

Conference Paper

Erect Position as the Alternative Technique in Achilles Tendon US: Comparison with Prone Position

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Abstract

Background: Ultrasonography (US) is the cheaper and non-invasive modality to determine Achilles tendon. Prone position is the standard position of Achilles tendon US. However, it is a discomfort for an uncooperative patient and a difficult technique too. The erect position is an alternative technique of Achilles tendon US. The goal of this study is to compare the erection as an alternative position with prone as a standard position.

Material and Method: The patient who had an injury or any inflammation process of Achilles tendon were excluded. The patient underwent two positions of Achilles tendon US, 90° and dorsiflexion. Longitudinal axis measured tendon thickness and transversal axis covered the cross-sectional area of tendon.

Result: From all the 21 patients coming, 13 patients were males (61.9%) and 8 were females (38.1%). The mean of tendon thickness and cross-sectional area in 90° prone position were 4.24 ± 0.24 mm, 30.08 ± 2.86 mm, respectively. The mean of tendon thickness and cross-sectional area in 90° erect position were 4.27 ± 0.23 mm, 31.36 ± 2.19 mm, respectively. There was no anisotropy effect during longitudinal axis examination.

Conclusion: We found that there was no significant differences between prone and erect position ($p < 0.05$). The erect position could be an alternative position, uncooperative patient in particular, without reducing the diagnostic value.

Keywords: Achilles tendon US, erect position, prone position, tendon thickness, cross-sectional area

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1. Introduction

Achilles tendon is the largest and strongest tendon in the human body, but it is also mostly affected by trauma. Trauma to the Achilles tendon is usually associated with poor flexibility and stability of ankle and also over use of them [1–3].

Currently, *Ultrasound* (US) musculoskeletal is the alternative choice for patient as a supporting diagnostic besides Magnetic Resonance Imaging (MRI), because *Ultrasound* (US) musculoskeletal is cheap, not invasive and it can be done quickly. In clinical practice, *ultrasound* musculoskeletal is widely accepted and developed in Europe and in United States [4, 5]. Standard position for assuring the *ultrasound* (US) of the Achilles tendon is anatomically in *prone* position or in standard 90° [4, 6, 7]. If this position is in relatively long period, it will cause a discomfort, a distress to the patient and difficult in technique. The patients will suffer those bad cause; moreover, to the patients with certain clinical conditions.

2. Material and Method

There are a total of 21 healthy patients being tested for their US Achilles tendon at Airlangga University Hospital. Every patient was examined of Achilles tendon US in prone position anatomically (90°) and also dorsiflexion and in erect position anatomically (90°) and also dorsiflexion. The inclusion criteria are that the patients: (1) have never been experienced in an inflammation, a trauma or structural abnormalities of the ankle area, (2) the patients are able to be examined of US in the position of both prone and erect. The US examination used an US device of Siemens brand, Acuson X150 with a linear probe. Every position was done US examination by measuring the tendon thickness, transversal axis, wide and longitudinal axis. The data were analyzed by using a comparison test.

2.1. Examination technique with prone position

All patients are tested for their US Achilles tendon in a 90° *prone* position and in a dorsiflexion. At that 90° positions the patient's feet were hanging over the end of the examination table, and the position of feet dorsiflexion rested on the examination table (Figure 1). The *probe* used is a linear probe with its depth of 4 mm, the probe placement area is parallel to the medial malleolus. The Achilles tendon will then be examined in a longitudinal axis, as a result of *ultrasound*, it is to be measured its tendon thickness

which is also called diameter of Achilles tendon *anteroposterior*, the measurement is started by drawing a straight line from the upper limit of the tendon to the lower limit of the tendon. In the transverse incision the extent area is measured or it is called the circumference of a circle of the Achilles tendon (Figures 2–5). The measurement using the *calliper* menu – starts the area from the outer boundary line of the surrounding *Achilles* tendon.

2.2. Examination techniques in a standing (Erect) position

It is similar to the prone position that all patients will be US checked at the 90° position and at the dorsiflexion. In the 90° standard standing positions, the samples are instructed to stand upright on the *step ladder* or on the top of the step ladder (Figure 1). The next step is to place the probe in a longitudinal slice to examine the Achilles tendon thickness and to place the probe on transversal slice to be examined the tendon extent area (Figures 6–9).

2.3. Statistical analysis

The consecutive (list of) data were displayed in the form of an average following its standard deviation. Data variation on the size of a thickness and wideness of the Achilles tendon were analyzed with the independent variables, namely: the 90° standard *prone* positions, the dorsiflexion *prone* position, the 90° standard standing positions, and the standing dorsiflexion position. The data were tested using independent *t*-test. Differences were considered significant when $P < 0.05$. The data were processed using SPSS 16.0 *for Windows*.

