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Investigation of The Accuracy of Palpation of Physical Therapy Students to Different Anatomical Landmarks**

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ABSTRACT:
Purpose: Surface anatomy plays a crucial role in physical therapy education as it enables the examination of subcutaneous structures through palpation. This study aims to investigate the accuracy of palpation on landmarks among physical therapy students (PT).
Material and Methods: This cross-sectional, observational study evaluated the accuracy of palpation on anatomical landmarks. The researchers specified 21 landmarks for palpation assessment. Each landmark was scored on a scale of 0 to 3, and the Landmark Total Palpation Score (L_t) was calculated based on the scores of all 21 landmarks. A higher score indicated poorer accuracy in identifying anatomical landmarks. A total of 88 individuals included in this study. Intrarater reliability was examined with weighted kappa statistics.
Results: The participants' L_t scores had a mean of 10.09 ± 9.66, with a standard deviation. The weighted kappa of each landmark ranged from 0.89 to 1.0.
Conclusion: The results of this study showed that there was a good level anatomical landmark identification among PT students.
Keywords: *Physical Therapy Education; Surface Anatomy; Landmark; Palpation, Physiotherapy*

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INTRODUCTION

Anatomy has long held a central position and served as a foundational element in health education throughout history (Louw et al., 2009). Traditional anatomy lectures have traditionally followed theoretical and practical models, including the use of plastic models and cadaver dissection. However, with the advancements in visualization and simulation techniques, as well as the internet, a new and modern educational approach has emerged (Tam et al., 2009; Lim et al., 2016). These techniques have significantly improved anatomy education on an international scale (Sugand et al., 2010).

Surface anatomy is considered one of the most crucial methods contributing to an ideal anatomy education (Sugand et al., 2010). The study of surface anatomy provides a deeper understanding of the static anatomy of cadavers by enabling students to observe the movement and functionality of phenotypical structures, particularly those related to the musculoskeletal system, in living individuals. Surface anatomy allows for the evaluation of subcutaneous structures through techniques such as percussion, auscultation, and frequently, palpation (Bergman et al., 2013). Physical therapists often rely on palpation to assess superficial anatomy. Knowledge of surface anatomy in physiotherapists ensures accurate patient assessment and treatment.

Additionally, proficient clinical assessment is a vital component of effective decision-making (Smith et al., 2008).

The objective of this study was to investigate the accuracy of palpation on different anatomical landmarks among physical therapy (PT) students. These landmarks are crucial for precise clinical diagnosis and are necessary for palpation-guided therapeutic practices.

MATERIAL and METHODS

Sampling and participant

This study was designed as a cross-sectional and observational study in accordance with the Guidelines for Reporting Reliability and Agreement Studies (Kottner et al., 2011). This study was conducted at Muğla Sıtkı Koçman University and Gazi University in Turkey during the 2017-2018 academic year, involving 88 students. Both Physiotherapy departments offer an anatomy course in the first year, while rehabilitation courses and clinical internships are integrated into the curriculum in subsequent years. The inclusion criteria for participants were as follows: being a final-year student in the Department of Physical Therapy and Rehabilitation, successfully completing summer trainings in the second and third years, currently undergoing clinical training in the final year, and voluntarily agreeing to participate in the study.

According to the findings obtained from the research, the effect size was found to be 0.36 based on the palpation total score when post hoc power analysis was performed using the G-power program. The power analysis, based on a significance level of 0.05, a sample size of 88, and an effect size of 0.36, yielded a research power of 94%, which was considered sufficient.

Procedure

After collecting the demographic characteristics of the 88 students, including age, gender, Body Mass Index (BMI), and university grade-point average, the accuracy of palpation on landmarks was evaluated. Each student was assigned a number ranging from 1 to 88, and pairs of students were randomly created by drawing numbers. A total of 44 pairs of students were formed, with each pair consisting of a student who performed palpation and their partner as the recipient. The accuracy of palpation was assessed without providing any feedback to the students regarding their assessments. To evaluate intra-rater reliability, the same evaluator re-evaluated 30 students (15 pairs) on the 5th day after the initial assessment. The purpose of this intra-rater reliability evaluation was to measure the consistency of the rater's scores for the students and ensure self-consistency in the assessment process.

