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A fascial canal for the great saphenous vein: gross and microanatomical observations

N. J. PAPADOPOULOS*, M. F. SHERIF AND E. N. ALBERT

Department of Anatomy, Athens University School of Medicine, Athens, Greece and Department of Anatomy, The George Washington University Medical Center, Washington, D.C., U.S.A.

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INTRODUCTION

A fascial canal for the great saphenous vein has not as yet been fully described. The majority of classical anatomical textbooks and most surgical anatomical studies pertaining to the great saphenous vein (Tandler, 1926; Bleicher & Weber, 1932; Testut & Latarjet, 1948; Paturet, 1951; Depreux & Herlemont, 1958; Bruce, Walmsley & Ross, 1964; Sargeant, 1964; Astudillo, 1965; Warwick & Williams, 1973; DuPlessis, 1975) make no mention of such a canal. In only a few papers (Sherman, 1949, 1964; Anson & McVay, 1971) is mention made that part of the great saphenous vein in its course is covered by a 'lamina' derived from the superficial or deep fascia. Recently, Thomson (1979) noted that, "it is not generally realised the enclosure of the vein within a fibrous sheath (slender fascial compartment, according to Dodd & Cockett, 1976) lying almost invariably on the deep fascia."

This investigation was undertaken in order to confirm the presence of such a fascial canal, to study its anatomical arrangement and microscopical appearance and appreciate its possible role in the pathogenesis of varicosities of the great saphenous vein.

MATERIAL AND METHODS

The great saphenous veins of both lower limbs were dissected in 30 embalmed human cadavers (19 male and 11 female) in the Department of Anatomy, Athens University School of Medicine. In 10 of these cadavers the course of the vein and its relationship to the deep fascia was accurately defined by ligating it antero-superiorly to the medial malleolus and at the saphenofemoral junction and thereafter injecting the ligated portion with a coloured plastic chemical compound. This consisted of a combination of epoxy-resin ('Epikote 828' of Shell) and 8% triaethylentetramine. This compound infuses easily, when heated at 40 °–50 °C, and solidifies rapidly within the vessels.

In all the limbs, accurate anatomical dissection and definition of the great saphenous vein throughout its course was performed. In the majority of cases a part of the vein, along its course, was enclosed within a fascial canal apparently derived from the deep fascia of the lower limb (fascia lata in the thigh and crural fascia in the leg), continuous from the leg to the thigh. In contrast, all tributaries of the vein were outside the fascial canal, except their terminal parts (Figs. 1–3). The length of this

* Present address: Department of Anatomy, The George Washington University Medical Center, 2300 Eye Str. N.W., Washington, D.C., 20037.

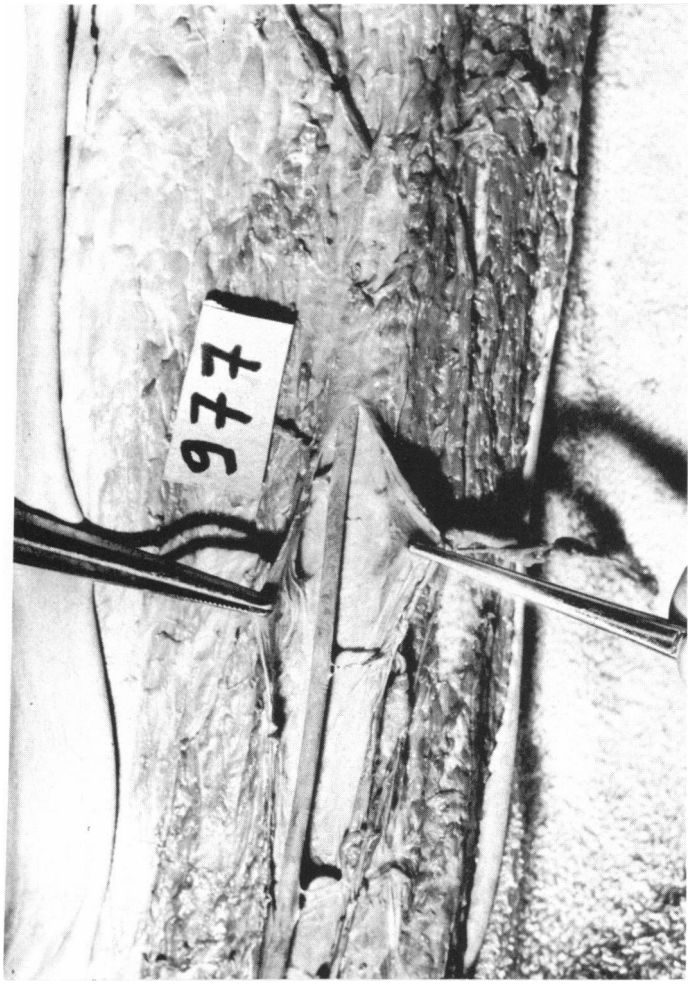

Fig. 1. The fascial canal for the great saphenous vein partly opened longitudinally at the junction between leg and thigh.

fascial canal, whenever present, and its length relative to that of the great saphenous vein was measured and the extent and site of the canal itself accurately defined.