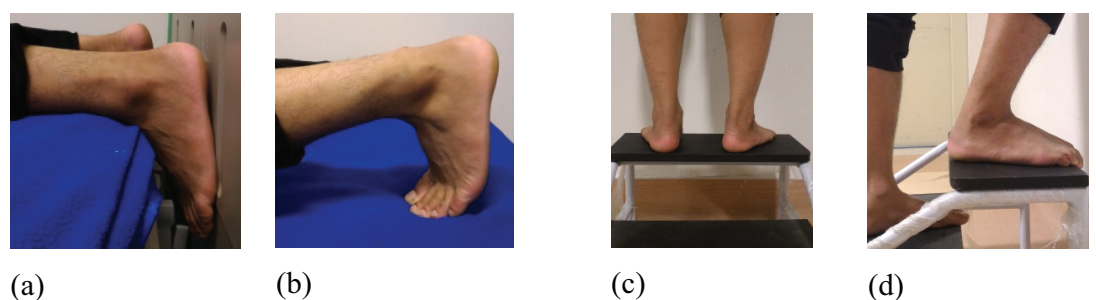


Figure 1: The checking position of the Achilles tendon. (a) The 90° standard prone position. (b) The dorsiflexion prone position. (c) The 90° standard standing position. (d) The dorsiflexion standing position.

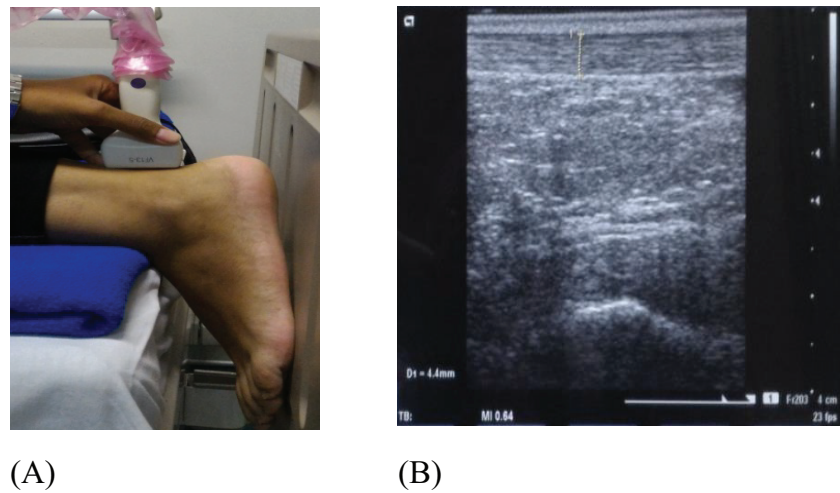


Figure 2: Position of probe in Achilles tendon on longitudinal axis with 90° prone position (A), the US result of Achilles tendon (B).

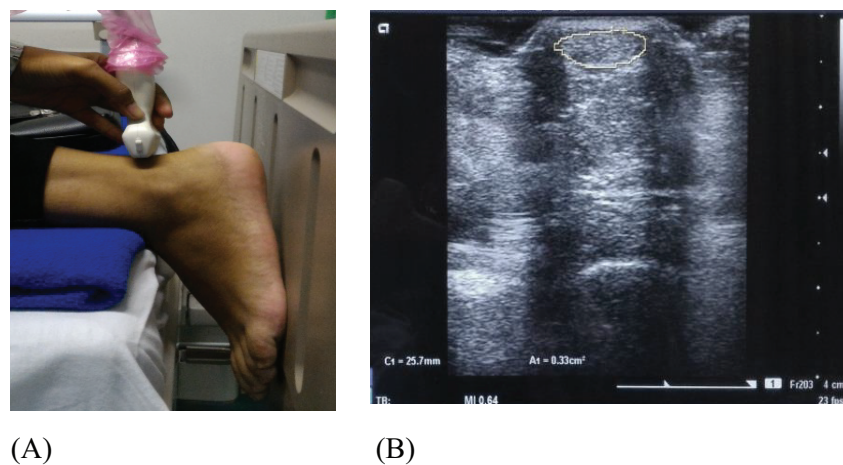


Figure 3: Position of probe in Achilles tendon on transversal axis with 90° prone position (A), the US result of Achilles tendon (B).

