Comparitive Study of Vas Scores and Pressure Algometry to Quantify Pain in Healthy Subjects

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Abstract:
Introduction : Pain quantification is essential for diagnostic and monitoring purposes where it is inherently subjective, and pain measurement in patients relies primarily on self-reports. The most common approaches to self-reported pain measurement are the use of a visual analog scale (VAS), numeric pain rating scales, and the Western Ontario and McMaster osteoarthritis Index pain scale. Objective pain measures are invaluable as they reflect different perspectives of the health condition like the physiological and psychological features of the patient making it difficult to interpret responses**.** Pain threshold is evaluated by methods including cuff algometry, pressure algometry, and algometry with electric stimulation. Pressure algometers(PA) are inexpensive, more convenient and widely available. **Objectives :** Primary: Is to determine in healthy volunteers the reliability of PA when it is applied on the medial part of the proximal tibia metaphysis along with VAS Scores **Secondary:** Is to evaluate if there were differences inpressure pain threshold(PPT) at the medial side of the knee between men and women. **Methodology:** After receiving the approval of the Institutional Ethics Committee 40 healthy volunteers under ASA 1 and 2 were included in a study using a randomized comparative study. All healthy volunteers both males and females age group between 15 to 65 years were the inclusion criteria in this study after obtaining written informed consent from healthy volunteers. Exclusion criteria for this includes those with a healthy subject with no history of lower limb, spine or pelvic fractures, with the absence of skin disorders, peripheral neuropathies or vascular diseases and those who took painkillers for any reason in the previous week will be excluded. PPT is determined using a handheld pressure algometer device with an increasing of the pressure of 20Kpa/s, all the measurements were performed from the medial knee joint line with the knee flexed at 90 degree, by pushing the algometer the force applied to the tibia gradually increased. The participants were not allowed to see the algometer display in any moment, and, as soon as they experienced a painful sensation, they said “stop”, the algometer is immediately released and the force (in Kpa) is read from the display and they were also asked to indicate their pain intensity on a 10 cm line by using the VAS score simultaneously, based on both scores they were graded into mild, moderate and severe. **Results:** No significant demographic differences in age, gender or ASA classification have been observed in my study. PA AND VAS- Frequency distribution of patients studied. In our study, when quantifying the pain threshold in healthy volunteers using Pressure algometry and VAS, we obtained similar results with p value of 0.397 and p value of 0.366 respectively but were unable to detect any statistical significance and as observed males have high pain threshold compared to females based on the standard deviation of 1.55±0.43 and 1.43±0.49 respectively measured in our study. **Conclusion:** Both Pressure algometry and VAS is a reliable tool to quantify the pain threshold in a healthy volunteer and males have a high-pressure pain threshold compared to females.

Keywords: Pressure algometry, Pressure pain threshold, Visual analogue scale.

Background (Introduction)

Pain quantification is essential for diagnostic andmonitoring purposes in disorders around the knee,whereas pain is inherently subjective, and pain measurement in patients relies primarily on self-reports. [1] . The most common approaches to self-reported pain measurement are the use of a Visual AnalogueScale (VAS), Numeric pain rating scales, and the Western Ontario and McMaster osteoarthritis Index pain scale [2,3], although self-reported pain intensity is important, it is a composite of the physiological and psychological features of the patient and their health problem that is further mediated by social aspects, which can make it difficult to interpret responses [4,5], thus, objective pain measures are invaluable as they reflect different perspectives of the health condition, therefore, measuring knee pain is an important component of clinical practice; its importance is evident in the frequency with which it drives healthcare utilization as well as its impact on quality of life[6].

An important step toward integrating pressure pain threshold (PPT) testing into routine clinical practice is the establishment of the reliability of viable instruments [7], such instruments must be commercially available, meet measurement standards, and function under ideal conditions; furthermore, they must not be cost-prohibitive when used in a clinical setting.

