Adıyaman Üniversitesi Sağlık Bilimleri Dergisi, 2026;12(2):200-208
doi:10.30569.adiyamansaglik.1934323

E-ISSN: 2458-9179
ADIYAMAN ÜNİVERSİTESİ SAĞLIK BİLİMLERİ DERGİSİ
JOURNAL OF HEALTH SCIENCES OF ADIYAMAN UNIVERSITY

Research Article/Özgün Araştırma

Effectiveness of ultrasound-assisted training and the role of learning styles in enhancing shoulder anatomy knowledge and palpation skills in physiotherapists

Fizyoterapistlerde omuz anatomisi ve palpasyon becerilerinin geliştirilmesinde ultrason destekli eğitimin etkinliği ve öğrenme stillerinin rolü

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Atıf gösterme/Cite this article as: Erkut Ü, Yıldız A, Mustafaoğlu R. Effectiveness of ultrasound-assisted training and the role of learning styles in enhancing shoulder anatomy knowledge and palpation skills in physiotherapists. *ADYÜ Sağlık Bilimleri Derg*. 2026;12(2):200-208. doi:10.30569.adiyamansaglik.1934323

Abstract

Aim: To evaluate the effect of ultrasound-assisted shoulder anatomy training on anatomical knowledge, palpation accuracy, and knowledge retention among physiotherapists.

Materials and Methods: Fifty licensed physiotherapists without prior musculoskeletal ultrasound training completed a 16-hour ultrasound-assisted training program. Anatomical knowledge, location identification, and palpation accuracy were assessed before and after training using a standardized protocol and a 4-point scale (0–3). Learning styles were determined using the VARK questionnaire.

Results: Significant improvements were observed in all outcomes (p<0.001). Median anatomical knowledge scores increased from 11 to 24, while location identification and palpation accuracy improved from 16 to 24. Kinesthetic learners showed the greatest improvement (32.7%), followed by multimodal learners (20.4%) (p<0.01).

Conclusion: Ultrasound-assisted training significantly improves anatomical knowledge and palpation skills in physiotherapists, with the greatest benefits observed in kinesthetic and multimodal learners.

Keywords: Musculoskeletal ultrasound; Palpation; Physiotherapy; Shoulder anatomy; VARK; Learning Styles.

Öz

Amaç: Fizyoterapistlerde ultrason destekli omuz eklem anatomisi eğitiminin palpasyon doğruluğu ve omuz anatomisi bilgisi üzerindeki etkisini değerlendirmek.

Gereç ve Yöntem: Daha önce kas-iskelet sistemi ultrason eğitimi almamış 50 lisanslı fizyoterapist, 16 saatlik ultrason destekli eğitim programına katıldı. Eğitim öncesi ve sonrası anatomik tanımlama, konum belirleme ve palpasyon doğruluğu 4 puanlık ölçek (0–3) ile standartlaştırılmış bir denek üzerinde değerlendirildi. Öğrenme stilleri VARK anketi ile belirlendi.

Bulgular: Eğitim sonrası tüm sonuçlarda anlamlı iyileşme saptandı (p<0,001). Medyan anatomik tanımlama puanı 11'den 24'e, konum belirleme ve palpasyon doğruluğu puanı ise 16'dan 24'e yükseldi. VARK'a göre en yüksek gelişim kinestetik (%32,7), ardından multimodal öğrenenlerde (%20,4) görüldü ve gruplar arasında anlamlı fark bulundu (p<0,01).

Sonuç: Ultrason destekli eğitim, fizyoterapistlerde anatomik bilgi ve palpasyon becerilerini anlamlı şekilde geliştirmektedir. En belirgin kazanımlar kinestetik ve multimodal öğrenenlerde görülmektedir.

Anahtar Kelimeler: Kas-iskelet sistemi; Ultrason; Palpasyon; Fizyoterapi; Omuz Anatomisi; VARK.

