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Original Research Article

Morphology and Morphometrical Studies of Sartorial Vascular Pedicles, Perfusion and its Clinical Implications

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ABSTRACT

Background
The sartorius is a muscle of lower limb thigh with variant morphological distribution of blood supply. The detailed knowledge vascular patterns of the muscle and overlying skin is an absolute guide in reconstructive surgery. In this study the vascular pattern is analyzed by dissection method both in sartorius and overlying skin.

Methods
50 sartorius muscles and the circumferential skin of the thigh were dissected from 25 cadavers. Anatomical morphology and Morphometrical parameters, such as pedicle number, location, diameter, and length, are recorded using vernier callipers. Thread method was used to measure the length of muscle supplied by a single pedicle which is defined as a major pedicle. Lastly, the area of cutaneous territory of each major pedicle was calculated.

Results
The sartorius muscle is supplied by 5 to 8 vascular pedicles. The major pedicles are proximal 20 to 28 cms from ASIS size around 2cms Distal major pedicle 32 to 40 cms from ASIS size around 2mm.

Conclusion
This vascular anatomical pattern study is a guideline in freeflap surgeries of sartorius muscle during transposition with the pedical of the sartorius muscle.

Keywords: Morphology, Morphometrical, Sartorial Vascular Pedicles, Anatomical Variations, Clinical Implications, Surgical Planning, Reconstructive Surgery.

INTRODUCTION

Reconstructive surgeries are based on the vascularity of an particular region.[1] Knowledge of myocutaneous flaps which are composed of skin and related muscle and the variating dominant

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vascular pedicals is absolutely essential in the regional reconstructive flap surgery.[2] Sartorius muscle is an classic example for harvesting in the reconstructive surgeries around the upper and lower thigh region. The sartorius muscle is limited from the Anterior superior iliac spine (ASIS) to pes anserinus which is the broad conjoined tendon of insertion of the sartorius, gracilis and semitendinosus muscles on medial surface of the proximal tibia. It receives variating blood supply in its upper - middle and the lower segments. The proximal third receive its vascular supply from branches of the femoral, deep femoral, lateral circumflex femoral arteries and/or artery of quadriceps (branch of either the femoral, deep femoral, or lateral circumflex femoral artery). The middle third is supplied by branches of the femoral artery. The distal third receives blood supply from the femoral artery and descending genicular artery. All the three segments of sartorius is supplied by the above arteries through the pedicles which are classified into major and minor pedicles. As the sartorius is receives variating segmental blood supply, hence the knowledge of the blood perfusion through the pedicles into the portion of the muscular segment is required to plan the reconstructive surgeries in the upper and the lower region of the thigh. The appropriate use of segmental movement of the flap is planned based on the pedicular perfusion knowledge.

AIM

To study the anatomical architecture of the vascular pedicals sartorius muscle and apply its knowledge in flap for coverage of the surgeries of the thigh, popliteal and upper one-third leg region.

1. To determine the Location of sartorial pedicals in the cadavers and its flap surgical applications.
2. To determine the area of the sartorial mass perfused by the major pedicles for application of its knowledge in Flap surgeries.

MATERIAL AND METHODS

Sample Size

50 lower limbs from 25 donated cadavers out of which 25 right side and 25 left side.

Setting

Dissection theatre, department of Anatomy SABVMCRI, Bengaluru.

Materials

1. Cadavers, dissection set, measuring tape, thread, scale, eosin, Indian ink, Green ink, Auto Pressured syringe, needle, tags.

Procedure

The side and the sample were taged with numbers and a clear dissection of the sartorius and the pedicles is performed.[3] The length of the sartorius from ASIS to pes anserinus was measured with a thread and calculated the values by keping on the measuring tape.

The pedicles were dissected and calculated and classified as major and minor pedicles. The major pedicles were further classified as upper segment major pedicle (USMP), lower segment major pedicle (LSMP) were identified and its numbers were noted. The number of minor pedicles were noted.

The measurement of the width of sartorius was noted and area of the muscular mass were calculated.[4] Through the lumen of the USMP Eosin was injected with auto pressured syringe and needle and through the LSMP Indian ink was injected till the colouration was obtained. Distance from ASIS to the point of colouration of eosin on the sartorius was noted and the muscle

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mass supplied USMP was calculated and the colouration for Indian ink measurements was noted for the calculation of the muscle mass. The above procedure was done for all the 50 specimens and all the parameters were taken for the statistical analysis.

