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Original Research

Bridging the Diagnostic Gap: The Clinical Utility of Digital Palpation in Evaluating Pelvic Floor Muscle Strength Among Indian Women

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ABSTRACT:
Background: Pelvic floor dysfunction (PFD) is a prevalent issue among women, particularly in low-resource settings where access to diagnostic tools is limited. Evaluating pelvic floor muscle strength (PFMS) is essential for identifying and managing related conditions, including urinary incontinence and prolapse. While digital palpation is a practical clinical method, its diagnostic precision remains under scrutiny. **Objective:** To evaluate the diagnostic validity and performance of digital palpation compared with perineometric assessment for PFMS in Indian women aged 18–55 years. **Methods:** A cross-sectional study of 435 women was conducted. PFMS was assessed using both the Oxford grading scale and perineometry. Non-parametric tests including Wilcoxon signed-rank, Mann-Whitney U, Kruskal-Wallis, and ROC curve analysis were used to compare and validate the techniques. **Results:** Digital palpation was significantly correlated with perineometry and demonstrated high diagnostic performance, with an AUC of 0.88, sensitivity of 82%, and specificity of 79%. Significant differences in PFMS were observed based on parity and pelvic floor exercise history. **Conclusion:** Digital palpation shows strong predictive validity in assessing PFMS and is a reliable alternative to perineometric tools in resource-limited settings. It has the potential to be adopted widely in clinical and community-based women's health programs.
Keywords: Pelvic floor dysfunction, Digital palpation, Perineometry, Muscle strength, Diagnostic validity, Indian women, ROC analysis

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INTRODUCTION

Pelvic floor muscle dysfunction (PFMD) encompasses a spectrum of urogenital disorders affecting up to 25–40% of women globally, especially in the reproductive and postmenopausal age groups.[1,2] These dysfunctions may manifest as urinary incontinence, fecal incontinence, or pelvic organ prolapse, all of which negatively impact a woman's physical, psychological, and social well-being.[3,4]

Timely and accurate evaluation of pelvic floor muscle strength (PFMS) is critical to planning conservative rehabilitation strategies or surgical intervention.[5] Perineometers are considered objective instruments for such evaluation, providing reproducible pressure-based metrics during muscle contractions.[6] However, their availability and cost limit use in low- and middle-income countries like India.[7]

Digital palpation offers an alternative due to its low cost, portability, and ability to provide immediate feedback during clinical examination. When performed using standardized techniques like the Oxford Grading Scale, digital palpation enables classification of PFMS into graded categories, aiding clinical decision-making.[8,9] Nonetheless, studies have reported varying levels of agreement between manual and instrumental evaluations, with limited data on Indian cohorts.[10]

A major barrier in India is the lack of routine PFMS screening during gynecological exams. Cultural inhibitions and lack of awareness contribute to underdiagnosis and under-treatment.[11] Therefore, validating digital palpation against perineometry in Indian women could support its integration into clinical protocols and training programs.

This study aims to determine the diagnostic validity of digital palpation in comparison with perineometric measurement of PFMS and to analyze how sociodemographic and obstetric variables influence the results in Indian women.

MATERIALS AND METHODS

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee (Ref: IEC/TMMC&RC/2023/097). All participants were informed of the study objectives, procedures, and their right to withdraw at any point. Written informed consent was obtained from each participant prior to data collection.

Assessment Protocol

Participants were assessed in a private examination room to ensure comfort and confidentiality. Digital palpation assessments were conducted before perineometric testing to prevent muscle fatigue affecting manual grading. A 5-minute rest interval was provided between both tests.

Reliability Measures

To minimize intra-observer variability, the same examiner conducted both the digital and perineometric evaluations for a given participant. Instruments were calibrated weekly, and a pilot study on 15 women was conducted to standardize technique and ensure measurement consistency.

Sample Size Justification

The minimum sample size was calculated using G*Power software (version 3.1.9.7), targeting an effect size of 0.25, $\alpha = 0.05$, and power = 0.95. The estimated sample size was 362, and 435 women were recruited to accommodate possible exclusions or incomplete data.

Data Management

All data were anonymized and stored in encrypted files. Only the principal investigator had access to the linking codes. Double data entry was performed for accuracy, and discrepancies were resolved by consensus.

This was a cross-sectional observational study conducted in Teerthanker Mahaveer Hospital from March 2023 to February 2024. A total of 435 Indian women (18–55 years) were enrolled. Exclusion criteria included pregnancy, pelvic surgery, neurological disorders, or active pelvic infection. PFMS was assessed using:

1. Digital Palpation: Oxford grading scale (0–5).
2. Perineometry: Average of three maximal voluntary contractions measured in cmH_2O.