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Geliş Tarihi/Received:20.04.2026 **Kabul Tarihi/Accepted:**19.05.2026 **Yayım Tarihi/Published online:**20.08.2026

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Bu makale araştırma ve yayın etiğine uygun hazırlanmıştır.
intihal incelemesinden geçirilmiştir.

Introduction

Musculoskeletal (MSK) disorders are a leading cause of disability worldwide. The effective management of these conditions relies heavily on the clinical skills of healthcare professionals, particularly their ability to accurately palpate anatomical structures.[1] MSK disorders are a diverse group of conditions that affect the bones, joints, muscles and connective tissues. These disorders can cause pain and loss of function, and are among the most debilitating.[2] Following low back and knee pain, shoulder pain is estimated to be the third most common MSK condition presenting in primary care.[3] The shoulder girdle comprises the clavicle and the scapula, which connects to the proximal humerus of the upper limb. There are four joints in the shoulder: the sternoclavicular (SC), acromioclavicular (AC) and scapulothoracic joints, and the glenohumeral joint. The glenohumeral joint is a highly moveable ball-and-socket synovial joint that is stabilized by the rotator cuff muscles that attach to the joint capsule, as well as the tendons of the biceps and triceps brachii. The humeral head articulates with the glenoid fossa of the scapula. The muscles of the shoulder connect the scapula and/or the clavicle to the humerus. These include the supraspinatus, infraspinatus, teres major, subscapularis and rhomboid majör.[4]

Palpation is the process of gathering information by examining part of the body via its surface using the sense of touch.[5] Finding areas of focal tenderness is important; for instance, tenderness in certain areas may represent acromioclavicular osteoarthritis, bicipital tendinitis, or rotator cuff disorders.[6] MSK ultrasound is a rapidly growing, non-invasive and safe method of assessing MSK structures, eliminating the need for expensive and potentially harmful studies such as radiography or MRI scanning.[7] Four categories of ultrasound have been identified in physical therapy: diagnostic, rehabilitation, interventional and research.[8] In the MSK system, palpation involves applying light to firm pressure in order to identify and quantify abnormalities in the relevant MSK structure. However, a poor understanding of anatomy, particularly surface anatomy, can result in inaccurate palpation.[9]

Although palpation is a fundamental aspect of physiotherapy, there is a lack of objective metrics for evaluating student proficiency in the pedagogical landscape. Current training models predominantly rely on subjective instructor feedback, which often fails to bridge the gap between students' self-perception and their actual anatomical precision. Integrating ultrasound-assisted assessment addresses this deficit by providing real-time visual validation.[9] Therefore, systematically evaluating ultrasound-guided instruction is crucial for establishing data-driven educational frameworks and refining the acquisition of clinical skills within the physiotherapy curriculum. This study aimed to evaluate the impact of ultrasound-assisted anatomical instruction on the accuracy of manual palpation and the retention of shoulder anatomy knowledge among physiotherapists. Additionally, it sought to investigate how individual learning preferences, categorized by the Visual, Aural, Read/Write, Kinesthetic (VARK) model, influence the development of these clinical competencies. We hypothesized that physiotherapists receiving ultrasound-assisted anatomical instruction would demonstrate greater manual palpation accuracy and superior retention of shoulder anatomy knowledge compared with conventional instruction approaches. Furthermore, learning preferences categorized by the VARK model were expected to influence clinical skill acquisition.

Materials and Methods

Characteristic of participants

The study cohort comprised 50 licensed physiotherapists, recruited through a randomized selection process, who were actively practicing in either the private or public healthcare sectors. The research was conducted at the Kurbaa Education and Consultancy Centre, utilizing a clinical environment that integrated subjects receiving trigger point therapy alongside peer-to-peer practical training sessions. To ensure high pedagogical standards, the lead instructor was a highly qualified expert with ten years of

clinical experience, holding advanced certifications in basic, advanced, temporomandibular joint (TMJ), and pelvic floor MSK ultrasound. Participants were included in the study if they met the following criteria: (a) they were licensed physiotherapists; (b) they had no prior professional experience or formal training in MSK ultrasound; and (c) they provided both written and verbal informed consent prior to participation. Participants were excluded if they had cognitive or communication difficulties that prevented them from following the standardised ultrasound and palpation protocols, if they provided incomplete responses to the survey or scale items, or if they missed more than 30 minutes of the training.

