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Ultrasound Measurement of the Thickness of Supraspinatus and Subscapularis Muscle Tendons in the Healthy Adult Population and Explore Correlations with Other Patient Demographic Characteristics

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ABSTRACT
An efficient and trustworthy approach for determining the thickness of the rotator cuff tendons is ultrasound. The easiest technique to evaluate the tendon's thickness is to compare it to the tendon in the opposite shoulder. Ultrasound measurement of the thickness of supraspinatus and subscapularis muscle tendons in the healthy adult population and study correlations of this muscle tendon thickness with other patient demographic characteristics. This quantitative observational study was performed on 1000 patients between 18-60 years coming for ultrasound using high frequency linear transducer of Samsung RS 80 EVo at Radiology department. Pre-defined inclusion and exclusion criteria applied and patients are scanned in sitting position. Both shoulders are scanned for supraspinatus and subscapularis tendons of both shoulder at distance of 5, 10, 15 mm from its insertion point and average is taken of all three measurements. The data was analysed with standard statistical test. Subscapularis and Supraspinatus tendon thickness on both sides are compared in difference age groups, gender, BMI, handedness and occupation. Both subscapularis and supraspinatus tendon thickness was significantly higher among males (compared to females), overweight subjects, heavy workers, dominant (as compared to non dominant) as compared to normal weight subjects on both side ($p<0.05$). Increase in subscapularis and supraspinatus tendon thickness was observed with age among both male and females. Both subscapularis and supraspinatus tendon thickness was observed nearly similar between right and left handed subjects at both side ($p>0.05$). Present study has proposed normal dimensions of the rotator cuff for subscapularis and supraspinatus of Indian population. This study emphasizes screening of the other shoulder as a control.

INTRODUCTION

The shoulder is a complex joint as it is one of the most freely moveable in the human body due to the articulation at the glenohumeral joint. The high range of motion of the shoulder comes at the expense of decreased stability of the joint and it is prone to dislocation and injury[1].

Shoulder pain is the third most common musculoskeletal problem with significant negative impact on quality of life. Other than that significant number of the population living with asymptomatic shoulder injury. Among asymptomatic individuals the prevalence for rotator cuff tears is 23% in the general population. There are several reasons of shoulder discomfort, which is a frequent ailment. Among other reasons, this includes tendinitis, arthritis, fractures, subacromial and subdeltoid bursitis, tendinosis, adhesive capsulitis and rotator cuff tears. Other imaging modalities may need to be employed in addition to plain radiographs, which are frequently normal, to make a diagnosis[2].

Even while MRI is effective at scanning the shoulder joint, its disadvantages include a high per-scan cost, a lack of resources in distant places and a lengthy waiting period. Patients are also asked to lay motionless for extended periods of time. Additionally, these scans cannot evaluate dynamic motions. Ultrasound (US) is a technology that provides dynamic imaging examinations and is commonly utilized since it is affordable and simple to evaluate[3,4].

According to reports, ultrasound can diagnose full thickness tears with a sensitivity of 92.4-96% with a specificity of 93-94.4% and partial-thickness tears with a sensitivity of 66.7-84% with a specificity of 89-93.5%[3,5]. As a result, ultrasonography has shown to be a reliable and efficient way to gauge tendon thickness[6]. The easiest technique to evaluate the tendon's thickness is to compare it to the tendon in the opposite shoulder. Numerous worldwide ultrasonography investigations on rotator cuff disorders such tears, tenosynovitis and tendinopathies have been reported[7]. However, there isn't a nearby trustworthy source that can offer shoulder ultrasound measures that are typical across a range of age groups. In order to give precise standards for rotator cuff measurements, the ultrasonic thickness of the supraspinatus and subscapularis tendons was evaluated in this study. Additionally, the probable variability across various sexes, dominant hands and ages was assessed.

Aims and objectives:

- To study ultrasound measurement of the thickness of supraspinatus and subscapularis muscle tendons in the healthy adult population
- To study correlations of subscapularis and supraspinatus muscle tendons thickness with other patient demographic characteristics

MATERIALS AND METHODS

Study population: Patients having no complain related to shoulder coming to radiology department of SSG Hospital.

Sample size and sampling method: Total 1000 patients of age group 18-60 years were randomly selected.

Inclusion criteria:

- Normal healthy person of age between 18-60 years
- Patients having no complain related to shoulder

Exclusion criteria: Patients with:

- Shoulder joint pain and pathology related to shoulder joint or shoulder girdle
- Lesion of cervical spine
- Diabetes induced Peripheral neuropathy
- Obstacle of central nerve

Study design: Descriptive study.