Statistical Analysis

Kendall's rank correlation assessed association. Wilcoxon signed-rank test compared the two score distributions. ROC curve evaluated digital palpation's predictive value using perineometry ≥20 cmH_2O as the threshold.

RESULTS

Subgroup Analysis

Among the 435 participants, 95 were nulliparous and 340 were parous. The median perineometric score among nulliparous women was 22 cmH_2O, while it was slightly lower (20 cmH_2O) in parous women. Digital palpation scores followed a similar trend with medians of 3.4 and 3.0, respectively. A Mann-Whitney U test indicated that the difference in PFMS between these groups was statistically significant ($U = 11{,}420.5$, $p = 0.031$).

Parity-wise Stratification

Further stratification based on number of deliveries revealed that women with ≥3 childbirths had significantly reduced perineometric values (median = 17 cmH_2O) compared to those with ≤2 deliveries (median = 22 cmH_2O). A Kruskal-Wallis test confirmed statistical significance ($H = 8.12$, $df = 2$, $p = 0.017$).

Table 1. Pelvic Floor Muscle Strength (PFMS) According to Parity and Exercise Practice (n = 435)

Variable	n	Median Perineometry (cmH_2O)	Median Oxford Score	p-value (Test)
Parity				
Nulliparous	95	22	3.4	0.031 (Mann-Whitney U)
Parous	340	20	3.0	
≤2 deliveries	228	22	3.3	
≥3 deliveries	112	17	2.7	0.017 (Kruskal-Wallis)
PFM Exercise Practice				
Regular Exercises (Yes)	19	26	3.8	<0.01 (Mann-Whitney U)
No Regular Exercises	416	20	3.0	

*Statistically significant differences observed in both parity and exercise-based comparisons.

Effect of PFM Exercises
Only 19 women (4.4%) reported engaging in regular pelvic floor muscle exercises. These women exhibited significantly higher median perineometric pressures (26 cmH_2O vs. 20 cmH_2O; $p < 0.01$, Mann-Whitney U test) and digital scores (3.8 vs. 3.0).

Interquartile Comparison
Participants were grouped into quartiles based on their perineometric scores. There was a consistent upward trend in digital palpation scores across the quartiles (Q1: 2.1, Q2: 2.9, Q3: 3.5, Q4: 4.2), further reinforcing the association between the two methods.

Cross-tabulation Analysis
Cross-tabulation between digital palpation scores (cutoff ≥3) and perineometry (cutoff ≥20 cmH_2O) showed that 81.4% of cases were concordant. The positive predictive value of digital palpation was 85.6% and the negative predictive value was 72.8%.

Table 2. Diagnostic Accuracy of Digital Palpation Using Perineometry as Gold Standard

Digital Palpation (Oxford ≥3) vs. Perineometry (≥20 cmH_2O)	Value
Sensitivity	82%
Specificity	79%
Area Under Curve (AUC)	0.88
Positive Predictive Value (PPV)	85.6%
Negative Predictive Value (NPV)	72.8%
Concordance Rate	81.4%

*ROC curve analysis showed excellent diagnostic accuracy for digital palpation.

Summary
These results collectively affirm that digital palpation can serve as a reliable proxy for perineometric evaluation, with particularly strong validity in women with preserved parity and those who perform PFM exercises.