3. Result

Of all 21 patients who underwent the test consisted of 13 men (61.9%) and of 8 women (38.1%) with the mean of 21.9 y.o \pm 2.143. The mean of height and weight were 165.52 cm \pm 7.776 dan 63.38 kg \pm 12.294, respectively. In this study were not studied due to the effect of height and weight on the measurement results of the Achilles tendon. The result of the Achilles tendon measurement is shown in Table 1. The *mean* value or mean of the extent area of the Achilles tendon in the 90° standard prone positions is 30.08 \pm 2.86 mm, while in the 90° standard standing position, the values obtained are 31.36 \pm 2.19 mm. The *mean* value or mean of the extent area of the Achilles tendon

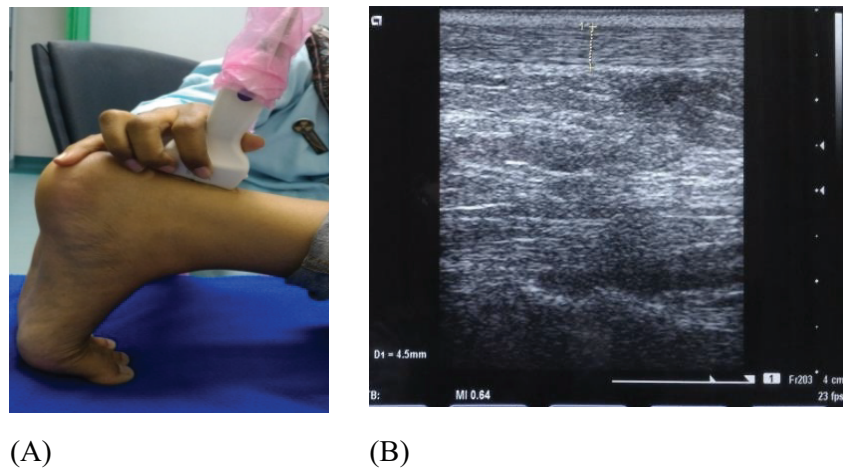


Figure 4: Position of probe in *Achilles tendon* on longitudinal axis with dorsiflexion prone position (A), the US result of *Achilles tendon* (B).

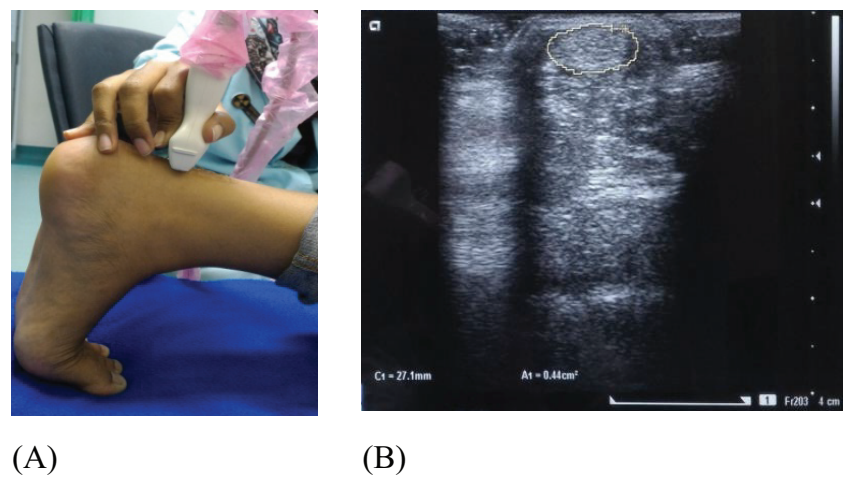


Figure 5: Position of probe in *Achilles tendon* on transversal axis with dorsiflexion prone position (A), the US result of *Achilles tendon* (B).

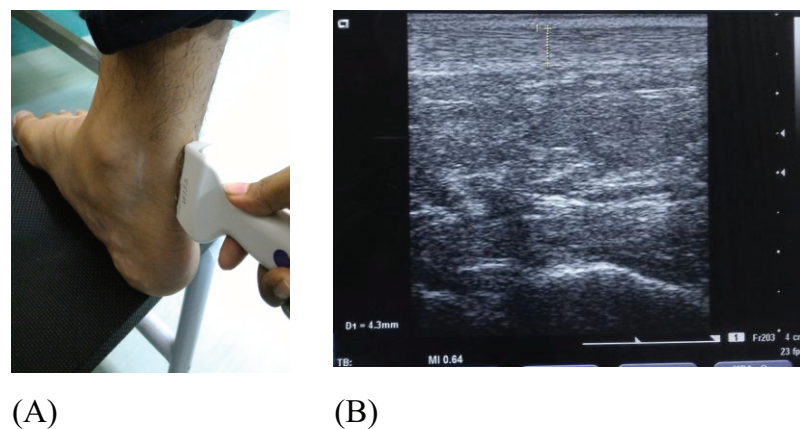


Figure 6: Position of probe in *Achilles tendon* on longitudinal axis with 90° erect position (A), the US result of *Achilles tendon* (B).