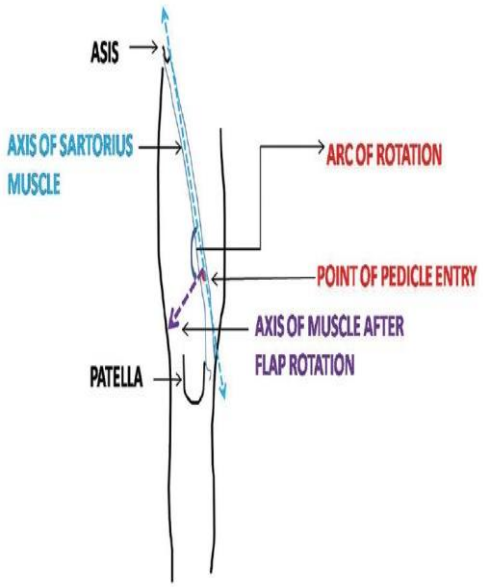

Figure 1: Origin of Sartorius muscle

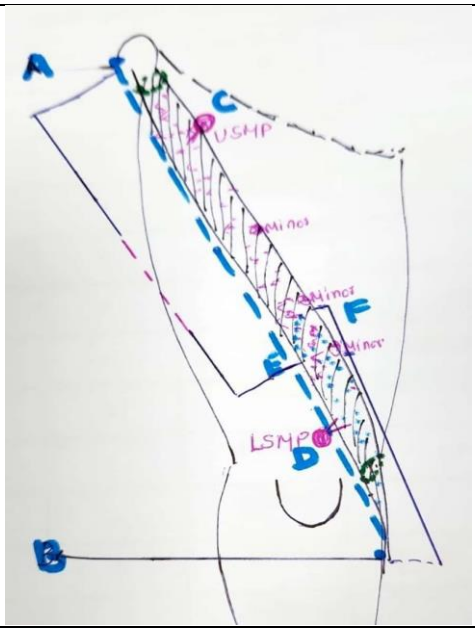

Figure 2: Parameters taken for calculation

Parameters taken for calculation

1. Length of sartorius -A TO B
2. Number of Major pedicles
3. Number of Minor pedicles
4. Length of the sartorius supplied by Upper pedicle (USMP)

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(Eosin) (A-E)

5. Length of the sartorius supplied by

Lower pedicle(LSMP) Indian ink (B-F)

6. Radius of Muscle at Upper end
7. Radius of muscle at lower end
8. Mass of the muscle supplied by USMP
9. Mass of the muscle supplied by LSMP $(2\pi rh+2\pi r2)$

RESULTS

Sl. no	Sartorius parameters	Right	Left	Difference
1	Mean Length of sartorius	47.024	46.78	0.2
2	No of Major Pedicle	2	2	0.0
3	No of Minor Pedicle	3.4	3.4	0.0
4	Mean total mass of sartorius	800.3	796.4	3.9
5	Mean Area mass supplied by USMP	471.2	473.400	-2.2
6	Area mass supplied LSMP	370.4	364.3	6.1
7	% of sartorius supplied by USMP	58.9	59.4	-0.6
8	% of sartorius supplied by LSMP	46.3	45.7	0.5