Study procedure:

- A samsung RS 80 EVo ultrasound equipment with an 8-12 MHz linear transducer was used to do the ultrasounds
- In both shoulders, the supraspinatus and subscapularis were ultrasonographically examined twice
- From these images, the thickness between SST and SSC was calculated
- Subjects were seated while the SST was scanned
- The subject's head, shoulders and elbows were all in neutral alignment. The subject's elbow was fully extended
- The transducer was positioned with the scapular spine in parallel. The distal transducer was then positioned on the larger tubercle's superior facet (SF), while the proximal transducer was positioned on the acromion
- The transducer was then positioned where the subscapularis muscle is visible by moving it up and down. Following that, measurements are obtained as indicated in the following figure and it is scanned similarly to the supraspinatus
- Schematic representation of thickness of supraspinatus and subscapularis to be measured

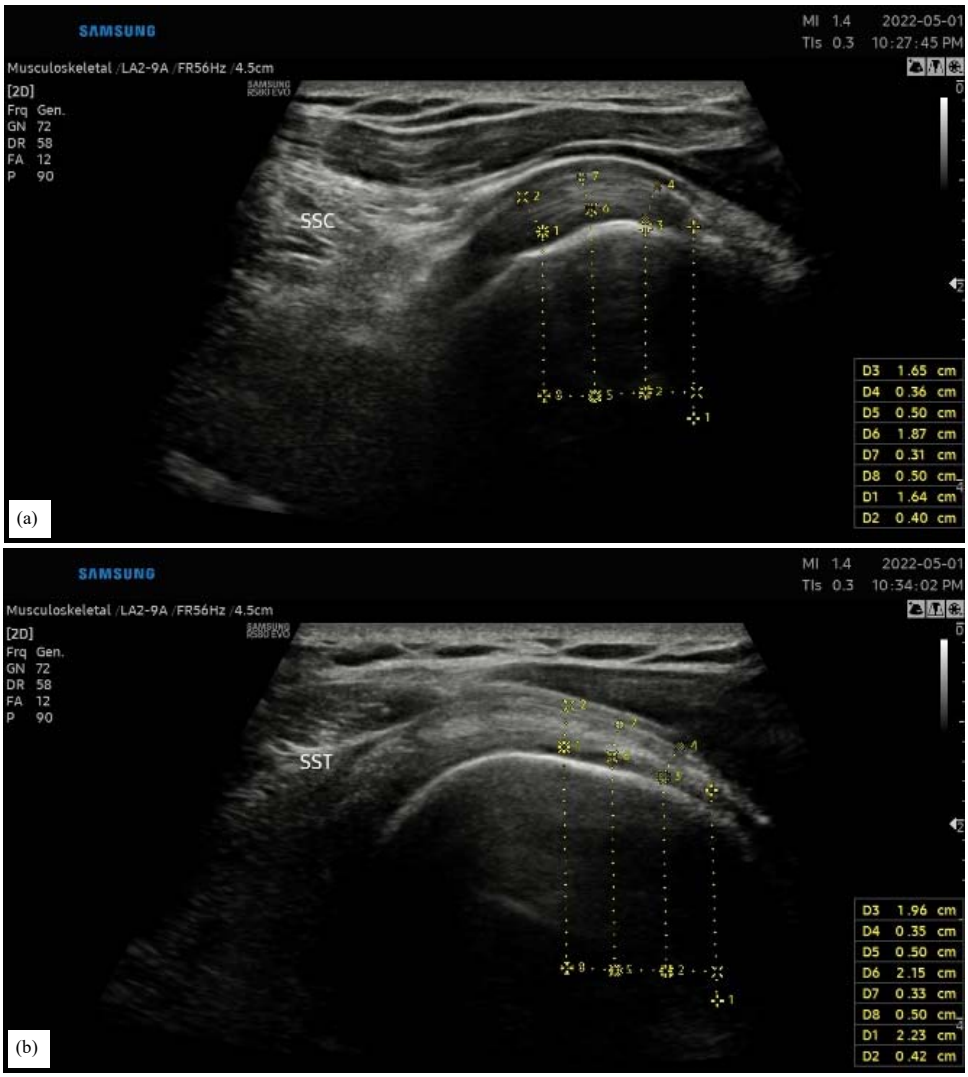

Fig. 1(a-b): Long axis scanned image of subscapularis (SSC) and supraspinatus (SST) with measurements at various level from attachment

Measurement of tendon thickness: As shown in Fig. 1a and b measurement of both subscapularis and supraspinatus is taken at its insertion site along the long axis at three different level e.g., 5, 10 and 15 mm from its insertion point measurement are different at different level and average is taken of all three measurements. Same measurement is taken in opposite shoulder and compared.