Pain threshold is evaluated by methods including cuff algometry, pressure algometry, and algometry with electric stimulation [7,8,9].

Pressure algometers are inexpensive, more convenient, and more widely available [10], Moreover, pressure algometry methods can be used for clinical research to measure the efficacy of therapeutic interventions for the treatment of pain as well as general psychophysiological research [7].

Lacuna in Knowledge:

Quantification of the pain is essential for diagnostic and monitoring purposes in which tenderness is the major symptom of muscle skeletal dysfunction and its accurate evaluation is important in the diagnostic procedure.

In the clinical practice, digital pressure palpation is normally used to locate and assess the pain, however, this method is difficult to quantify and standardize because of the different degrees of pressure applied by the same or different examiners as well as the subjective report of pain by the subjects. [11].

The Pressure Pain Threshold (PPT) is defined as the point at which a non-painful pressure stimulus turns into a painful pressuresensation.

Pressure algometry (PA) is a method described to objectify this PPT, this technique is a well-known and well-validated method to induce acute experimental pain. Until now, the most objective tool and the gold standard method to quantify the pain is the Visual Analogue Scale (VAS).This score is very subjective depending on the person and a high correlation with the PA has been observed in a previous study [16,17,18]. Given the need to better improve the method to quantify the tenderness and to monitor the pain [19], it was considered the possibility to apply the PA in the healthy volunteers.

Objectives:

PRIMARY: Is to determine in healthy volunteers the reliability PA when it is applied on the medial part of the proximal tibia metaphysis along with VAS Scores

SECONDARY: Is to evaluate if there were differences in PPT at the medial side of the knee between men and women.

Materials & Methods:

Source of data:

This study will be conducted on healthy volunteers at R. L. Jalappa Hospital and Research centre,Tamaka, Kolar.

- Study Design: Comparative study.
- Sample Size: Single group with sample size of 40 healthy volunteers.
- Duration of study: One month

Method of Collection of Data:

- The experimental procedure will be explained and signed informed consent will be obtained from each participant.
- The ethics committee approval of our institution will be taken.
- Result values will be recorded using a Proforma.

Inclusion Criteria:

- All healthy volunteers.
- Both males and females age Ranging from 15 to 65 years.

Exclusion Criteria:

- Healthy subjects with no history of lower limb, spine or pelvic fractures.
- Healthy subjects with the absence of skin disorders, peripheral neuropathies or vascular diseases.
- Healthy subjects who took painkillers for any reason in the previous week will be excluded.

Methodology:

1) Detailed demography and history of the healthy subjects will be taken.
2) Complete physical examination will be done.
3) PPT is determined using a handheld Pressure algometer device with a 1 cm2 probe area with an increasing of the pressure rate of 20Kpa/s (Fig 1).
4) The pressure algometer consists of a "pistol" handle and a rod with a pressure-sensitive gauge strain at the tip.
5) All the measurements will be performed at 1 cm distal from the medial knee joint line with the knee flexed at 90 degrees.
6) This location was chosen because it is the point usually used to evaluate the presence of pain in the medial part of the knee when considering a surgical procedure like a noncompartmental or total knee arthroplasty or a high tibial osteotomy.
7) PA is performed on the same day under quiet and nonstressful conditions.
8) The tip of the algometer is positioned on this specific point.
9) By pushing the algometer, the force applied to the tibia gradually increased. The participants were not allowed to see the algometer display in any moment, and, as soon as the volunteers experienced a painful sensation, they said "stop", the algometer is immediately released and the force (in Kpa) is read from the display.
10) Two trained raters were instructed in the application of algometry.
11) To determine the value of PPT, we used the method described by Nussbaum and Downes [20].
12) Both raters made 3 consecutive algometry applications at the prescribed rate of 20KPa/s, 1 minute apart.