Ethics committee approval

The study protocol was rigorously reviewed and granted ethical approval by the Ethics Committee of the Rectorate of the Sakarya University of Applied Sciences (Date: 11/10/2024; Ref No: E-26428519-050.99-145542). In strict adherence to the ethical principles outlined in the Declaration of Helsinki, all participants provided written informed consent, ensuring their autonomy and confidentiality throughout the research process.

Sample size

The sample size was determined to ensure sufficient statistical power to detect training effects. An a priori power analysis was performed using G*Power software (version 3.1.9.7) for a within-subject pre-post design. With a significance level of alpha=0.05 and a high statistical power of 0.90, a minimum of 44 participants was required to detect a moderate effect size of 0.50.[10] To account for potential data loss or incomplete assessments, the study recruited a total of 50 participants. This sample size was deemed robust enough to evaluate primary outcomes and conduct subgroup analyses based on VARK learning styles.

Outcome measures

Characteristics of the participants

Age, gender, height, weight, body mass index (BMI), years of experience of all participants were recorded.

Comprehensive shoulder anatomy and ultrasound training

The training duration was designed based on a competency-based educational framework rather than a fixed hourly requirement, in line with the recommendations of Whittaker et al.[11]. As no standardized duration has been established in the literature, the distribution of 6 hours of theoretical instruction and 10 hours of supervised practical training was defined by the authors, informed by commonly applied structures in international ultrasound training programs, to ensure adequate acquisition of both cognitive and psychomotor competencies. To ensure the mastery of diverse clinical skills, the training curriculum was intentionally designed to include the integration of palpation skills, ultrasound imaging, and dynamic clinical assessment, all of which require supervised psychomotor practice.

Assessment and standardization protocol

To ensure the transparency and reproducibility of the assessments, a standardized protocol was strictly followed. Baseline (pre-training) evaluations were conducted before the didactic sessions began, and participants were not informed beforehand that they would be evaluated on specific anatomical landmarks to prevent prior preparation. During the assessment phases (both pre- and post-training), all identification tasks—comprising anatomical localization, manual palpation, and ultrasound visualization—were performed on a standardized subject (the instructor's assistant) to ensure anatomical consistency across all participants. Each participant's performance was directly evaluated by the lead instructor, who has nine years of clinical experience and advanced certification in MSK ultrasound. To maintain procedural rigor, a strictly timed one-minute window was provided for each identification task. In contrast, the practical training sessions were conducted using a peer-to-peer approach, where participants were paired and rotated roles, alternating as both the

'examiner' and the 'model' to gain hands-on proficiency. During these sessions, the instructor provided immediate corrective feedback to ensure correct technique. The same time-limited assessment attempt was applied identically during both phases to allow for a direct and valid comparison of the training's effectiveness.

Palpation

The MSK structures to be evaluated in the shoulder region include the spine of the scapula, the inferior angle of the scapula, the acromion, the C7 spinous process and the rhomboid, supraspinatus, infraspinatus, and teres major muscles. The accuracy of anatomical localization and palpation of these structures was evaluated before and after the training. The selected anatomical landmarks (scapular spine, inferior angle of the scapula, acromion, and C7 spinous process) and muscles (rhomboid, supraspinatus, infraspinatus, and teres major) were chosen based on their clinical relevance, palpation accessibility, and suitability for MSK ultrasound training. These structures are commonly used as reference points for shoulder assessment, scapular orientation, and ultrasound probe positioning, and are frequently included in educational frameworks aimed at improving palpation and imaging skills.[11,12] Additionally, they represent a combination of superficial and deeper structures, allowing a comprehensive evaluation of both palpation accuracy and ultrasound visualization competency.

