

# Shapes of semitendinosis and gracilius tendon auto graft in anterior cruciate ligament reconstruction

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## Summary

Hamstring graft was commonly used in anterior cruciate ligament (ACL) reconstruction. However, shapes of graft may affect the result of the surgery. *Objective:* To study the shapes of Hamstring graft in ACL reconstruction. *Subject and method:* 77 patients, aged from 20 to 46 (mean 31.12 years old) underwent arthroscopic ACL reconstruction using semi-tendinosis and gracilius tendon graft from Oct. 2019 to Aug. 2020. After the removal of all muscles, we used ruler to measure the length and diameter of the remaining tendons. *Result:* The folded in half semi-tendinosis grafts were 13.58cm (11 - 16cm) in length and 5.89mm (5.0 - 6.5mm) in diameter. The folded in half gracilius tendon grafts were 11.96cm (10.5 - 14cm) in length and 4.33mm (3.5 - 5.5mm) in diameter. Hamstring grafts were 11.14cm (10 - 13cm) in length and 7.14mm (6 - 8mm) in diameter. *Conclusion:* Hamstring allo graft had the suitable dimension for ACL reconstruction.

*Keywords:* Shapes, Hamstring, anterior cruciate ligament.

## 1. Background

ACL rupture is a common knee injury. If not treated properly, peripheral injuries like meniscus tear and femur cartilage damage would occur. All ACL treatments aim to stabilize, recover the ROM and function of the knee. However, ACL reconstruction is the best method due to the maximum recovery of the anatomic location and the ligament function, therefore stabilizing the knee.

Materials used for ACL reconstruction vary, such as IT band, gracilius, semitendinosis and patella tendon. The load capacity also varies from one to another, and most of them have different structure from the ACL. Most of the authors used gracilius and semitendinosis for ACL reconstruction. Clinical studies showed that half folded gracilius and

semitendinosis are more stable compared to ACL. Moreover, the removal of grafts leads to fewer complications and soft tissue injuries. However, the author observed that the graft size is not constant.

Therefore, our subject is to study the dimension of semitendinosis and gracilius in ACL reconstruction.

## 2. Subject and method

### 2.1. Subject

77 patients (59 male, 18 female), 20-46 years of age (mean: 31.12) underwent ACL reconstruction using half-folded semitendinosis and gracilius tendon grafts, stabilized using endo button in femur tunnel at 108 Military Central Hospital from October 2019 to August 2020.

### 2.2. Method

This is a cross-sectional descriptive clinical trial study, no control group.

Study process includes ACL reconstruction using semitendinosis and gracilius tendon graft.

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A skin incision, about 2-3cm is performed in the medial tuberculos. Expose the gracilius and semitendinos tendon.

Take out the gracilius and semitendinos.

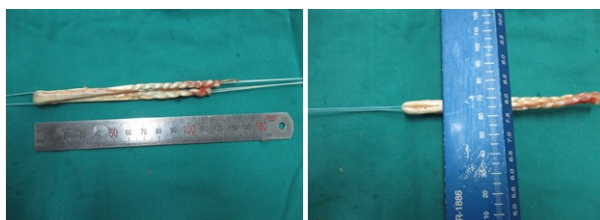
Measure the graft: The diameter and the length of half-folded gracilius and semitendinos tendon.

Measuring the grafts using ruler (cm).

Measuring the diameter of the graft using tools provided by Stryker. The diameter of the graft is measured at the smallest number that the tendon can be pulled through (mm), rounded to the first decimal place. The farther point of the graft (in the femur tunnel) is bigger and contains more tendon, the diameter at the nearer point was chosen as the diameter of the graft.



