

## AN ANATOMICAL STUDY OF GRACILIS MUSCLE AND ITS VASCULAR PEDICLES

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### ABSTRACT

**Background:** Gracilis muscle being easily accessible and functionally a weak muscle is suitable for muscle graft to replace the damaged muscle in any part of the body. The length of the muscle, vascular pedicles and limited donor site morbidity helps the surgeon to plan accordingly. The muscle receives a number of vascular pedicles ranging from one to five. The source of these pedicles varies.

**Material and Methods:** The study was conducted on 36 formalin fixed lower limbs of both sexes of unknown age from the department of Anatomy, BMCRI, Bangalore.

**Results and Discussion:** In 75% of limbs two vascular pedicles were seen penetrating the muscle at different levels and in 25% accessory pedicles were seen in the lower 2/3<sup>rd</sup> of the muscle.

**Conclusion:** The findings suggest that the first vascular pedicle to the muscle is always constant in position accompanied by its venae comitans and branch from obturator nerve and is placed at a distance of 10.5cms±2cms from the pubic tubercle.

**KEY WORDS:** Gracilis Muscle, Vascular Pedicle, Muscle Transplantation, Flap Reconstruction.

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### INTRODUCTION

Gracilis muscle is used oftenly in reconstructive plastic surgery, mainly in setting of tendon grafting and muscle transplantation. Gracilis tendon grafts are used in repair of anterior cruciate ligament of knee joint. It has also been used for a wide variety of procedures including breast reconstruction, lip augmentation, facial palsy management, anorectal and urethral fistula. A technique called dynamic Graciloplasty where in the gracilis muscle along with its nerve supply has been used for restoration of anal

function in patients with faecal incontinence [1]. "Gracilis" the muscle derives its name from the latin word meaning slender. It is the most superficial of the adductor group of muscles which is thin, flat and broad above and thick, narrow and tapering below. It arises by a thin aponeuroses from the medial margins of the lower half of the body of the pubis, the whole of the inferior ramus of pubis and the adjoining part of ischial ramus. The fibres descend and curve around the medial condyle of the tibia, where it fans out and attaches to the upper part of the

medial surface of the tibia just below the condyle, proximal to that of semitendinosus, and its upper edge is overlapped by the tendon of sartorius, with which it blends partly. It is innervated by the anterior division of obturator nerve and derives its blood supply from the obturator artery, medial circumflex femoral artery, descending genicular artery, or from the superior and inferior medial genicular arteries or from femoral artery [2]. Usually two or three vascular pedicles accompanied by venae comitans, enter the muscle from its deep surface and nourish it. Of these the proximal pedicle is generally the dominant blood supply to the muscle and supplies 70% of the bulk of the muscle. The number of minor pedicles range from one to five which distally supply 15%-30% of the bulk of the muscle [3].

**MATERIALS AND METHODS**

The study was conducted on 36 formalin fixed lower limbs of both sexes, 30 male and 6 female of unknown age from the department of Anatomy, BMCRI, Bangalore. The skin over the medial compartment of the thigh was reflected and the gracilis muscle was exposed, the muscle was cleaned from the surrounding structures and along its entire length to note the number and entry points of the vascular pedicles.

The objectives of the study is to find the total length of the muscle, width of the muscle at the point of entry of the neurovascular pedicle, number of vascular pedicles and source of the arteries.

**OBSERVATIONS**

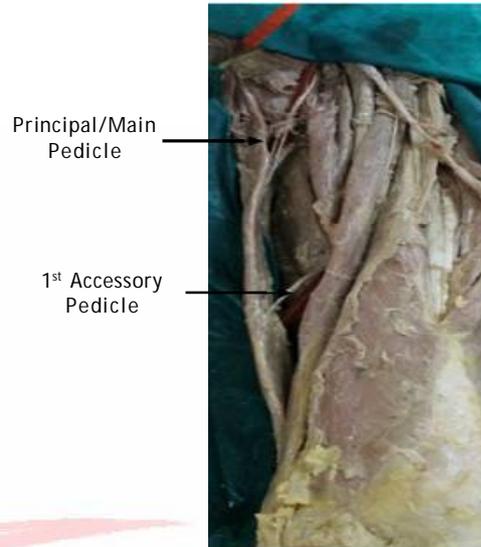
**Fig. 1:** Showing length of the gracilis muscle.