13) The first measurement was considered as a trial and the final value of the PPT is calculated from the mean of the second and third measurements.
14) The number of raters (2), the time elapsed between both measurements (3–4 hours) and the time between measurements per participant (10–20 minutes) were decided on with the purpose properly evaluating the device and avoiding potential disturbances of any clinical variation of the patientbetween measurements [1,15].
15) The two self-reported scales have verbal anchors at the beginning and end with "no pain" and "worst pain imaginable", respectively. Patients were asked to indicate their pain intensity on a 10 cm line when using the VAS score(Fig 2) simultaneously while using a pressure algometry device.

Fig 1:Pressure Algometer

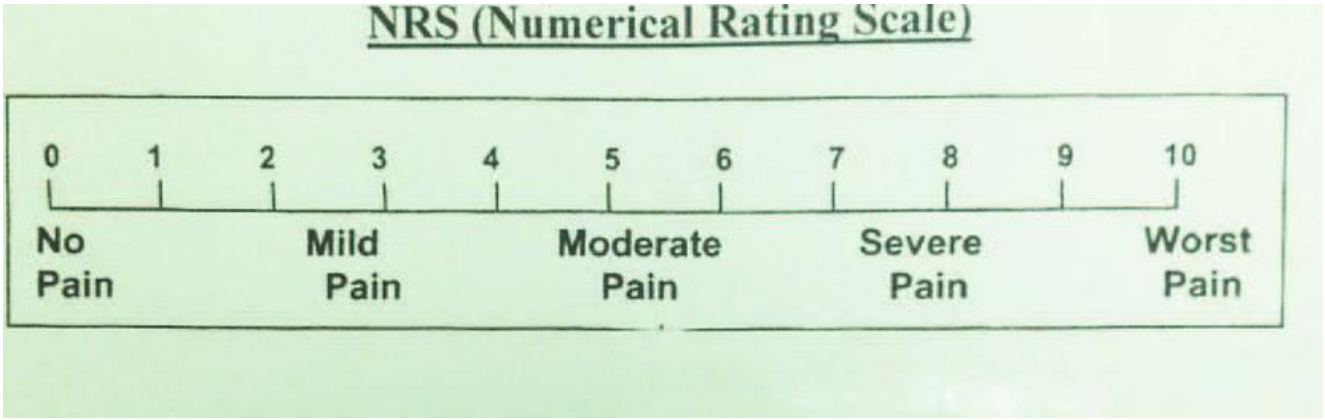

Fig 2: Vas Score Scale(Nrs Scale)

Forty volunteers were finally assessed.

Statistical Methods:

- Study design:Comparative study
- Statistical Analysis:
- Continuous variables are described as the average and standard deviation or as the median and interquartile range, according to their distribution. Categorical variables are expressed as the absolute and relative frequencies. The results of the right- and left-side algometric measurements and the NRS and VAS results were compared by Wilcoxon's test. The agreement between the scales was assessed by the intraclass correlation coefficient (ICC). Moreover, Bland-Altman's method was used to assess the agreement for pain.
- The comparison of the scales and algometry results according to the cause of pain was determined by Mann-Whitney or Student's test for continuous variables, according to the distribution, and for categorical variables, Pearson's chi-square test was used. The correlation between the scales and algometry results was assessed using Spearman's correlation coefficient.

Parameters to be Observed:

- Vas Scores
- Algometer Scores.

Results:

Forty volunteers were finally assessed, 20 men and 20 women, with a mean age of 36.7 years and SD 15.81) (Table 1). Pressure algometry was well-tolerated by all the participants.
All values showed in Tables 1–4 presented an excellent correlation.
No significant demographic differences in age, gender or ASA classification have been observed as shown in table 1 to table 4.