**Figure 1.** Measuring the length and diameter of the half folded semitendinos and gracilius tendon



**Figure 2.** Measuring the length and diameter of the half-folded Hamstring

### 3. Result

*The length of half-folded semitendinos tendon*

**Table 1. Length of half-folded semitendinos (n = 77)**

Length	Number of patient	Ratio
11 - 12cm	7	9.1
> 12 - 13cm	27	35
> 13 - 14cm	26	33.8
> 14 - 15cm	14	18.2
> 15cm	3	3.9
Total	77	100
Mean ± SD	13.58 ± 1.07	

Min - Max	11 - 16cm
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The mean length of half-folded semitendinos graft was 13.58cm, shortest at 11cm, longest at 16cm, the most popular length ranged from 12 - 14cm, only one graft at 11cm long.

*The length of half-folded gracilius graft*

**Table 2. The length of half-folded gracilius graft (n = 77)**

Length	Number of patients	Ratio
10 - 11cm	19	24,6
> 11 - 12cm	31	40,3
> 12 - 13cm	25	32,5
> 13 - 14 cm	2	2,6
Total	77	100
Mean ± SD	11.96 ± 0.86cm	
Min - Max	10.5 - 14cm	

The mean length of half-folded gracilius graft was 11.96cm, shortest at 10.5cm, longest at 14cm, the most popular length ranged from 11 - 13cm.

*The diameter of half-folded semitendinos graft*

**Table 3. The diameter of half-folded semitendinos graft (n = 77)**

Diameter	Number of patients	Ratio
4.5 - 5.5mm	27	35.1
> 5.5 - 6.5mm	50	64.9
> 6.5mm	0	0
Total	77	100
Mean ± SD	5.89 ± 0.36mm	
Min - Max	5.0 - 6.5mm	

The mean diameter of half-folded semitendinos graft was 5.89mm, smallest at 5.00mm, largest at 6.5mm, the most popular diameter ranged from 5.5 - 6.5mm. 11 cases had the diameter of 6.5mm.

*The diameter of half-folded gracilius graft*

**Table 4. The diameter of half-folded gracilius graft (n = 77)**

Diameter	Number of patients	Ratio
3.5 - 4.5mm	65	84.4
> 4.5 - 5mm	10	13
> 5 - 5.5mm	2	2.6

Total	77	100
Mean $\pm$ SD	4.33 $\pm$ 0.41mm	
Min – Max	3.5 - 5.5mm	

The mean diameter of the gracilius graft was 4.33mm, smallest at 3.5mm, largest at 5.5mm, the most common was 4.0mm (38/77), only 2 at 5.5mm.

#### *Length and diameter of the Hamstring graft*

**Table 5. Length of the Hamstring graft (n = 77)**

Length (cm)	10 - 11cm	> 11 - 12cm	> 12 - 13cm	Total
Number of patients	53	21	3	77
Ratio	68.8	27.3	3.9	100

The mean length of the graft was 11.14cm (shortest: 10cm, largest: 13cm). The most common length was at 11cm (36 patients).

**Table 6. Diameter of the Hamstring graft (n = 77)**

Diameter (mm)	6.0mm	6.5mm	7mm	7.5mm	8mm	Total
Number of patients	2	16	27	22	10	77
Ratio	2.6	20.7	35.1	28.6	13	100

The mean diameter of the graft was 7.14mm (smallest: 6mm, largest: 8mm).

#### **4. Discussion**

Semitendinosis and gracilius grafts were commonly used by international and Vietnamese surgeons such as Dang Hoang Anh [1], Truong Tri Huu [3], Nguyen Van Hy [2], Gadikota [6], Plawesky S [9], who observed the following advantages:

They are constant tendons [2], [9].

After the semitendinosis and the gracilius tendon were taken out, the movement function of the lower limb was not affected [7]. These two tendons played secondary roles in the flexion motion of the knee and the extension of the hip. Femur bicep, semi membranous, popliteus tendon and gastrocnemius tendon participated in the flexion motion of the knee. The extension of the hip occurred by the combination of femur bicep, semi membranous and gluteus tendon.