Data Collection Tools

Palpation on anatomical landmarks: To assess the accuracy of palpation on anatomical landmarks, the researchers selected twenty-one commonly used landmark points, which are taught in basic undergraduate courses. These landmark points include: C7 spinous process, mastoid, occiput, acromion, biceps long tendon, medial condyle of humerus, styloid process of radius, anterior superior iliac spine, posterior superior iliac spine, iliac crest, xiphoid process, greater trochanter, medial condyle of femur, tibial tubercle, head of fibula, medial malleolus, navicular tuberosity, head of the first metatarsal, head of the third metacarpal, greater tubercle of humerus, and jugular notch. Trainee physiotherapists were instructed to perform palpation on these landmark points on their peers. To assess each of this palpation, we used a qualitative grading system that ranged from 0 =excellent to 3 = incorrect (Fernández-Lao et al, 2016). The higher points were given as the palpation moved further away from the landmarks. For each participant, a Landmark Total Palpation Score (L_t) was calculated, ranging from 0 to 63.

Statistical Analysis

The data analysis was carried out using SPSS version 22 (SPSS Inc.). Descriptive statistics were employed to present the demographic characteristics of the participants. Spearman correlation analysis was conducted to examine the relationship between age, BMI, and Lt. The Mann-Whitney U test was utilized to assess differences between gender and Lt. For analyzing the differences between university grade-point average and Lt, the Kruskal-Wallis's test and post hoc analyses were conducted. Intra-rater

reliability was determined using Kappa coefficients, as anatomical landmarks scoring is a numerical grading system. The classification system proposed by Landis and Koch (Landis et al., 1977) was employed to determine the level of reliability (poor: kappa smaller than zero; slight: zero to 0.20; fair: 0.21 to 0.40; moderate: 0.41 to 0.60; substantial: 0.61 to 0.80; almost perfect: 0.81 to 1.00).

Ethical Approval

This study obtained ethical approval from the Ethical Committee of Gazi University. Prior to participation, all participants were fully informed about the study objectives and procedures, and they provided their informed consent by signing consent forms. The assessments were conducted by the first author, who was also responsible for overseeing the clinical internship of the students.

RESULTS

One hundred and twenty students met the inclusion criteria, of which eighty-eight voluntarily agreed to participate in the study. Table 1 presents the descriptive characteristics of the participants. The mean Landmark Total Palpation Score (L_t) was found to be 10.09 ± 9.66, indicating the overall accuracy of palpation. The palpation scores for each landmark are provided in Table 2.

Table 1: Demographic characteristics of participants (n=88)

Total (n=88)	**Mean ± Sd**
Age (year)	22.73 ± 1.49
BMI (kg/m²)	22.57 ± 3.41
	n (%)
Gender	
Female	56 (63.6)
Male	32 (36.3)
Grade-point average	
1.00-2.00	3 (3.4)
2.00-2.50	34 (38.6)
2.50-3.00	28 (31.8)
3.00-4.00	23 (26.1)

BMI: Body Mass Index

Table 2. The palpation scores for each landmark

Landmarks	**Asessment_1**	**Asessment_2**
C7 processus spinosus	0.01±0.10	0.01±0.10
Mastoid	0.72±1.51	0.65±1.55
Occiput	0.14±0.61	0.15±0.63
Acromion	1.42±1.59	1.05±1.12
Biceps long tendon	1.25±1.58	1.25±1.58
Medial condyle of humerus	0.10±0.71	0.00±0.00
Radius styloid process	0.21±0.85	0.30±0.60
Spina iliaca anterior süperior	0.45±0.42	0.10±0.50
Spina iliaca posterior süperior	0.53±1.10	0.45±1.10
Crista iliaca	0.53±1.33	0.70±1.07
Processus xiphoideus	0.77±1.54	0.72±1.55
Trochanter major	0.24±0.71	0.30±0.65
Medial condyle of femur	0.09±0.35	0.09±0.35
Tibial tubercle	0.38±0.97	0.87±0.65
Head of fibula	1.13±1.68	1.50±1.25
Medial malleol	0.00±0.00	0.00±0.00
Tubercle of navicula	0.81±1.57	0.80±1.55
Head of 1. Metatars	0.05±0.30	0.00±0.00
Head of 3. Metacarp	0.01±0.10	0.00±0.00
Greater tubercle of humerus	1.12±1.46	1.05±1.55
Incisura jugularis	0.42±1.39	0.32±1.39