Table 1: Age in Years-Frequency distribution of patients studied

Age in Years	No. of Healthy Volunteers	%
15-30	23	57.5
31-40	5	12.5
>40	12	30.0
Total	40	100.0

Mean ± SD: 36.70±15.81

Table 2: Gender- Frequency distribution of patients studied

Gender	No. of Healthy Volunteers	%
Female	20	50.0
Male	20	50.0
Total	40	100.0

Table 3: Age in Years- Frequency distribution of patients studied

Age in Years	Gender		Total
	Female	Male	
15-30	13(65%)	10(50%)	23(57.5%)
31-40	2(10%)	3(15%)	5(12.5%)
>40	5(25%)	7(35%)	12(30%)
Total	20(100%)	20(100%)	40(100%)
Mean ± SD	33.45±11.39	39.95±19.02	36.7±15.82

P=0.198, Not Significant, Student t test

Table 4: ASA Grade- Frequency distribution of patients studied

ASA Grade	Gender		Total
	Female	Male	
1.00	9(45%)	8(40%)	17(42.5%)
2.00	11(55%)	12(60%)	23(57.5%)
Total	20(100%)	20(100%)	40(100%)

Table 5: PA AND VAS- Frequency distribution of patients studied

Variables	Gender		Total
	Female	Male	
Pressure Algometry Score			
• Mild	9(45%)	6(30%)	15(37.5%)
• Moderate	4(20%)	6(30%)	10(25%)
• Severe	7(35%)	8(40%)	15(37.5%)
Visual Analog Score (VAS)			
• Mild	14(70%)	12(60%)	26(65%)
• Moderate	6(30%)	8(40%)	14(35%)
• Severe	0(0%)	0(0%)	0(0%)
Total	20(100%)	20(100%)	40(100%)

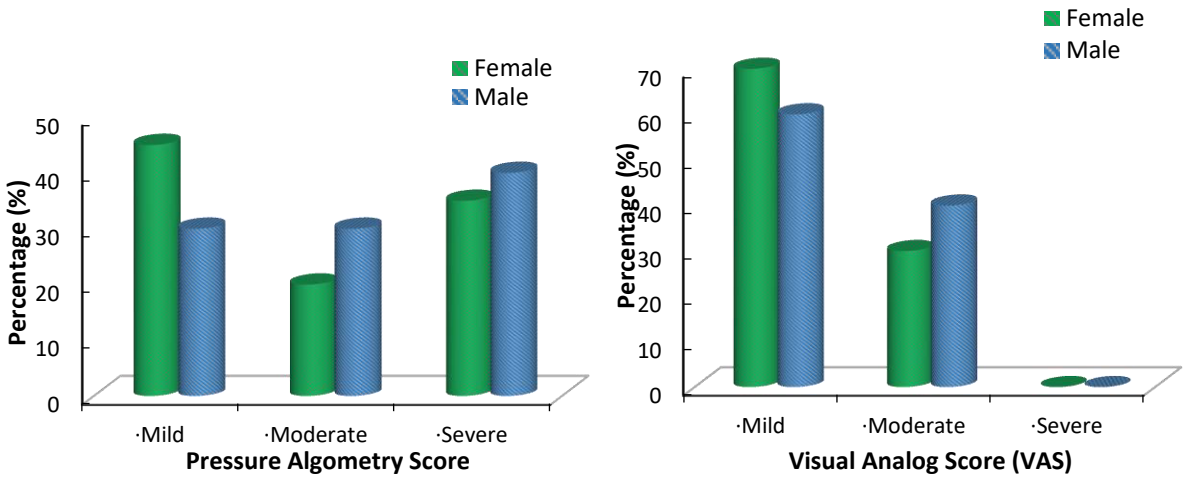

Fig 3: Showing PA and VAS score

Table 6: Comparison of PA and Vas in Males and Females Studied

Variables	Gender		Total	P Value
	Female	Male		
Pressure Algometry Score	1.43±0.49	1.55±0.43	1.49±0.46	0.397
Visual Analog Score (VAS)	3.1±0.85	3.35±0.88	3.23±0.86	0.366