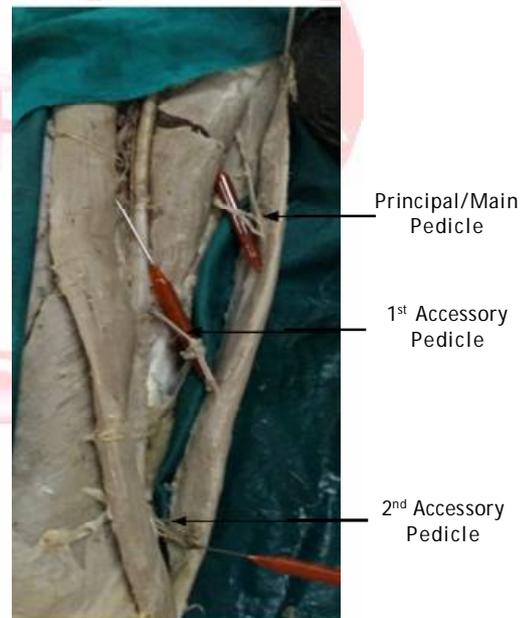
**Table 1:** Showing Mean length and Mean width of the muscle. (Fig.-1)

<b>Mean Length</b>	42.2±2cm
<b>Mean Width</b>	3.9±2cm

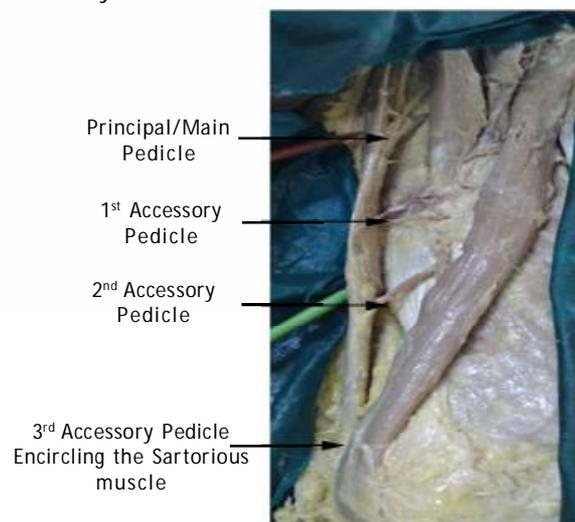
**Fig. 2:** Showing One Principal/ Main pedicle and one accessory Pedicle.



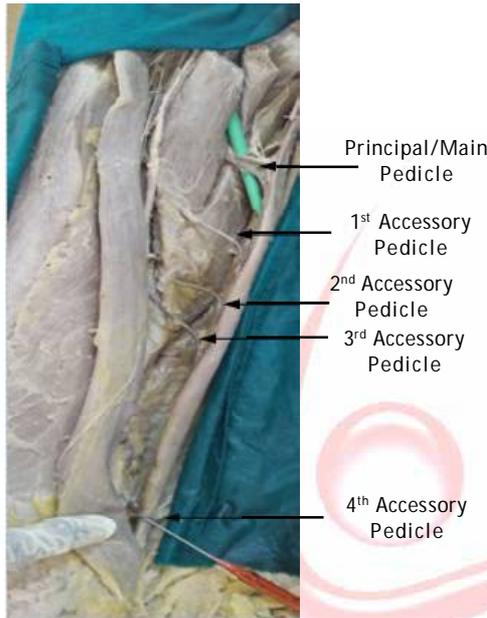
**Fig. 3:** Showing one principal/main pedicle and 2 Accessory pedicle.



**Fig. 4:** Showing One Principal/main pedicle and 3 Accessory Pedicles.



**Fig. 5:** Showing One Principal /Main pedicle and 4 Accessory Pedicle.



which the proximal pedicle is considered as the principal or the main pedicle and provides nutrition to the upper two thirds of the muscle. The accessory pedicle, if present they are seen mainly in the lower two thirds of the muscle. Occasionally a small minor accessory pedicle that is proximal to the main or principal pedicle may be present which is known as proximal accessory pedicle [3]. The dominant pedicle originates from the artery for adductors in 46% and 73% respectively [4,5]. The vessels normally entered the deep surface of the muscle through the anterior border. Majority of the muscle had one principal/ main pedicle and one accessory pedicle and belonged to Type-B of [6] classification. The source of principal pedicle observed in our study is similar to the observations seen in study [7]. The source of these arteries is not always constant but varies from one population to another.

