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RELIABILITY, STANDARD ERROR AND MINIMAL DETECTABLE CHANGE OF THE PECTORALIS MINOR LENGTH MEASUREMENT IN HEALTHY SUBJECTS

[1]Dayana Patricia Rosa, [2]John D. Borstad and [1,3]Paula Rezende Camargo
[1]Program in Physical Therapy, Universidade Metodista de Piracicaba, Piracicaba, SP, Brazil
[2]School of Health and Rehabilitation Sciences, The Ohio State University, Columbus, OH, USA
[3]Program in Physical Therapy, Department of Physical Therapy, Universidade Federal de São Carlos, São Carlos, SP, Brazil
email: dad_rosa@hotmail.com

SUMMARY

The purpose this study was to establish the intra-trial reliability of using a tape measure to measure pectoralis minor length, and to evaluate the between-day reliability of a tape measure and electromagnetic system to measure the pectoralis minor length in young asymptomatic subjects. It was also aim of the study to examine the agreement between the tape measure and the electromagnetic system. A convenience sample of 25 asymptomatic subjects (12 males and 13 females; 25±3.97 years; 65±11.47kg; 1.7±0.08m) participated in this study. The length of the pectoralis minor on the dominant side of the subjects was measured with a tape measure and the Flock of Birds® electromagnetic tracking system. The procedures were repeated with an interval of 24-72h to determine the between-days reliability. Intra-trial reliability was considered very good for assessing the pectoralis minor length with the tape measure at day 1 (ICC=0.82, SEM=0.72cm, MDC_{95}=2.01cm) and day 2 (ICC=0.84, SEM=0.58cm, MDC_{95}=1.63cm). The slightly better reliability showed on day 2 may be due to a learning effect of the evaluator. There was good between-days reliability for assessing the pectoralis minor length with the tape measure (ICC=0.75, SEM=0.77cm, MDC_{95}=2.14cm) and the electromagnetic device (ICC=0.67, SEM=0.98cm, MDC_{95}=2.72cm). Visual inspection of the Bland-Altman plots indicate a small lack of agreement between the two instruments. Therefore, the agreement between the measurement methods indicates that the tape measure overestimates pectoralis minor length and that the same instrument should be used when evaluating length change over time.

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INTRODUCTION

Some studies have shown that pectoralis minor adaptive shortening may bring changes in the rest positioning of the scapula and in the scapular kinematics during elevation of the arm [1,2]. These position and motion alterations may contribute to narrowing of the subacromial space and shoulder injuries [3,4].

The electromagnetic 3-dimensional motion capture device has been used as the "gold standard" method to assess pectoralis minor length [4]. However, using this system is time consuming and they are not widely available in a clinical setting due to high cost. Therefore, it is very important to evaluate a more accessible instrument to measure the length of the pectoralis minor in a clinical setting.

The purpose this study was to establish the intra-trial reliability of using a tape measure to measure pectoralis minor length, and to evaluate the between-day reliability of a tape measure and electromagnetic system to measure the pectoralis minor length in young asymptomatic subjects. Standard error of measurement (SEM) and the minimal detectable change (MDC) were also determined in order to facilitate clinical interpretation of change in pectoralis minor length over time. It was also aim of the study to examine the agreement between the tape measure and the electromagnetic system.

METHODS

A convenience sample of 25 asymptomatic subjects (12 males and 13 females; 25 ± 3.97 years; 65 ± 11.47 kg; 1.7 ± 0.08 m) participated in this study. The subjects were included if they had no history of shoulder or cervical pathology. Exclusion criteria included: pregnancy; ligamentous laxity based on positive Sulcus and Apprehension tests; positive impingement tests based on Hawkins, Neer and Jobe, or pain during external rotation with the arm in 90° of elevation in the coronal plane; history of clavicle, scapula or humerus fracture; systemic illnesses; tape allergy; and body mass index > 28kg/m^2. The subjects gave their written and informed consent agreement to participate in this study, which was conducted according to the Helsinki Statement.

The length of the pectoralis minor on the dominant side of the subjects was measured with a tape measure and the Flock of Birds® electromagnetic tracking system. The measurements were taken with the subject standing with the arms relaxed at the side of the body in a neutral position. The length of the muscle was represented by the distance between the caudal edge of the fourth rib at the sternum and

inferomedial aspect of the coracoid process. These landmarks represent the origin and insertion of the muscle, respectively.

At first, 2 measurements were taken with the tape measure. Then, the measurement was taken with the electromagnetic tracking device in the same position with the transmitter directly behind the shoulder tested. During data collection, the subjects were asked to remain in "relaxed posture" to avoid postural correction. The same procedures were repeated with an interval of 24-72h to determine the between-days reliability. The evaluators were blinded to the resting length of the muscle during the entire data collection session. The same evaluators performed all measurements.