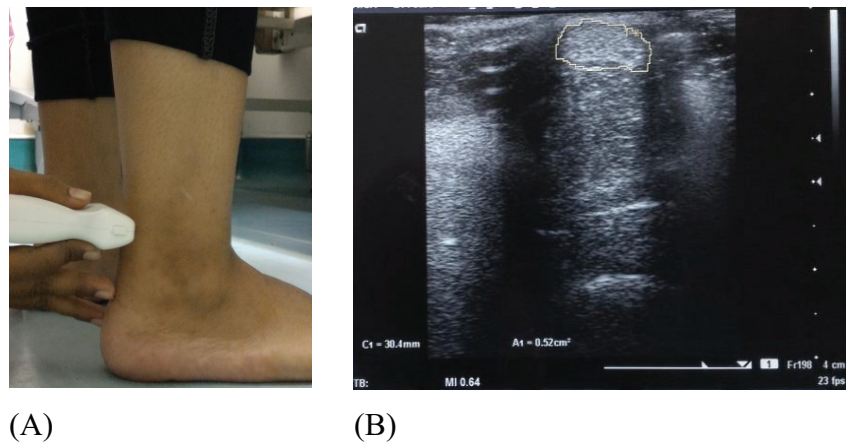


Figure 7: Figure 7: Position of probe in *Achilles tendon* on transversal axis with 90° erect position (A), the US result of *Achilles tendon* (B).

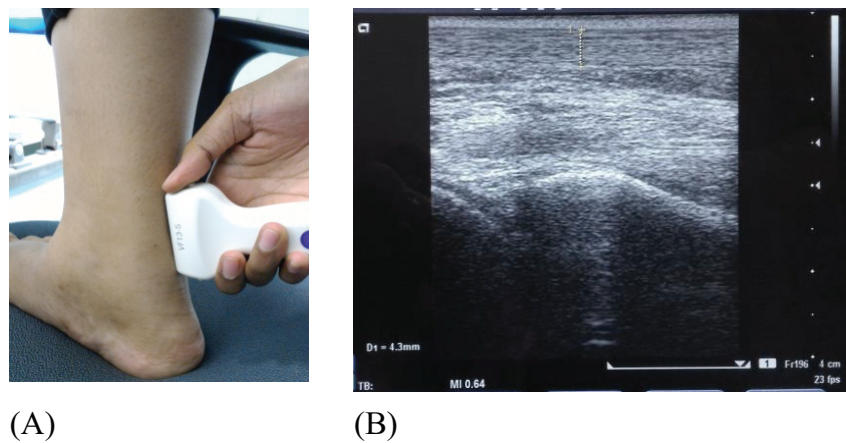


Figure 8: Position of probe in *Achilles tendon* on longitudinal axis with dorsiflexion erect position (A), the US result of *Achilles tendon* (B).

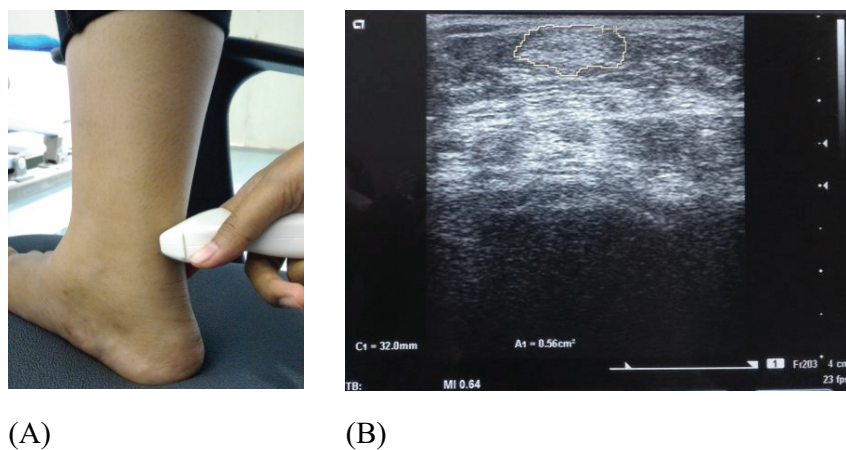


Figure 9: Position of probe in *Achilles tendon* on transversal axis with dorsiflexion erect position (A), the US result of *Achilles tendon* (B).

in the dorsiflexion prone position is 31.51 ± 2.33 mm, while in a dorsiflexion standing position the value obtained is of 32.08 ± 2.28 mm.