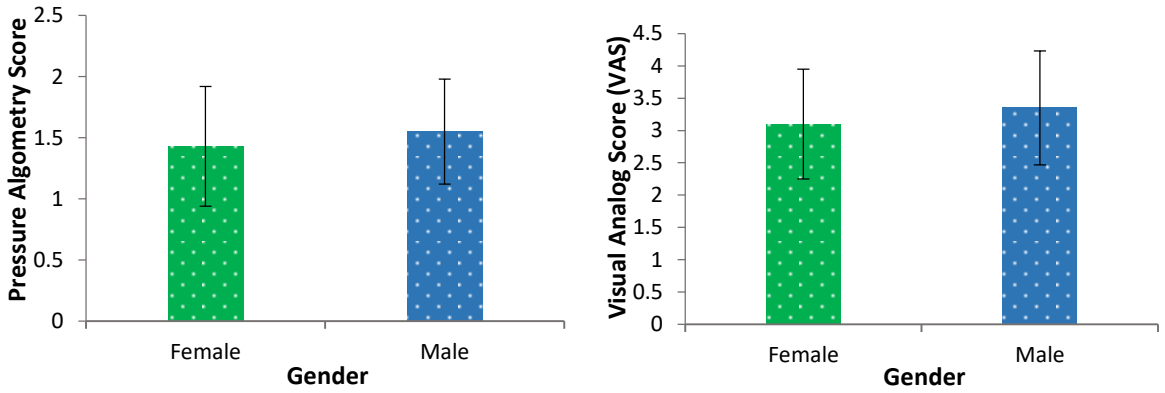

Fig 4: Showing PA & VAS scores and Gender

Table 7: Pressure Algometry Score- Frequency distribution of patients studied

Pressure Algometry Score	Visual Analog Score (VAS)		Total
	Mild	Moderate	
Mild	10(38.5%)	5(35.7%)	15(37.5%)
Moderate	5(19.2%)	5(35.7%)	10(25%)
Severe	11(42.3%)	4(28.6%)	15(37.5%)
Total	26(100%)	14(100%)	40(100%)

P=0.499, Not Significant, Fisher Exact Test

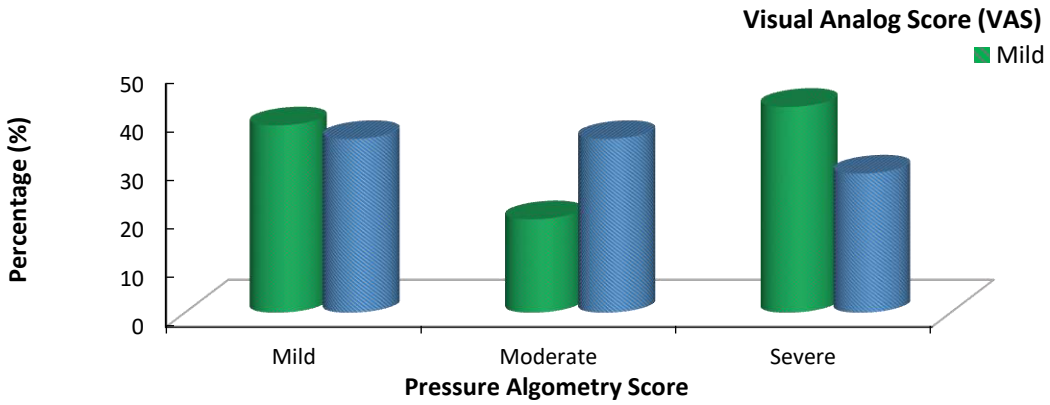

Fig 5: Showing comparison of PA and VAS

Table 8: Comparison of Baseline clinical variables in male and females studied

Variables	Gender		Total	P Value
	Female	Male		
Height (cm)	159.45±3.95	165±7.54	162.23±6.57	0.006**
Weight (kg)	68.6±11.06	74.25±11.75	71.43±11.62	0.126
Heart Rate(bpm)	80.35±8.32	80.35±9.48	80.35±8.8	1.000
Baseline Blood Pressure (SBP)	121±11.65	122±8.94	121.5±10.27	0.762
Baseline Blood Pressure (DBP)	78.5±10.89	82.5±10.2	80.5±10.61	0.238