Relative reliability was determined by calculating the Intraclass Correlation Coefficient (ICC) for both intra-trial and between-days reliability. The absolute reliability was defined as the SEM and the MDC_{95} (95% of confidence interval). The mean of the 2 trials taken with the tape measure was used for the calculations. Bland-Altman plots were also constructed to examine the agreement between the measures taken with the tape measure and the electromagnetic system at the days 1 and 2.

RESULTS AND DISCUSSION

Intra-trial reliability was considered very good for assessing the pectoralis minor length with the tape measure at day 1 (ICC=0.82, SEM=0.72cm, MDC_{95}=2.01cm) and day 2 (ICC=0.84, SEM=0.58cm, MDC_{95}=1.63cm). The slightly better reliability showed on day 2 may be due to a learning effect of the evaluator.

There was good between-days reliability for assessing the pectoralis minor length with the tape measure (ICC=0.75, SEM=0.77cm, MDC_{95}=2.14cm) and the electromagnetic device (ICC=0.67, SEM=0.98cm, MDC_{95}=2.72cm). These data support the use of both instruments to detect change in the pectoralis minor muscle over time. However, it is important to consider that to be meaningful, changes should exceed the SEM.

Visual inspection of the Bland-Altman plots (Figure 1A and 1B) shows that most subjects (~20) were within 1SD of the mean difference between both instruments (tape measure and electromagnetic device) at both days of evaluation. Both plots indicate a small lack of agreement between the two instruments, with mean differences of 1.7cm and 1.6cm, respectively. However, the spread of the difference scores indicates that there is no bias in error toward one particular instrument. Overall, the plots suggest that while there is good correlation among the two instruments, there is not perfect agreement between the instruments to measure the length of the pectoralis minor in the resting position.

CONCLUSIONS

A single rater can reliably measure pectoralis minor length within the same day, and reliability appears to improve with practice. Both the tape measure and electromagnetic device methods appear to have adequate response stability, making them acceptable to quantify change in the pectoralis minor muscle length over time. Because the agreement between the measurement methods indicates that the tape measure overestimates pectoralis minor length, the same instrument should be used when evaluating length change over time.

REFERENCES

1. Ludewig PM, Cook TM. Alterations in shoulder kinematics and associated muscle activity in people with symptoms of shoulder impingement. *Phys Ther*. **80**(3):276-291, 2000.
2. Borstad JD, Ludewig PM. The effect of long versus short pectoralis minor resting length on scapular kinematics in healthy individuals. *J Orthop Sports Phys Ther*. **35**:227-238, 2005.
3. Borstad JD, Ludewig PM. Comparison of three stretches for the pectoralis minor muscle. *J Shoulder Elbow Surg*. **15**:324–330, 2006.
4. Borstad JD. Measurement of pectoralis minor muscle length: validation and clinical application. *J Orthop Sports Phys Ther*. **38**(4):169-74, 2008.

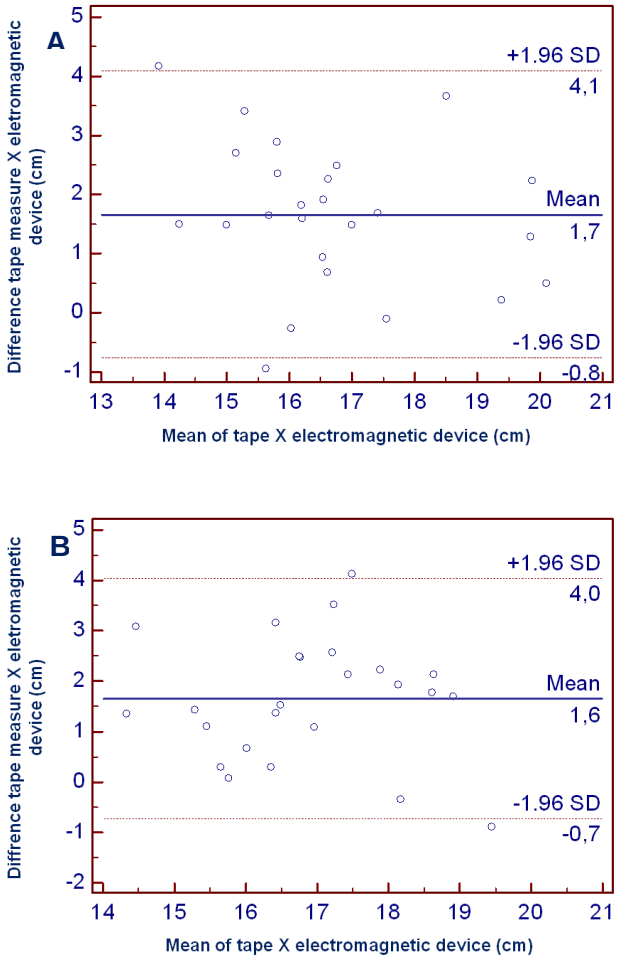

Figure 1. Bland-Altman plots for agreement between tape X electromagnetic at Day 1 (A) and Day 2 (B).