When the medial ligament was in normal condition, the use of semitendinosis and gracilius tendons for graft did not affect the stabilization of the knee due to its thickness and stability.

It is easy to take out the graft. The incision is small and is also the position to drill the tibial tunnel.

These two tendons when half-folded still cover enough length for ACL reconstruction [2], [3].

The chance of pain complication is lower than pantella graft. They also do not hinder the extension motion [4].

The grafts are stable enough to substitute ACL, which had been proved through numerous studies.

The mean length of the graft was 11.14cm (shortest: 10cm, longest: 13cm). The most common length was at 11cm (36 patients) (Table 5). The mean diameter of the graft was 7.14mm (smallest: 6mm, largest: 8mm) (Table 6).

The mean length of half-folded semitendinosis graft was 13.58cm, shortest at 11cm, longest at 16cm, the most popular length ranged from 12 - 14cm, only one graft at 11cm long (Table 1). The mean diameter of half-folded semitendinosis graft was 5.89mm, smallest at 5.00mm, largest at 6.5mm, the most popular diameter ranged from 5.5 - 6.5mm. 11 cases had the diameter of 6.5mm (Table 3).

The mean length of half-folded gracilius graft was 11.96cm, shortest at 10.5cm, longest at 14cm, the most popular length ranged from 11 - 13cm (Table 2). The mean diameter of the gracilius graft was 4.33mm, smallest at 3.5mm, largest at 5.5mm, the most common was 4.0mm (38/77), only 2 at 5.5mm (Table 4).

Vietnamese studies reported the use of semitendinosis and gracilius grafts in ACL

reconstruction, for example, author Dang Hoang Anh [1] stated that the mean length of half-folded semitendinosis and gracilius tendon was 11.2cm, mean diameter was 7.25mm, the mean length of semitendinosis was 26.3cm, the mean length of gracilius tendon was 21.3cm. Trương Tri Huu [3] reported the mean length of half-folded semitendinosis and gracilius tendon was  $10.13 \pm 0.37$ cm, the mean diameter was  $7.56 \pm 0.38$ mm, the length of semitendinosis was  $26.2 \pm 1.4$ cm, the length of gracilius tendon was  $21.9 \pm 1.5$ cm. Authors suggested that the size of semitendinosis and gracilius tendon were not affect by the bodyweight, but rather by the intensity of movement and the patient's gender.

Studies by Rafael NP et al [10] reported that the length of semitendinosis was  $28.75 \pm 2.91$ cm, the diameter when half-folded was  $6.24 \pm 0.75$ ; the length of gracilius tendon was  $25.28 \pm 3.81$ cm, the diameter when half-folded was  $5.16 \pm 0.81$ mm. Jarvela et al [8] reported that the mean diameter of half-folded semitendinosis was 7mm, for gracilius tendon: 6mm. The study by Le Manh Son [5] reported that the half-folded semitendinosis was  $7.67 \pm 0.62$ mm, the diameter of half-folded gracilius tendon was  $5.67 \pm 0.59$ mm, which was appropriate since the anthropometric index of Vietnamese people is limited compared to the rest of the world.

Therefore, it can be concluded that our results about the length and diameter of half folded grafts are similar to authors mentioned above.

## 5. Conclusion

**Length of grafts:** The mean length of half-folded semitendinosis graft was 13.58cm (ranged from 11 to 16cm). The mean length of half-folded gracilius graft was 11.96cm (ranged from 10.5 to 14cm). The mean length of the Hamstring graft was 11.14cm (shortest: 10cm, largest: 13cm).

**Diameter of grafts:** The mean diameter of half-folded semitendinosis graft was 5.89mm (ranged from 5.0 to 6.5mm). The mean diameter of the gracilius graft was 4.33mm (ranged from 3.5 to 5.5mm). The mean diameter of the Hamstring graft was 7.14mm (smallest: 6mm, largest: 8mm).

The length and diameter of half folded auto grafts are suitable for ACL reconstruction.

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