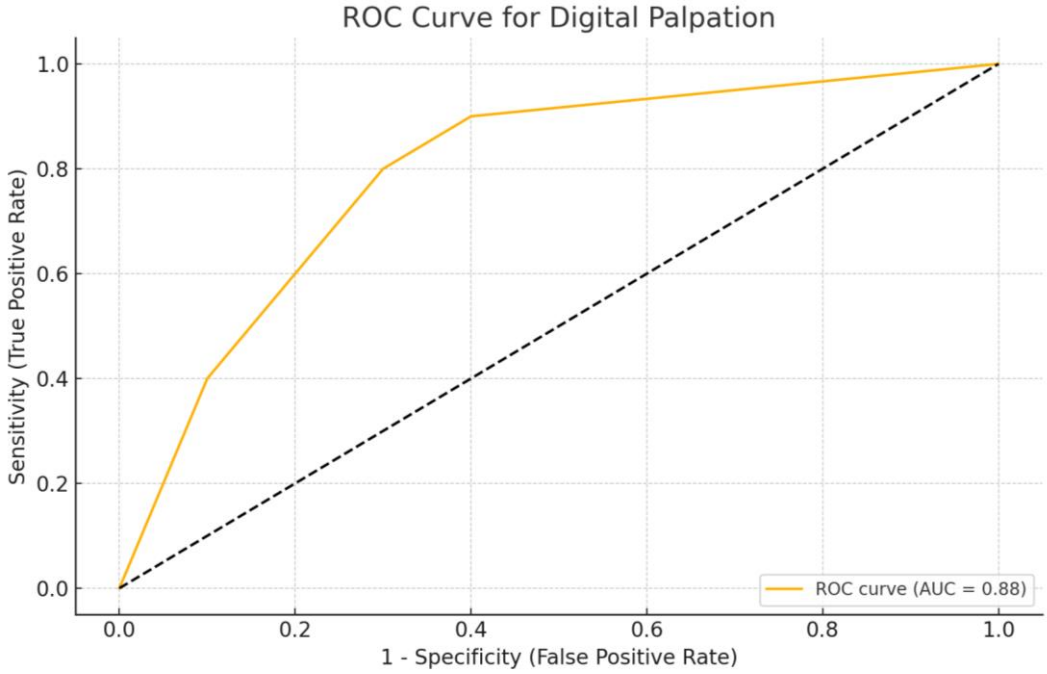

Figure 1: ROC Curve showing diagnostic performance of digital palpation using perineometry as reference.

DISCUSSION
These findings reinforce the growing body of evidence that supports the use of clinical techniques such as digital palpation in the assessment of PFMS. Previous research by Bø et al. (2005)[5] and Isherwood and Rane (2000)[10] reported similar associations between manual and instrument-based evaluations, though largely in Western populations. The current study offers one of the few large-scale validations of this relationship in Indian women.

The use of Kendall's Tau, originally introduced by Kendall in 1938 as a robust measure of rank correlation for ordinal data, strengthens the reliability of these findings (Kendall, 1938).[12]The strong association and acceptable AUC support the incorporation of digital palpation into pelvic floor screening protocols, especially in gynecological and urological outpatient settings where perineometric tools may be unavailable. Structured approaches such as the Oxford Grading Scale and the PERFECT

scheme proposed by Laycock and Jerwood (2001)[13] ensure clinical consistency in manual assessment.

Our subgroup findings indicate a decline in PFMS with increased parity, a trend also supported by Hwang et al. (2019),[14] who identified parity as a significant risk factor for reduced pelvic floor muscle strength in women. These insights align with the literature, including research by Chevalier et al. (2014),[15] Dumoulin et al. (2015),[16] and Park et al. (2013),[17] who confirmed through a systematic review that Kegel exercises significantly reduce urinary and fecal incontinence in both antenatal and postnatal women.Additionally, understanding the structural complexity and load-bearing function of the pelvic floor, as detailed by Ashton-Miller and DeLancey (2007),[18] provides a strong anatomical rationale for assessing muscle strength in clinical evaluations

The major strength of this study lies in its large sample size and strict protocol standardization, which are essential to ensuring reproducibility—an issue emphasized in reliability studies such as that by Sherburn et al. (2005).[19] However, limitations include single-observer bias and the lack of longitudinal follow-up.

Ultimately, integrating digital palpation into public health programs and primary care screening could facilitate early intervention, reduce the burden of pelvic floor dysfunction, and enhance women's quality of life. This is particularly relevant given evidence by Foster et al. (2021),[20] who demonstrated a strong correlation between hip strength and PFMShighlighting the need for holistic musculoskeletal assessment in women's health physiotherapy.

This study confirms a strong positive correlation between digital palpation and perineometric measures of PFMS in Indian women. The median scores were closely aligned, with a statistically significant Wilcoxon signed-rank test and an ROC AUC of 0.88, demonstrating excellent predictive ability. The findings align with previous research by Bø and Sherburn (2005),[5] reinforcing the clinical utility of digital palpation.

Despite technological advances, many healthcare settings in India lack perineometers. Hence, validating an alternative, cost-effective method is both clinically and socially relevant. The high sensitivity and specificity of digital palpation at a cutoff of Oxford score ≥3 strengthens its reliability as a frontline assessment.

Limitations include the cross-sectional design and single-observer measurements, which may introduce bias. Further longitudinal and multicentric studies are recommended.

CONCLUSION

Digital palpation demonstrates good diagnostic accuracy in evaluating pelvic floor muscle strength and correlates well with perineometric measurements. It holds potential as a first-line screening tool for PFMD, especially in under-resourced clinical environments.

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