The study participants had a mean BMI of 22.57 ± 3.41, indicating a relatively homogeneous group in terms of body mass index (BMI). The correlation analysis did not find a statistically significant correlation between BMI and Lt ($p>0.05$). Similarly, there was no statistically significant correlation observed between age and Lt ($p>0.05$). The Mann-Whitney U test did not show any statistically significant differences between gender and Lt ($p>0.05$), but the Kruskal-Wallis's test revealed statistically significant differences between grade-point average and Lt ($p<0.05$). The students with

higher grade-point averages demonstrated better palpation skills compared to others. The weighted kappa for each landmark ranged from 0.89 to 1.0.

DISCUSSION

Anatomical landmark palpation skills have been shown to be a crucial aspect of manual therapy (Salvia et al., 2009). However, there is a lack of comprehensive studies evaluating the knowledge of students or clinicians in this area. This study aimed to assess the accuracy of palpation on 21 different landmarks among physiotherapy students from two different universities using an objective and simple method. The results revealed that students had a good ability to determine surface anatomy through palpation.

Previous studies have provided conflicting findings regarding the impact of BMI on the palpation of spinal landmarks. Some studies indicated that BMI negatively affects the accuracy of surface anatomy palpation methods in obese individuals (Harlick et al., 2007; Robinson et al., 2009). Excessive subcutaneous fat in obese patients can interfere with the accuracy of palpation based on surface anatomy. However, in some studies, similar to the present study, no significant difference was observed between BMI and palpation skill (Shin et al., 2011; Kawchuk et al., 2011). One limitation of this study is that the majority of students had normal or overweight BMI, with only one student classified as "obese" according to the World Health Organization's BMI classification. This may have contributed to the higher accuracy of palpation in this study. Therefore, further comprehensive studies are needed to better understand the relationship between BMI and palpation accuracy. Such studies can provide valuable insights into the reliability and effectiveness of palpation methods, especially in obese individuals, which can significantly impact accurate diagnoses and treatment planning.

Among the 21 landmarks assessed in this study, the best palpation scores were achieved for the medial malleolus, C7 spinous process, 3rd metacarpal head, and 1st metatarsal head. On the other hand, the worst palpation scores were obtained for the long tendon of the biceps, fibular head, and acromion. Consistent with the current study, McDevitt et al.'s (2020) study demonstrated that the accuracy of biceps long tendon palpation among physiotherapists is low (McDevitt et al., 2020). These findings suggest that additional identification methods may be necessary for more effective determination of these landmarks, in addition to palpation.

Reliability is crucial for scientific measurement and assessment in medicine. In this study, we assessed the interrater reliability of each landmark using weighted kappa statistics, which measure the agreement among assessments adjusted for the amount of agreement expected by chance and the magnitude of disagreements. According to the criteria by Fleiss (Fleiss, 1981), our study demonstrated perfect intrarater reliability. However, it is essential to acknowledge that the validity of the assessment method was not investigated in this study. Validity refers to how well a measurement accurately captures the intended construct or phenomenon. In the context of palpation evaluations, the validity of the method should be tested against gold-standard methods such as ultrasonography (US) or magnetic resonance imaging (MRI) (Mieritz et al., 2016; Rho et al., 2014). The lack of investigation into the validity of the palpation assessment method is considered a notable limitation of this study.

Previous studies have suggested that incorporating US into musculoskeletal palpation can enhance learning and improve palpation techniques (Walrod et al., 2018). However, utilizing ultrasound for educational purposes may not be practical due to logistical and training constraints, as physiotherapists may not possess extensive training in the use of imaging methods. Therefore, despite the potential benefits of incorporating imaging methods like ultrasound, palpation remains the most commonly utilized, quick, and practical evaluation method for diagnosing and treating patients, particularly for physiotherapists. It is crucial for future studies to explore the validity aspects of palpation assessments and compare them with gold-standard imaging techniques to further enhance the reliability and accuracy of the evaluation method.

Conclusion

As a result of this study, it was concluded that the 21-reference point evaluation method was reliable for determining anatomical landmarks by palpation in physiotherapy students, and that physiotherapy students had a good level of palpation ability.

Conflict of Interest

No conflict of interest

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