

**Research Article****Musculotendinous Junction of Soleus and its Clinical Correlation****Pradnya Gurude<sup>1</sup>, Sheetal Joshi<sup>2\*</sup>, Amit Kale<sup>3</sup>, Nutan Mandke<sup>4</sup>, Bahetee BH<sup>5</sup>, Ajay Chandanwale<sup>6</sup>**<sup>1,2</sup>Assistant Professor, Department of Anatomy, B. J. Government Medical College and Sassoon General Hospitals, Station Road, Pune- 400 001, Maharashtra, India<sup>3</sup>Assistant Professor, Department of Orthopedics, B. J. Government Medical College and Sassoon General Hospitals, Station Road, Pune- 400 001, Maharashtra, India<sup>4</sup>Professor, Department of Anatomy, B. J. Government Medical College and Sassoon General Hospitals, Station Road, Pune- 400 001, Maharashtra, India<sup>5</sup>Professor and Head, Department of Anatomy, B. J. Government Medical College and Sassoon General Hospitals, Station Road, Pune- 400 001, Maharashtra, India<sup>6</sup>Dean, B. J. Government Medical College and Sassoon General Hospitals, Station Road, Pune- 400 001, Maharashtra, India**\*Corresponding author**

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**Abstract:** The achilles tendon is the strongest and thickest tendon in the body and is formed by gastrocnemius and soleus. The aim of this study was to study the distance between musculotendinous junction of soleus and the most proximal point of insertion on calcaneum. In the present study, the average distance between musculotendinous junction of soleus and the most proximal point of insertion was found to be 4.29cm. Interestingly in one case, we noted, that the muscle fibres of soleus were extending further down right uptill its insertion on the calcaneus. A detailed knowledge of distance from musculotendinous junction of soleus to its insertion on calcaneus is important for surgeons doing calcaneal tendon repair following rupture and also in reconstructive surgeries using soleus muscle flaps.**Keywords:** Achilles tendon, Musculotendinous junction, Soleus.

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**INTRODUCTION**

The Achilles tendon is highly characteristic feature of Human Anatomy and it has been suggested that the tendon has helped to shape human evolution [1].

Gastrocnemius and soleus which are the powerful plantar flexors of ankle joint unite to form the Achilles tendon. It begins superficially in the middle one third of leg, where muscular belly of gastrocnemius ends but it continues to receive muscle fibres on its anterior surface from the soleus almost to the malleolar level [2].

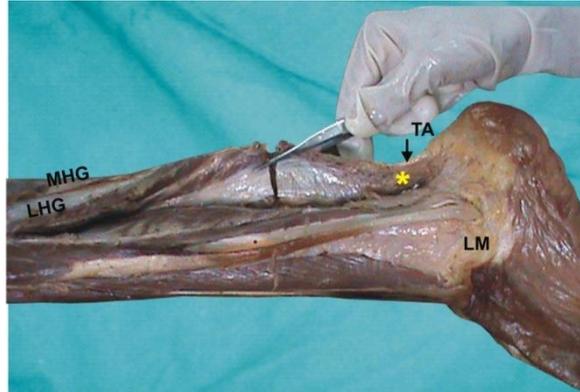
While the basic anatomy of the soleus muscle has been previously described, but very few researchers have commented on the distance from musculotendinous junction of soleus to the most proximal point of insertion of Achilles tendon on calcaneus. So, the present study is an attempt to address the distance between musculotendinous junction of soleus and the most proximal point of insertion on calcaneum.

**MATERIALS AND METHODS**

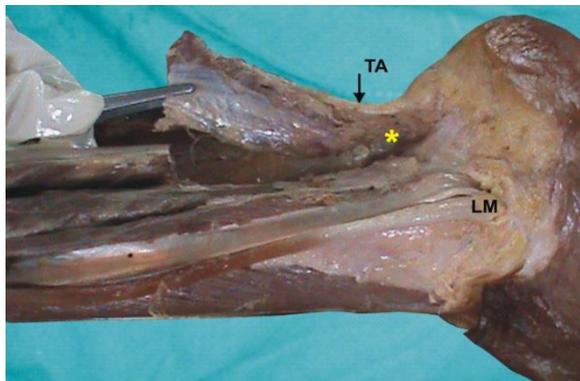
The present study was carried out in the department of Anatomy at B. J. Government Medical College, Pune. Lower limbs of twenty adult cadavers preserved in 10% formalin, were dissected to study the tendo Achilles. The length of the tendon was measured from musculo-tendinous junction of soleus muscle to the most proximal point of insertion site of the tendon on calcaneus using a vernier caliper. The findings were recorded and the observations were photographed.

**RESULTS**

In the present study, the average distance between musculotendinous junction of soleus and the most proximal point of insertion was found to be 4.29cm. Interestingly in one case, musculotendinous nature of tendoachillis was observed uptill the point of insertion on the calcaneus in left leg of an adult male cadaver. Careful observation indicated that the skeletal fibres of soleus were extending anterior to tendo achillis tendons till the site of insertion on the calcaneus (Fig. 1 and 2).