Ultrasound evaluation

In the ultrasound evaluation phase, the bony landmarks (the spine of the scapula, the acromion) and muscles (the rhomboid, supraspinatus, infraspinatus, and teres major) were initially identified by an expert. Subsquently, participants were required to visualise these structures using a portable ultrasound (FUJIFILM Sonosite M Turbo, Inc., Bothell, WA, USA) to assess their anatomical positioning (see figure 1).[12] The performance of ultrasound, location finding and palpation identification was evaluated using a semi-quantitative 4-point scale (0–3). This scoring system was adapted based on the methodological framework of the OMERACT consensus for ultrasound scoring, which suggests that a 0–3 scale provides the most reliable approach for assessing anatomical and pathological structures by reducing inter-observer variability.[13,14] The scores were defined to reflect increasing levels of proficiency: 0 (unable to identify), 1 (minimal identification; <50% accuracy), 2 (moderate identification; >50% accuracy), and 3 (complete and accurate identification). To minimize procedural bias, all ultrasound evaluations were conducted by an independent investigator who was blinded to the participants' clinical data and had no prior contact with the study population.

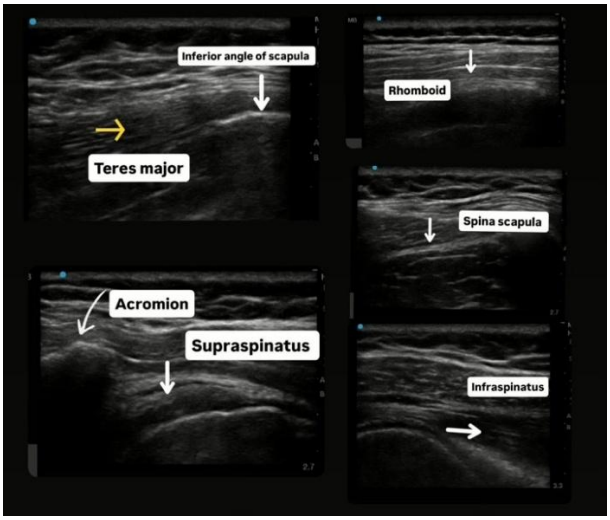

Figure 1. Ultrasound evaluation.

Learning style assessment

Participants' learning preferences were assessed using the VARK (Visual, Aural, Read/Write, Kinesthetic) questionnaire, which was developed by Neil D. Fleming.[15] The VARK is a widely used instrument designed to identify individual learning style preferences based on sensory modalities. The questionnaire consists of 16 multiple-choice questions, with each question allowing participants to select one or more responses that best reflect their preferred learning style. Each response option corresponds to one of the four learning modalities: visual (V), aural (A), read/write (R) or kinaesthetic (K). Participants were instructed to select all options that applied to them for each item. Scoring was conducted according to the standard VARK chart, with the number of responses corresponding to each modality summed to

obtain individual scores for the V, A, R and K categories. Participants were then classified into their dominant learning style based on the highest score. Where multiple modalities had similar scores, participants were categorised as multimodal learners.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows 27.0 (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Shapiro–Wilk test and by examining their distributional characteristics. Data showing a normal distribution were presented as mean ± standard deviation, while data not showing a normal distribution were presented as median (interquartile range, IQR). Categorical data were summarized using counts and percentages. In addition, participants were classified according to their dominant learning style based on their highest VARK score; if participants had the same highest score in more than one subscale, they were classified as multhimodal. Since one participant was missing the kinesthetic score, the dominant learning style analyses were conducted on 49 participants. The educational activity was evaluated based on the pre-test and post-test scores for total anatomical site description, total location identification, and total correct palpation of the target point. Due to the observation of a clear ceiling effect in the post-test scores and the limited/discrete nature of the score distributions, the Wilcoxon signed-rank test was used for pre-test–post-test comparisons. The Kruskal–Wallis test was used to compare baseline scores and change scores across learning style groups. The relationships between VARK subscale scores and post-training gains were examined using Spearman's rank correlation analysis. Additionally, to assess the independent effect of learning style, multiple linear regression models were constructed using each change score (post-test – pre-test) as the dependent variable, along with the initial score and the VARK subscale scores. In all analyses, a *p*-value of <0.05 was considered statistically significant.

