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ORIGINAL RESEARCH

# Reliability and validity of active and passive pectoralis minor muscle length measures

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**KEYWORDS**
Shoulder;
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**Abstract**
*Background:* Pectoralis minor muscle length is believed to play an important role in shoulder pain and dysfunction. Current clinical procedures for assessing pectoralis minor muscle length may not provide the most useful information for clinical decision making.
*Objective:* To establish the reliability and construct validity of a novel technique to measure pectoralis minor muscle length under actively and passively lengthened conditions.
*Design:* Cross-sectional repeated measures.
*Methods:* Thirty-four healthy adults (age: 23.9, SD = 1.6 years; 18 females) participated in this study. Pectoralis minor muscle length was measured on the dominant arm in three length conditions: resting, actively lengthened, and passively lengthened. Based upon availability, two raters, out of a pool of five, used a caliper to measure the distance between the coracoid process and the 4th rib. The average of two pectoralis minor muscle length measures was used for all muscle length conditions and analyses. Intraclass correlation coefficients determined intra-and inter-rater reliability, and measurement error was determined via standard error of measurement and minimal detectable change. Construct validity was assessed by ANOVA to determine differences in muscle length across the three conditions.
*Results:* Our intra- and inter-rater reliability values across all three conditions ranged from 0.84 to 0.92 and from 0.80 to 0.90, respectively. Significant differences ($p < 0.001$) in muscle length were found among all three conditions: rest-active (3.66; SD = 1.36 cm), rest-passive (4.72, SD = 1.41 cm), and active-passive (1.06, SD = 0.47 cm).
*Conclusions:* The techniques described in this study for measuring pectoralis minor muscle length under resting and actively and passively lengthened conditions have acceptable reliability for clinical decision making.


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## Introduction

Shoulder pain has been reported to affect up to 67% of the general population across the lifetime.[1] Rotator cuff disease is the most common cause of shoulder pain, interferes with work and functional related activities, and has a negative impact on health-related quality of life.[2–7]

The alignment–impairment model has been proposed as a way to understand how multiple factors contribute to the development of shoulder pain and dysfunction.[8,9] This model describes how alignment deviations give rise to structural alterations, which then lead to pathomechanical alterations and development of shoulder pain. The model proposes that several factors contribute to resting scapular alignment, including the thoracic spine, shoulder girdle musculature, and tissue flexibility. Persistent postures and repetitive activities that place the shoulder in a protracted position are believed to result in adaptive muscle shortening, which may contribute to malalignment, pain, and ultimately movement dysfunction.[8–10] Collectively, these impairments are believed to lead to development of shoulder pain and dysfunction.[8,11–15]

The pectoralis minor muscle is believed to play an important role in shoulder girdle alignment and movement.[16] The relationship between resting pectoralis minor muscle length and scapulothoracic movement has been studied in a healthy, young population.[11,12,17] Individuals with shorter resting pectoralis minor muscle length have been shown to have reduced scapular upward rotation and scapular posterior tilting during humeral elevation.[11] The significance of this information is that these motion patterns are similar to those reported in individuals with shoulder pain secondary to subacromial impingement,[14] rotator cuff disease, and glenohumeral instability.[18,19] Based on this, clinical assessment of resting scapular alignment and pectoralis minor muscle length is widely performed as part of a physical therapy examination for individuals with shoulder pain and dysfunction.[16]

While resting pectoralis minor muscle length appears to provide potentially useful information about scapular alignment and scapulothoracic motion, it does not provide all of the necessary information for determining how much the muscle can lengthen (muscle extensibility). In light of the fact that a modeling study has shown that the pectoralis minor muscle elongates up to 67% of its initial length during overhead arm motions,[20] information about pectoralis minor muscle extensibility could provide further clinical insight into the influence of this muscle on scapulothoracic motion.[9,10,21] However, determining pectoralis minor muscle extensibility requires a valid and reliable method for measuring pectoralis minor muscle length when the muscle is in a lengthened position.

Therefore, the purposes of this study were to establish the rater reliability and construct validity of our technique for measuring pectoralis minor muscle length under actively and passively lengthened conditions. It was hypothesized that our proposed technique would demonstrate good relative and absolute reliability and result in a significant increase in pectoralis minor muscle length as compared to the resting length, thereby establishing the validity of the technique. These measures of pectoralis minor muscle length were then used to determine pectoralis minor muscle extensibility.

## Methods

### Study design

A cross-sectional, repeated-measures design was employed.

### Participants

Participants were recruited from a university campus by personal contact and advertisements. Individuals were eligible to participate if they were between 18 and 35 years of age, free of current shoulder pain, and able to elevate their arms at least 130°. Individuals were excluded from participating if they self-reported any of the following: previously diagnosed scoliosis; a current episode of cervical or lumbar spine pain; shoulder, elbow, forearm, wrist, or hand pain; brachial plexus injury; or nerve palsy affecting the shoulder girdle or upper extremity. Thirty-five participants (female = 18) met the criteria and were enrolled in the study.

### Ethical approval statement

All participants signed an informed consent, approved by the Drexel University Institutional Review Board (Protocol # 1408003050), Philadelphia, PA, USA, prior to beginning study procedures.

### Raters

Five raters (two licensed physical therapists and three final year physical therapy students) underwent an approximately 90-min measurement procedure training session. This session consisted of reviewing the measurement procedures and having each rater practice on one another until all raters felt comfortable performing all measurements. Rater selection for all participant measurement sessions was based upon rater availability. All raters contributed to data collection sessions, and an attempt was made to balance the number of measurement sessions among raters.

### Study procedures

#### Pectoralis minor muscle length

Pectoralis minor muscle length was defined as the distance between two bony landmarks: the coracoid process and the inferior medial aspect of the 4th rib adjacent to the sternocostal junction. Initial landmark identification occurred with the participant supine where the landmarks were palpated and marked with a dark marker. Landmark location was reassessed while the participant stood in their natural relaxed posture and any necessary adjustments in landmark location were made (Fig. 1A). In an attempt to minimize the influence of anterior chest wall soft tissue mass on pectoralis minor muscle length measures, we used a caliper (palpation meter – PALM) rather than a tape measure. To prevent bias and to mask the rater, for all measures the PALM was placed with the meter facing away from the rater. A second



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