**Fig. 1: Showing lateral view of left leg of an adult cadaver (MHG – Medial head of gastrocnemius, LHG – lateral head of gastrocnemius, LM – lateral malleolus, TA – tendoachillis, \* - skeletal fibers of soleus on the anterior aspect of tendoachillis)**



**Fig. 2: Showing lateral view of left leg of an adult cadaver highlighting musculotendinous nature of tendoachillis till the site of insertion on calcaneus. (TA – tendoachillis, LM – lateral malleolus, \* - skeletal fibers of soleus on the anterior aspect of tendoachillis)**

**DISCUSSION**

Abnormalities and disorders of the tendoachilles are common problems in many sports [3]. Achilles tendon rupture is most common in men in 4-5<sup>th</sup> decade of life [4].

Consequently, there are important socio-economic implications in choosing the correct treatment. There is considerable debate in the literature concerning surgical versus non-surgical treatment and most surgeons would elect not to repair a rupture within the muscle belly above the musculotendinous junction. There is a wide anatomical variation in the exact location of the Achilles musculotendinous junction, which can lead to confusion among surgeons when trying to identify the location of a rupture and treatment plan [5].

Various clinical aspects related to Achilles tendon impress its importance to be studied in details. The present study focus on the role of soleus in formation of this tendon and its musculotendinous junction in particular.

Researchers like Wolfgang Pichler *et al.* [6] studied musculotendinous junction of soleus muscle. They measured the distance between the distal point of attachment of the soleus muscle fibers (the musculotendinous junction) and the designated measuring point. The findings were divided into three groups. In correlation with his work Group 2 also comprised major group in present study (Table 1).

**Table 1: Showing Comparison between observations of present study with Wolfgang Pichler *et al.* [6]**

Study	Sample size	Group 1 ( 0-1 inches)	Group 2 (1-3 inches)	Group 3 ( more than 3 inches )
Wolfgang Pichler <i>et al.</i> [6]	80	12.5% (10cases)	70% (56 cases)	17.5% (14 cases)
Present Study	40	12.5 % (5cases)	85% (34cases)	2.5% (1case)

Anatomical and histological study of the tendo achilles was done by Abdel-Ghany Hassan Abdel-Ghany .They measured the length of the part of tendo

Achilles extending from the musculotendinous junction of the soleus muscle till its attachment to the calcaneus . It ranged from 6 to 10.50 cm with a mean of 7.62 ± 1.71

cm. Our findings are slightly at a lower level than above findings. The probable reason would be the racial difference [7].

Typically, full incorporation of the soleus and gastrocnemius tendons into the Achilles tendon is evident 8–10 cm above the calcaneal attachment site, but occasionally the tendon of soleus can remain separate from that of gastrocnemius as far as the insertion itself [8].

But in the present study only a specimen bilaterally showed that the muscular fibers of soleus traversed along with the tendon of gastrocnemius till the site of insertion on the calcaneum.

Hall and coworkers reported a congenital short tendo-calcaneous, a condition in which children muscle fibres extending farther down than usual [9].

In the present study also, in one case the skeletal fibres of soleus also extended till the point of insertion on calcaneus along with tendoachillis bilaterally. Since history of the diseased cadaver was not available in our study it is not possible to comment on the condition if any suffered by him during life.

Richard cove, David Weller, Mark Westwood [5] did a survey of orthopaedic surgeons in which delegates at a regional orthopaedic meeting were asked to fill in a questionnaire, which showed a photograph of a lower limb. They were asked to draw two transverse lines, the first identifying the musculotendinous junction, and the second marking the highest level at which they would consider a surgical repair. They were asked about their understanding of the term “musculotendinous junction”.

Twenty two delegates (n =22) of various degrees of seniority responded. There was a wide variety of answers, with the average level of the musculotendinous junction identified as being 10.1cm above the insertion into the calcaneum. The average highest level for considering surgical intervention was 8.71cm above the insertion into the calcaneum. Cadaveric measurements have shown that in fact the Achilles musculotendinous junction lies on average 5.51cm above the tendons attachment to the calcaneum.

In the present study anatomical level of musculotendinous junction was 4.29cm slightly lower than the recording of Richard cove, David Weller, Mark Westwood [5].

## CONCLUSION

A detailed knowledge of the anatomic variations of soleus at its insertion into Achilles tendon is important for surgeons doing calcaneal tendon repair following rupture and also in reconstructive surgeries using soleus muscle flaps. [7].

There is confusion regarding the exact location and nature of the Achilles musculotendinous junction amongst orthopaedic surgeons. Particular care is advised when interpreting ultrasound reports. An Achilles surgical zone has been identified (0–10 cm from the calcaneal insertion) within which the majority of surgeons would consider surgical intervention for rupture.

We would suggest that the term musculotendinous junction should continue to define the point at which the last fibres of soleus attach to the Achilles tendon. Proximal to this there is a musculotendinous zone [5].

The present study is an attempt to evaluate the distance between the musculotendinous junction of soleus and the most proximal point on calcaneus in cadavers which would, comprise a significant information for implications to operating surgeons.

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