.8 kPa;[22] this study also shows that SEM intra-assessor and inter-assessor ranges from 27–65 kPa. These results indicate that the handheld PPT also provides error-free reliability. In addition, other studies show very well to excellent reliability while measuring PPT of the knee.[20,29] The SEM and MDC values in this study likewise suggest that the clinical measurement properties of PPT are appropriate. Both the relative and absolute error shows that PPT is a reliable tool to measure the PPT of KOA. The higher ICC for both inter-assessor and intra-assessor reliability for hand-held PPT could be due to the fact that the examiners had extensive training in physical therapy.[30] There is a dearth of available literature based on the reliability of PPT as a means of measuring pain in Saudi Arabian populations, so this current study is unique and contributes significantly.

A purpose of this study was to test the reproducibility of the subject rating their pain from a measured mechanical stimulus on a VAS scale over a short period. The study in this was established internal validity by selecting reliable instruments, strict compliance with the procedures, and blinding participants from the PPT scores, and other participants. External validity was ensured by using a standard testing protocol, outcome measures, and validated instrumentation. Currently, there is no reference standard scale to compare to the PPTs.[31] Interpretation of pressure palpation is subjective, and thereby results vary among clinicians considering there is no standard reference as yet. This is due to some of the limitations reported among systematic reviews, including methodological variability and lack of standardization among available studies that have together created a gap regarding PPT.[32,33] Prior research comparing the process of manual palpation and VAS was done for fibromyalgia and has seen good results[34] whereas for KOA studies have found a significant correlation between VAS and PPT.[35] Studies have also shown that the relation between VAS and PPT is negative.[36] This finding concurs with the results of the current study. In terms of concurrent validity, the correlation between before treatment VAS and PPT shows a higher correlation (negative) than the correlation between after treatment in both VAS and PPT. Patients were more pain-sensitive before treatment. In terms of construct validity, the result shows a significant difference between the scores before and after the treatment, for both PPT and the VAS scale. The validity in terms of power shows that PPT exhibits a power of 1.00 compared to VAS that has a power of 0.99. Indeed, results here establish the reliability and validity of PPT.

The second objective of the study was to evaluate the treatment effectiveness of physiotherapy. A study conducted by Tok *et al*. concluded in their findings that knee OA patients could improve their balance function in both static and dynamic conditions using electrical stimulation combined with continuous passive versus isometric exercises. Their main outcome measures were pain, WOMAC score, SF-36 score, and knee and thigh circle measurements, balance tests were done at baseline and after the treatment.[37] physical therapy intervention is effective in pain-relieving and improving the quality of life in patients with a knee.[38] Over recent decades, a lot of scientific societies have produced guidelines for physical therapy intervention for KOA to improve quality of life.[39] Another study conducted by Gaines *et al*. concluded that there was an immediate decline in arthritis knee pain that occurred when neuromuscular electrical stimulation when used only for 15 min per day for 3 days per week.[40]

A study done by Abdel-aziem *et al*. concluded that KOA patients with pain can directly get benefited from physical therapy intervention.[41] The results of the present study indicate that patients with KOA who received physical therapy treatment-experienced clinically meaningful improvements in pain as evidenced by the effect sizes for pain and the effect size sensitive for detecting changes over time.

The findings show that even though VAS is a gold standard for measuring arthritic pain, even PPT is responsive to a physical-therapeutic intervention. The mean values are given alongside intra-assessor and inter-assessor reliability show progressive PPT exhibited by the patients before and after treatment. VAS score tends to be very subjective, depending on the type of patient[42] while studies have observed PPT is a potentially effective tool to evaluate and monitor the clinical evolution of pain syndrome in KOA patients.[43,44]

Pain is a highly subjective experience because it is both a sensory and emotional experience, and researchers have highly criticized the VAS scale.[45] The reason was for this criticism is the difficulty comprehending VAS scale compared to other numerical rating scales. There are studies that point out that PPT is a stimulus-dependent method; for example, it depends on the stimulus intensity or the duration and tends to detect a single point of threshold level. VAS, on the other hand,

is a response-dependent method that can result from a whole perceptual range.[46] In our study, the head of the PPT probe was 1 cm^2 and the VAS assessment was approximately the distance of 1–2 cm. Our results concur with those of a similar study that found that in a larger stimulated area, the pain pressure would reduce because the pressure spreads across the tissue which accordingly makes VAS less reliable as a tool.[46] Individual differences in pain tolerance also impact response to the VAS scale.[47] The present study results also show that the above 60-year group had recorded their pain on VAS scale as 7.56 whereas their PPT value before treatment was found to be lesser than the below 60 year age group respondents. The below 60-year age group respondents recorded higher VAS pain score but had a slightly higher PPT which also would prove the problem of VAS among older age people above 60 years. Similarly, the 60 above age group recorded a higher VAS pain after the treatment, while their PPT values showed a significant increase than the other group.

The current study also compared the PPT baseline and the 4th week after treatment data; the physical therapy treatment showed statistical significance. PPT shows a higher rate of effect size than VAS. It was estimated by the ratio of the pooled variance of the treatment groups. This study, therefore, concludes that physiotherapy modality can reduce KOA pain and improve the quality of life for patients and that PPT is an objective, reliable, and valid tool for measuring pain both before and after treatment. The difference between self-reported pain and objective measurement is well established here. Self-reported questionnaires provide subjective information about the disease process, while performance-based tests objectively measure patients' pain. A major limitation of the current study is that it only considered the pain-sensitive area. The Western Ontario and McMaster Universities Arthritis Index score or Numeric Rating Scale would have provided more validity to the treatment's effectiveness. Another limitation is that the current study has employed follow-up data.

Conclusion

PPT has excellent intra- and inter-assessor reliability for KOA patients; the effect size in this study was high at 1.94 and more, indicating that PPT is adequately sensitive for detecting changes over time. This study, therefore, concludes that PPT is a reliable and valid tool for measuring pain in older adult populations, which are more likely to have sensory deficits, memory problems that interfere with the effect of the intervention, and difficulty understanding the prognosis when a clinician measures pain subjectively with VAS. This study strongly establishes the difference between self-reported pain and PPT measures. Self-reported questionnaires provide subjective information about the disease and pain, while performance-based tests like the PPT objectively measure patients' pain accurately during the intervention. The latter thereby has excellent intra- and inter-assessor reliability. PPT pain assessment is easy to conduct in any clinical setting, requires less training time and physical space, and perhaps most importantly it is a high precision tool for measuring pain that is consistent compared to other subjective methods.

Author contribution

Khalid A Alahmari and S Paul Silvian are responsible for the conception and design of study and analysis of data. Along with Ravi Shankar Reddy, they drafted the article and approved the final manuscript after critical revision. Irshad Ahmed, Paul Silvian and Venkata Nagaraj Kakaraparthi contributed towards acquisition of data. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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Khalid A Alahmari and S Paul Silvian are responsible for the conception and design of study, acquisition and analysis of data. Along with Ravi Shankar Reddy, they drafted the article and approved the final manuscript after critical revision. Irshad Ahmed and Venkata Nagaraj Kakaraparthi contributed towards acquisition of data. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) has been completely observed by the authors.

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Conflicts of interest

There are no conflicts of interest.

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