Results

The mean age of the participants was 24.90±5.20 years, with an average body weight of 65.06±13.16 kg and a mean height of 1.69 ± 0.08 m. Analysis of the VARK learning style subscale scores demonstrated that the median score for the visual domain was 4 (interquartile range [IQR]: 3–6), while the aural domain showed a slightly higher median score of 5 (IQR: 4–8). The read/write domain yielded a median score of 4 (IQR: 3–6), whereas the kinesthetic domain had the highest median value of 6 (IQR: 5–8), indicating a tendency toward experiential and hands-on learning preferences among participants (Table 1). Among the 50 participants with complete VARK assessments, learning styles were categorized according to dominant modality. The kinesthetic learning style was the most frequently identified dominant modality, accounting for 32.7% of participants, followed by other learning preferences with lower proportions (Table 2).

Table 1. Participant characteristics and VARK scores.

Variables	Value
Age (years)	24.90± 5.20
Weight (kg)	65.06 ± 13.16
Height (m)	1.69 ± 0.08
Sex (female/male), n (%)	28(56), 22(44)
Years of professional experience*	1 (1–3)
VARK-Visual	4 (3–6)
VARK-Aural	5 (4–8)
VARK-Read/Write	4 (3–6)
VARK-Kinesthetic	6 (5–8)

Table 2. Distribution of dominant VARK learning styles.

Dominant Learning Style	n	%
Visual	7	14.3%
Aural	13	26.5%
Read/Write	4	6.1%
Kinesthetic	16	32.7%
Multhimodal	10	20.4%

Statistically significant increases were observed in all primary outcome measures following the training. The median total anatomical site description score increased from 11 (9–13.75) to 24 (24–24), the median total location identification score increased from 16 (12–20) to 24 (24–24), and the median total correct palpation score increased from 16 (12–19.75) to 24 (24–24) (p<0.001 for all comparisons). While all participants showed

improvement in anatomical description, 47 participants showed improvement in locating the site and 3 showed no change; in palpating the correct point, 49 participants showed improvement and 1 showed no change. No participant showed a decrease in their final test score (Table 3).

Table 3. Pre- and -post training comparisons.

Outcome Variable	n	Pre-training Median (IQR)	Post-training Median (IQR)	*p**	Increase	Same	Decrease
Total anatomical site description	50	11 (9–13.75)	24 (24–24)	<0.001	50	0	0
Total location identification.	50	16 (12–20)	24 (24–24)	<0.001	47	3	0
Total correct palpation points	50	16 (12–19.75)	24 (24–24)	<0.001	49	1	0

Note: IQR = interquartile range.
*Wilcoxon signed-rank test.

The intra-group changes in outcome measures according to dominant learning styles are presented in Table 4. Participants with an aural learning style demonstrated statistically significant increases in total anatomical site description, total location identification, and total correct palpation points (all $p<0.001$). Similarly, individuals classified as kinesthetic learners showed significant improvements across all outcome variables, including anatomical site description, location identification, and correct palpation performance (all $p<0.001$). In the multimodal learning group, statistically significant improvements were also identified in all evaluated parameters, with median change scores indicating notable gains in anatomical knowledge and palpation accuracy ($p=0.002$ for all outcomes). In contrast, although participants with a read/write learning style demonstrated higher median change scores numerically, these improvements did not reach statistical significance ($p=0.250$). For the visual learning style, significant within-group improvements were observed in total anatomical site description ($p=0.016$), total location identification ($p=0.031$), and total correct palpation points ($p=0.016$)**.** In comparisons of change scores between groups, no significant difference was found in terms of total anatomical location description change (Kruskal–Wallis H=8.31; $p=0.081$). In contrast, total location-finding change (H=14.81; $p=0.005$) and total correct-point-palpation change (H=14.60; $p=0.006$) showed significant differences across dominant learning style groups.