TABLE 1: The measurements results of the Achilles tendon.

	Thickness (mm)	Area wideness (mm ²)
Position 90° Standard		
Prone	4.24 ± 0.24	30.08 ± 2.86
Standing	4.27 ± 0.23	31.36 ± 2.19
<i>P</i>	0.829	0.212
Dorsiflexion		
Prone	4.20 ± 0.21	31.51 ± 2.33
Standing	4.15 ± 0.21	32.08 ± 2.28
<i>P</i>	0.952	0.724

4. Discussion

The Achilles tendon is the largest and the strongest tendon in the body [2, 3]. It is formed by the combined tendon of the gastrocnemius and soleus muscles (triceps surae). The Achilles tendon begins at the junction between gastrocnemius and soleus tendon in the middle of the calf [3, 7, 9].

In terms of morphology, normal *Achilles* tendon thickness should be no more than 8 mm in the dimensions of anteroposterior (AP), it becomes proximally thick and slightly tapers along the third distal for insertion on the calcaneal tubercle. The normal retrocalcaneal caudex should produce a radiolucent anterior to the distal fibers of insertion of the *Achilles* tendon which extends at least 2 mm below the superior surface of the calcaneus [3, 4, 10].

On the examination of the *Achilles* tendon, the previous patient is in a lying face downward or in a *prone*, that is, the patient's legs is dangling at the end of the examination table. The scan is performed on the Achilles tendon subsequently with a linear probe from the *myelotendinous junction* until insertion calcaneal on the *transversal* and *longitudinal* area [6, 7, 11, 12]. The scanning is set at the medial level of the malleolus with the ultrasound probe is situated perpendicular of the *Achilles* tendon. In addition to the standard position, the dorsiflexion position will straighten the *Achilles* tendon to avoid anisotropy [4, 12, 13]. The anisotropy is seen as an hypo-echoic focal area when the angle of the probe was not in a 90 degrees on the structure depicted. It is easily found when the results of the *Achilles* tendon picture are as if the hypo-echoic which indicate pathological features up under the tendon [7, 15].

In some people or in certain conditions, the default position will cause the patient a discomfort and technically it will be difficult to be done as if there were a respiratory problem.

Modification of the *ultrasound* examination technique of the *Achilles* tendon is a new kind of research, there has been no similar study comparing the positioning techniques of *Achilles* tendon ultrasound. The *Achilles* tendon size obtained from this study is a new kind of innovation, because there is no specific reference to the size of the *Achilles* tendon for the Southeast Asian, especially Indonesian. Previous study by Pang in 2006 at The Hong Kong Polytechnic University discussed about the size of thickness, wide area, and length of the *Achilles* tendon by age, weight and use of dominant foot [1, 14, 16].

Pang et.al. found that the thickness and area wideness of the tendon with a lifespan of samples of 20 to 29 years, is $5.14 \text{ mm} \pm 0.57$ and $57.80 \text{ mm}^2 \pm 11.61$. While this study reveals that the *Achilles* tendon thickness on the 90° standard prone position is $4.24 \text{ mm} \pm 0.24$, the area wideness of the *Achilles* tendon is $30.08 \text{ mm}^2 \pm 2.86$. The result difference of the *Achilles* tendon measurement obtained by the research may have been influenced by certain factors, namely: race factors, height, weight, and feet activity which are frequently used.

Of the 21 samples being studied consisted of 13 men (61.9%) and of 8 women (38.1%) with a mean of 21 years of age. The data analysis of the measurement using the *independent t-test* showed the thickness and the size of the prone position of the *Achilles* tendon, the 90° standard standing positions and dorsiflexion have resulted the same value of $P > 0.05$. This value means that there is no significant difference in the results. The examination results of the US *Achilles* tendon in both prone and standing position shows no description of anisotropy.

Due to no significant difference of thickness measurement results and area wideness of the *Achilles* tendon in a prone position and standing; moreover, in both standard and dorsiflexion, the standing position can then be used as an alternative technique to test the *Achilles* tendon ultrasound.

5. Conclusion

Modification technique of testing the *Achilles* tendon *ultrasound* in a standing position reveals no significant different of the measurement results compared to a standard

position, prone. Thus, the standing position becomes the alternative position of measurement technique on Achilles tendon US for sonographer, doctor of radiology in improving patients' comfort without affecting the diagnostic value.

Conflict of Interest

None declared.

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