Table 1: Right and left Sartorial muscle parameters and difference

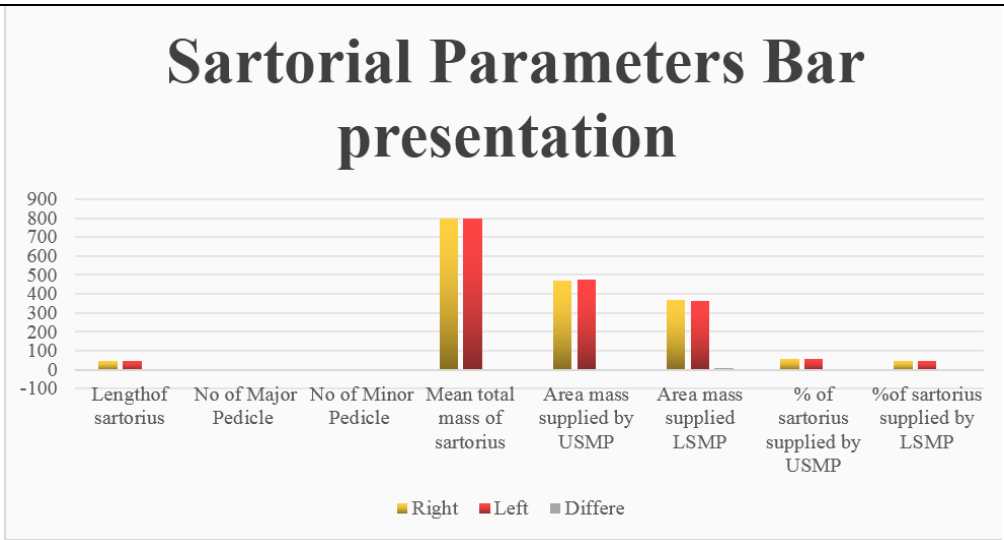

Figure 3

Left Sartorius total number -25		Right Sartorius total number -25	
No. of cadavers	**No. of pedicles**	**No. of cadavers**	**No. of pedicles**
15	**5=60%**	**15**	**5=60%**
7	**6=28%**	**7**	**6=28%**

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2	**7=8%**	**2**	**7=8%**
1	**4=4%**	**1**	**4=4%**

Table 2: Average Pedicels IN Left & Right

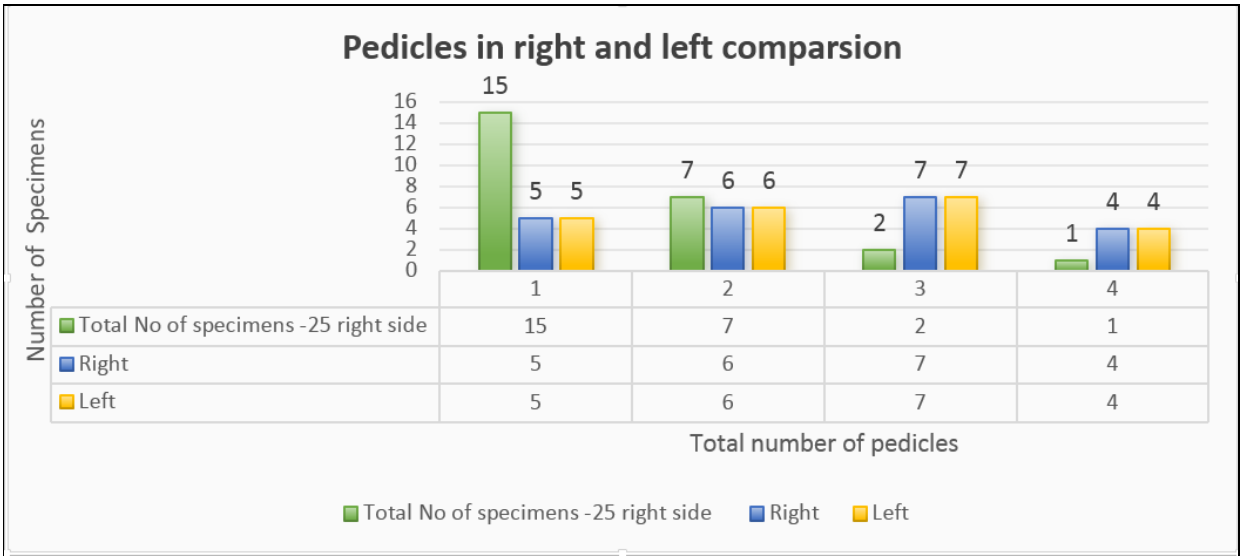

Figure 4

- Variation in number of pedicles in right and left side is not significant

DISCUSSION

According to Kaiser et al in 1984,[5] out of dissections of 40 specimen the sartorius is supplied by 2-4 arteries, which originate from the middle and distal third of the femoral artery. As a result of the dissections they stated that the sartorius receives an adequate supply, when only the proximal or distal artery remains intact. Which supports the finding that the sartorius is suitable as a proximally or distally based flap surgery. Our studies also supports the finding that all the 50 specimens were presented with a proximal and distal artery.

In 1989 Meyer JP et al[6] has concluded that effective soft tissue coverage and salvage of exposed infrainguinal vein bypass grafts can be accomplished in selected cases by means of sartorius muscle rotation-transfer because of the rich perfusional pedicular anastomosis. In our studies the mean of perfused sartorial by upper major pedicle is 555cm^2 of upper segment which serves rich perfusional pedicular anastomosis.