Table 4. Intra-group changes according to dominant learning styles.

Dominant Learning Style	Outcome Variable	n	Medain Change (IQR)	*p**
Aural	Total anatomical site description	13	13(10-13)	<0.001
Aural	Total location identification	13	8 (4–9)	<0.001
Aural	Total correct palpation points	13	8 (5–9)	<0.001
Kinesthetic	Total anatomical site description	16	13 (11.25–14.25)	<0.001
Kinesthetic	Total location identification	16	7 (3–12)	<0.001
Kinesthetic	Total correct palpation points	16	7.5 (3.75–12)	<0.001
Multhimodal	Total anatomical site description	10	13 (11.25–14)	0.002
Multhimodal	Total location identification	10	9 (5.5–11.75)	0.002
Multhimodal	Total correct palpation points	10	9 (7–12)	0.002
Read/Write	Total anatomical site description	4	18 (16–19)	0.250
Read/Write	Total location identification	4	16 (14.5–18)	0.250
Read/Write	Total correct palpation points	4	16 (15.5–18)	0.250
Visual	Total anatomical site description	7	9 (6.5–12.5)	0.016
Visual	Total location identification	7	2 (1–3.5)	0.031
Visual	Total correct palpation points	7	3 (3–4.5)	0.016

*Wilcoxon signed-rank test.

Discussion

The present study demonstrates that ultrasound-assisted anatomical instruction may serve as a valuable pedagogical approach for enhancing the clinical competencies of physiotherapists. Our findings indicate statistically significant improvements in all evaluated domains, including anatomical site description, localization accuracy, and manual palpation precision. The emergence of a notable ceiling effect in the post-training scores may reflect the potential educational value of integrating real-time visual feedback into traditional palpation training, suggesting that sonographic validation may help bridge the gap between theoretical anatomical knowledge and practical psychomotor skills. Furthermore, the disproportionate gains observed in kinesthetic and multimodal learners highlight the potential importance of experiential learning frameworks in MSK education, suggesting that hands-on, visually-guided practice may support the development of complex spatial orientation skills in shoulder anatomy.

These findings are consistent with previous literature emphasizing the value of ultrasound as an adjunct to MSK training.[16] Ultrasound imaging provides real-time visual feedback, allowing learners to correlate tactile input with anatomical structures, thereby enhancing spatial awareness and palpation accuracy. In line with these results, Shin and Song[17] demonstrated that an ultrasound-assisted palpation training program significantly improved the accuracy of locating landmarks such as the long head of the biceps brachii and the lateral joint line of the knee in physical therapy students.[17] Similar improvements have been reported in studies evaluating ultrasound-guided palpation training among medical trainees and physiotherapists.[5,9] In addition, international consensus recommendations for medical education support the educational rationale of our study by noting that integrating ultrasound into the curriculum from the early stages enhances understanding of anatomical structures and reinforces physical examination skills.[18] One of the key mechanisms underlying these improvements may be the integration of visual and sensorimotor learning processes. Traditional palpation training relies heavily on subjective perception and instructor feedback, whereas ultrasound enables objective verification of anatomical structures. This immediate feedback loop may facilitate error correction and reinforces correct motor patterns, which may contribute to the development of psychomotor skills. Beyond technical precision, Shin and Song[17] reported that such programs also significantly bolster students' confidence in their palpation skills, with scores rising from 3.90 to 8.20 points following intervention.[17] Furthermore, the combination of cognitive (anatomical knowledge) and procedural (manual skills) learning may have contributed to the substantial gains observed in this study, in line with competency-based education models.[8]