In our study, when quantifying the pain threshold in healthy volunteers using Pressure algometry and VAS, we obtained similar results with p value of 0.397 and p value of 0.366 respectively but were unable to detect any statistical significance and as observed males have high pain threshold compared to females based on the standard deviation of 1.55±0.43 and 1.43±0.49 respectively measured in our study.

Discussion:

One of the key concerns for anaesthesiologist is identifying and treating pain.

In the present study, we investigated the correlation between self-reported pain perception instruments, the VAS and a pain provocation test with pressure algometry in a healthy volunteer.

A study conducted by X. Pelfort et al showed PPT is measured on the medial part of the proximal metaphysis of the tibia. Based on their hypothesis the results confirmed that algometry is a useful tool in objectifying pain in the medial part of the knee. Secondarily, it was observed a higher PPT values for men.[16]

By exerting a deep cross-friction pressure in the proximal gluteus region, Farasyn et al. investigated the usefulness of this technique in individuals with non-specific low back pain. Excellent inter- (ICC 0.97) and intra-rater (ICC 0.98) reliability was reported.[21]

The first dorsal interosseous muscle, the neck and head muscles or after a spinal manipulation are some other body regions where other authors have showed a good reliability for this approach. [11,14,22,23]

A study conducted by Pelfort X et al, Using the bone micro indentation technique, it was possible to determine the relationship between the emergence of end-of-stem pain and a preoperative reduction in local bone strength, as well as the potential value of pressure algometry in the diagnosis and monitoring of this particular group of patients, which resulted in the following conclusion: When applied to the tibial shaft, pressure algometry demonstrated high

intra- and interobserver correlation and was just as useful in quantifying stem tip discomfort as the VAS or functional measures.[26]

Our study likewise produced results that are similar to the study cited above, showing that both PA and VAS scores are accurate indicators for assessment of pain.

For the algometer to increase the local pressure while maintaining a constant speed (20 Kpa/s) during the measurement, the observer must be able to see the digital display. Due to this fact, the volunteer's "stop" command determines the final value (in Kpa), which is not blinded from the rater. This fact is considered as a study limitation in our study.

Another interesting finding of this study was the significant lower values of PPT obtained in women compared with men. Previous studies have found similar results when PA was applied in other locations of the human body [24,25]. Fisher et al., in a study, conducted in a healthy population found higher values of PPT in males in 8 out of 9 different muscle regions evaluated. In a recent study, Aweid et al. [27]analysed the PTT in healthy runners in the medial part of the distal tibia. They also observed a lower PTT in females compared to males. The reasons to explain these findings are not well-known, but different authors referred hormonal reasons as a possible explanation for these differences.

Similar to the abovementioned study, we also found a similar result was that significant lower values of PPT obtained in women compared with men.

We used one-dimensional instruments that have been recommended by several studies [25,26]. However, other authors have disagreed with that approach, as they consider one-dimensional instruments to be less effective because they do not reflect the full complexity of the pain. The complexity of the experience of pain requires multidimensional assessment that combines pain intensity scores and other measurements of the various domains of pain.

The crucial feature in the assessment of pain is not the choice of the scale to be used but the conditions of its use, which includes the following: the standardized anchor descriptors, methods of application, time intervals, interpretation of the clinical meaning, level of cognitive development, age, educational level, and patient's preferences [28].

Conclusion:

Both Pressure algometry and VAS is a reliable tool to quantify the pain threshold in a healthy volunteer and males have a high-pressure pain threshold compared to females.

Limitations:

In future we will need to employ a large sample size to look for any gender differences in pain threshold and can be applied to patients.

Conflict of Interest- Nil

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