In 1996 J Wysocki et al[7] described the vascularization of the 60 sartorius muscle from cadavers of both sexes of age from 17 to 69 years. The muscle receives 5 to 11 vessels originating from: superficial circumflex iliac, lateral femoral, deep femoral, descending geniculate, and femoral arteries. The vessels extend irregularly anastamosing along the muscle. The pattern of blood supply to the sartorius muscle is usually segmental.In our studies the mean vascularization was 5.5 pedicles which were anastamosing segmentally.

Yang D, Morris SF, Sigurdson L.[4] The sartorius muscle: Anatomic considerations for reconstructive surgeons. Surg Radiol Anat. 1998. In 1998 Yang D et al dissected 42 sartorius muscle, and studied the neurovascular hilum and branching patterns of the vessels by injecting lead oxide, gelatin and water under radiographic technique. In our studies we have injected the different dyes after dissection and ligation of femoral arteries and the pedicular stem with pressured technique. Both the results showed that the arterial branches run parallel to each other and to the muscle fibers. Hence both the studies conclude that it is possible to subdivide the muscle into functional units to harvest a segmental muscle flap.

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Buckland A, Pan WR, Dhar S, Edwards G, Rozen WM, Ashton MW, et al.[8] Neurovascular anatomy of sartorius muscle flaps: Implications for local transposition and facial reanimation. Plast Reconstr Surg 2009.

In 2009, Buckland A et al studied 55 human cadaveric sartorius muscles and 30 canine cadaveric sartorius muscles by angiographic and dissection method, which describes that sartorius receives mean 6 to 7 pedicles whereas in our studies mean 5.5 pedicles i.e., between 5 to 6 pedicles.

Year of Publication Authors	Discussion of the author	Discussion of the present study
1984 Kaiser et al	• sartorius receives an adequate supply, • The proximal or distal artery remains intact. • Hence proximally or distally based flap surgery • are selected from sartorius	• In Our studies the finding corresponds. • In all 50 specimens with a proximal and distal pedicles were present • Hence,sartorius is selected for flap surgergy
1989 Meyer JP et al	• sartorius muscle rotation-transfer is possible • because of the rich perfusional pedicular anastomosis.	• In our study the mean perfusion of sartorius mass by USMP is 471cm2 • The lower mass of sartorius perfusion by the LSMP is 370.4 cm2. • This supports the authour studies as rich pedicular anastomosis.
1996 J Wysocki et al	• The muscle receives 5 to 11 vessels originating from: superficial circumflex iliac, lateral femoral, deep femoral, descending geniculate, and femoral arteries. • The vessels extend irregularly anastamosing along the muscle. The pattern of blood supply to the sartorius muscle is usually segmental.	• In our studies the results supports by calculation significance. • That mean vascularization was 5.5 pedicles which were anastamosing segmentally.
1998 Yang D et al	The authour studied the • neurovascular hilum • branching patterns of the sartorius • vessels • by injecting lead oxide, gelatin and water under radiographic technique.	In our studies we have • injected the different dyes after dissection and ligation of femoral arteries and the pedicular stem with pressured technique. • Both the results showed that the arterial branches run parallel to each other and to the muscle fibers. • Hence both the studies conclude that it is possible to subdivide the muscle into functional units to harvest a segmental muscle flap .
2009 Buckland A et al	The authours studied 55 human cadaveric sartorius muscles and 30 canine cadaveric sartorius muscles by angiographic and dissection method, which describes that sartorius receives mean 6 to 7 pedicles and the total mass perfusion is 810 cm2 out of which is upper segment mass is 490 cm2 supplied by USMP and lower segment mass is 320 cm2 supplied by LSMP	• In our studies the mean pedicular value is between 5 to 6 pedicles which is one pedicle less on an average of the 50 specimens. • The total mass perfusion is 800 cm2 out of which is upper segment mass is 470 cm2 supplied by USMP and lower segment mass is 370 cm2 supplied by LSMP

CONCLUSION

Sartorius has a rich source of not only segmental blood supply but also relevant pedicular architecture with specificity of proximal and distal pedicles which makes the muscle a perfect component for harvesting in the Flap surgeries. An anatomical knowledge of sartorial pedicular distancing is a guideline to plan any harvesting procedures in flap surgeries.

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