Statistical analysis:

- Descriptive statistics (Mean, SD, frequency, Percentage) is used to depict the baseline profile of the study participants
- Statistical software SPSS 21 is used for data analysis
- Independent sample t test is used to compare tendon thickness with different variables
- A $p<0.05$ is considered statistically significant

RESULTS AND DISCUSSION

Due to its simplicity, cheap cost, excellent sensitivity and specificity, ultrasound shoulder is a developing imaging method[8]. Numerous common disorders, particularly those without trauma, have been quickly detected in patients. All of these support normal tendons thickness levels in the local population (Table 1)[9].

Both subscapularis and supraspinatus tendon thickness were significantly observed higher among male compared to female at both side ($p<0.05$). Both subscapularis and supraspinatus tendon thickness were significantly higher among overweight subjects compared to normal weight subjects at both side ($p<0.05$). No significant link between an individual's weight and any of the tendon measures was discovered by Karthikeyan *et al*.[10] ($p>0.05$). In our investigation, patients who were right- or left-handed showed virtually equal supraspinatus and subscapularis tendon thickness on both sides ($p>0.05$) (Table 2).

Table 1: Comparison of subscapularis tendons thickness with age and gender

	Subscapularis			
	Right		Left	
Age group (years)	Male	Female	Male	Female
18-30	3.67±0.54	3.17±0.47	3.59±0.69	3.22±0.50
31-40	3.92±0.70	3.53±0.64	4.09±0.82	3.60±0.81
41-50	3.81±0.57	3.75±0.36	4.05±0.87	4.35±1.11
51-60	4.22±0.94	3.61±0.61	4.06±0.66	3.50±0.69

Data are expressed as Mean±SD

Table 2: comparison of supraspinatus tendons thickness with age and gender

	Subscapularis			
	Right		Left	
Age group (years)	Male	Female	Male	Female
18-30	3.90±0.47	3.24±0.56	3.83±0.58	3.06±0.55
31-40	3.75±0.77	3.82±0.80	4.05±0.82	3.67±0.66
41-50	4.03±0.60	4.15±0.41	3.96±1.37	3.77±0.41
51-60	4.25±0.86	3.76±0.61	4.02±0.63	3.57±0.72

Data are expressed as Mean±SD

Table 3: Both subscapularis and supraspinatus tendon thickness comparison with handedness.

		Right			Left		
Thickness	Handedness	Mean	SD	p-value	Mean	SD	p-value
Subscapularis	Right	3.51	0.68	0.44	3.59	0.76	0.74
	Left	3.56	0.74		3.56	0.93	
Supraspinatus	Right	3.64	0.75	0.96	3.51	0.86	0.35
	Left	3.64	0.72		3.58	0.67	

SD: Standard deviation

Table 4: comparison of thickness with BMI

		Right			Left		
Thickness	BMI	Mean	SD	p-value	Mean	SD	p-value
Subscapularis	Normal	3.47	0.65	0.0001	3.55	0.79	0.0001
	Overweight	3.81	0.85		3.82	0.67	
Supraspinatus	Normal	3.57	0.72	0.0001	3.46	0.84	0.0001
	Overweight	4.11	0.75		3.89	0.71	

SD: Standard deviation

The supraspinatus, infraspinatus, subscapularis tendon and deltoid muscle thickness between males and females for dominant and non-dominant arms were substantially different in the study of Kim *et al*.[11]. It is believed that the male individuals in our study had an increasing propensity for rotator cuff thickness since men are thought to have stronger shoulders than women. As a person becomes older, both males and females have thicker supraspinatus and subscapularis tendons (Table 3).

In a study of ultrasonographic results in asymptotic shoulders, supraspinatus tendon thickness increased positively with age and was shown to be substantially thicker and to have a lower echogenicity ratio in elderly individuals above the age of 60[12]. This study made the claim that chronic tendinopathy brought on by aging-related degeneration may be the cause of the supraspinatus tendon's increased thickness (Table 4).

CONCLUSION

This study has suggested normal dimensions of subscapularis and supraspinatus tendons of Indian population. The shoulder ultrasound measurements in present study emphasizes the utility and appropriateness of routine screening of the other shoulder as a control. To further confirm our normative reference values, more research determining relevant variables and measuring normal rotator cuff tendon diameters is required. Further research is required to determine the cut-off value for rotator cuff lesions and to compare measures between normal, healthy persons and patients with rotator cuff lesions.

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