However, the efficacy of ultrasound assistance may vary by anatomical region. For instance, while significant gains were noted for the long head of biceps brachii tendon and lateral joint line of the knee, Shin and Song[17] found no statistically significant improvement in palpating the acromioclavicular joint. This suggests that certain structures remain inherently difficult to locate due to anatomical complexity or that longer training durations may be required. Regarding learning styles, the results indicated that all groups demonstrated significant improvements, regardless of their dominant modality. However, greater gains were observed in kinesthetic and multimodal learners, which may be expected given the hands-on and interactive nature of ultrasound-assisted training. These findings suggest that while certain learning styles may benefit more from experiential approaches, ultrasound-based education appears to be associated with improvements across different learner profiles. This may support the idea that multimodal teaching strategies can enhance educational outcomes in clinical skill acquisition.

An important observation in this study is the presence of a ceiling effect in post-test scores. While this may reflect improvements associated with the training, it may also limit the ability to detect differences between groups or further improvements beyond a certain level of proficiency. This phenomenon has been reported in similar educational intervention

studies; moreover, recent research suggests that technology-based objective assessment tools may help reduce such ceiling effects by providing more sensitive and scalable measurements.[19] Therefore, these factors should be considered when interpreting the results.

From a clinical perspective, improving palpation accuracy may be clinically relevant, as inaccurate anatomical localization may lead to misdiagnosis or ineffective treatment. The integration of ultrasound into physiotherapy training may therefore be associated with enhanced educational outcomes and may also contribute to improved patient care and clinical decision-making.

Despite its strengths, this study has several limitations. The absence of a control group limits the ability to attribute improvements solely to the intervention. Given the pre–post study design without a control group, causal relationships between the intervention and the observed improvements cannot be definitively established.

Additionally, the relatively short-term assessment does not allow conclusions regarding skill retention over time. Although all assessments were performed by a single blinded assessor to ensure procedural consistency, the use of a single evaluator may still introduce observer and expectation bias. Furthermore, the absence of inter-rater reliability analysis limits the ability to evaluate the reproducibility and objectivity of the measurements across different evaluators. Future studies should include randomized controlled designs, long-term follow-up, multiple blinded assessors, and objective inter-rater reliability analyses.

Conclusion

This study suggests that ultrasound-assisted training may be a valuable educational approach associated with improvements in anatomical knowledge and clinical palpation accuracy among physiotherapists. By facilitating real-time visual validation of subsurface structures, the integration of sonographic feedback may help reduce the inherent subjectivity of traditional manual palpation, potentially supporting the refinement of psychomotor skills. The marked improvements observed across all assessment parameters, culminating in a notable ceiling effect, suggest the potential educational value of this multimodal instructional approach in supporting the development of clinical competency. Furthermore, the particularly robust gains identified among kinesthetic and multimodal learners highlight the possible role of experiential, hands-on learning in mastering complex MSK anatomy. These findings support the potential integration of ultrasound technology into physiotherapy curricula and continuing professional development programs, as it may support diagnostic accuracy and facilitate the transition from theoretical knowledge to practical clinical application.

Acknowledgement

The study authors are deeply grateful for the participants' dedication to effectively conducting the measurements.

Ethics Committee Approval

The study protocol was rigorously reviewed and granted ethical approval by the Ethics Committee of the Rectorate of the Sakarya University of Applied Sciences (Date: 11/10/2024; Ref No: E-26428519-050.99-145542).

Informed Consent

All participants provided informed consent prior to their inclusion in the study. Participants were given detailed information regarding the purpose, procedures of the study, and they voluntarily agreed to participate.

Authorship contribution

Ü.E: Conceptualization, Project administration, Investigation, Data curation, Methodology, Writing – original draft, Validation, Software. **A.Y:** Conceptualization,Writing – review & editing, Formal analysis, Methodology. **R.M:** Project administration, Investigation, Data curation, Methodology, Writing – original draft, Validation.

Conflicting Interest

The authors declare that they have no conflicts of interest.

Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

Statement

The findings presented in this study have not been previously disseminated at any scientific conference or symposium.

Peer-review

Externally peer-reviewed.

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