**Table 2:** Showing Number of Pedicles. (Fig.-2,3,4,5)

Number of Pedicles	Percentage
Principal (Main) + 1 accessory pedicle	75.0% (27)
Principal + 2 accessory pedicle	16.6% (6)
Principal + 3 accessory pedicle	2.7% (1)
Principal + 4 accessory pedicle	5.5% (2)

Muscle grafts are frequently needed in reconstructive surgery anywhere in the body. Many surgeons prefer gracilis muscle for transplant as it fulfills the necessary criteria and the donor morbidity is less [8].

**Table 3:** Showing Entrypoint of Pedicles.

Pedicles	Distance from the pubic tubercle
Principal Pedicle	10.5±2 cms
1 <sup>st</sup> accessory pedicle	22±1.5 cms
2 <sup>nd</sup> accessory pedicle	28±1.5 cms
3 <sup>rd</sup> accessory pedicle	30±1.5 cms
4 <sup>th</sup> accessory pedicle	36±1.5 cms

Gracilis being a slender muscle is the surgeons first choice for foot and ankle reconstruction and in the treatment of chronic osteomyelitis as it adequately fill the small defect created by the debridement[9].

**Table 4:** Showing origin of the Pedicles.

Pedicles	Source of the pedicle					
	MCFA	PFA	OA	FA	DGA	SA
Principal Pedicle	55%	33.30%	6.15%	5.55%		
1 <sup>st</sup> accessory pedicle	-	16.70%	-	83.30%		
2 <sup>nd</sup> accessory pedicle		5.50%		11.10%		
3 <sup>rd</sup> accessory pedicle					2.70%	
4 <sup>th</sup> accessory pedicle						5.50%

**Table 5:** Shows comparison of the Mean length & width.

Authors	Methodology	Mean Length	Mean width
AJ.Hussey et al 2007 [10]	Dissection & Radiology	38.4 cm	6.2 cm
Machii.V et al 2008 [11]	CT Angiography	41±2.1 cm	44±1 mm
Harbans Singh 2011 [12]	Dissection	43±2.08 cm (M) 37.1±0.76 cm (F)	-
Present study	Dissection	42.2±2 cm	3.9±0.5 cm

## DISCUSSION

Gracilis muscle derives its vascular supply from a wide range of arteries. The number of pedicles to the muscle ranges from one to five, out of

**Table 6:** Shows comparison of the entry point of principal pedicle taken from pubic tubercle.

Authors	Methodology	Entry point of Principal Pedicle
AJ.Hussey et al 2007 [10]	Dissection & Radiology	9.4cm
Machii.V et al 2008 [11]	CT Angiography	10±1.3cm
Iain.S.Whitaker 2012 [3]	Dissection & Contrast Radiograph	10±2cm
Dorothee .C. 2006 [13]	Dissection & Contrast Radiography	9.28 cm
Present study	Dissection	10.5±2cm

**Table 7:** Shows comparison of Presence of Principal (Main) and Accessory pedicle.

	Xia ochun et al 2012 [6]	Present study
Methodology	Contrast Radiograph	Dissection
Single principal Pedicle	8.30%	-
One principal + 1 accessory. P	41.70%	75.00%
One principal + 2 accessory. P	33.30%	16.60%
One principal + 3 accessory. P	16.70%	2.90%
One principal + 4 accessory. P	-	5.50%

**Table 8:** Shows comparison of source of Principal (Main) vessel/Pedicle.

Source	PFA	A.A	MCFA	FA	
Iain.s.whitaker et al 2012 [3]	70%				
Machii.V et al 2008 [11]	45%	46%	9%	-	
Xiaochun et al 2012 [6]	54.20%	33.30%	12.50%		
Singh et al 2011 [12]	70%		30%		
Jurisc et al 1993 [5]		73%	19.20%		7.7% Dual
Dorothee et al 2006 [13]	-	81.25%	-		
Present study	33.30%	6.15%	55.00%	5.50%	

## CONCLUSION

Though previous and present studies report on the number of vascular pedicles, no two individuals are similar in their anatomical structures. Considering the factors from the present study the average length of the gracilis muscle is 42cm and the number of vascular pedicles range from one to four. A constant neurovascular pedicle is present in the proximal one third of the muscle which can be utilised for all muscle transplantation surgeries since both the nerve and the artery traverse together to enter the deep surface of the muscle through its anterior border.

## ABBREVIATIONS

**MCFA** - Medial Circumflex Femoral Artery

**PFA** - Profunda Femoris Artery

**OA** - Obturator Artery

**FA** - Femoral Artery

**AA** - Adductor Artery

**DGA** - Descending Genicular Artery

**SA** - Saphenous Artery

**Conflicts of Interests: None**

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