Ten more great saphenous veins were obtained from fresh cadavers in the Department of Anatomy, The George Washington University Medical Center. These veins were dissected carefully, together with their sheaths intact, fixed in 10% buffered formalin, double embedded in celloidin–paraffin and transversely sectioned at 40μm. The sections were treated according to the fast green modification of the Van Gieson staining procedure (Lillie, 1965).

RESULTS

I. *Length of the great saphenous vein*

This length was measured between two points of surgical importance, i.e. from the upper ridge of the medial malleolus to the saphenofemoral junction. This junction, as mentioned by Basmajian (1952) and Mavor & Galloway (1967), is an accurately

Fig. 2. The great saphenous vein and its fascial canal opened longitudinally.

defined point 3 to 4 cm below the middle of the inguinal ligament and 1·7 cm lateral to the pubic tubercle. As an intermediate bony reference point, the easily palpable medial femoral epicondyle was used.

I (*a*). *Length of the great saphenous vein in the leg.* This length ranged between 31 and 37 cm, having a mean of 34·5 cm (34·9 cm in males and 33·8 in females).

I (*b*). *Length of the great saphenous vein in the thigh.* This length ranged between 30 and 37 cm, having a mean of 34·0 cm (34·6 cm in males and 33·2 in females).

I (*c*). *Total length of the great saphenous vein.* This length ranged between 61 and 74 cm, having a mean of 68·6 cm (69·5 cm in males and 67·1 in females).

II. *Features of the fascial canal for the great saphenous vein*

The canal of the great saphenous vein, when present, was continuous from leg to thigh, but in no case did it surround the whole length of the vein. Thus, its initial part, from medial malleolus proximally, and its terminal part, proximal to the saphenofemoral junction, were always outside the fascial canal.

The structure of this covering, macroscopically, consisted of filaments of deep

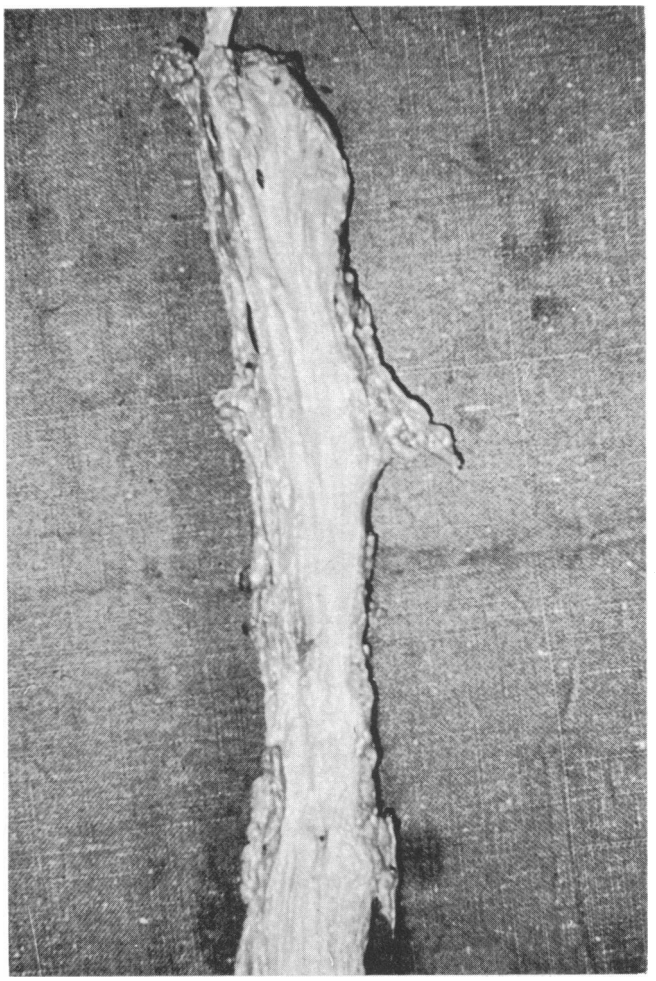

Fig. 3. The fascial canal. Posterior view.

fascia of different length, direction and thickness which interlaced so that in some cases the canal had small fissures, sometimes filled by adipose connective tissue.

Examination of the histological cross sections (Figs. 4, 5) revealed the presence of two fascial laminae surrounding the great saphenous vein, thus enclosing it within a fascial sheath. The posterior (deep) lamina represented the deep fascia itself while the anterior (superficial) lamina was derived from the former. It was found that another and thinner layer, derived from the deep fascia, was reflected at the margin of the sheath on to the deep surface of the anterior lamina and became continuous with it. By this means, the great saphenous vein was surrounded by a fascial sleeve fully differentiated from the adventitia. Some perivascular adipose tissue was contained within the sheath and was divided into loculi by thin fascial septa derived from the internal surface of the sheath. However, it was found that there were some deficient parts in the wall of the sheath through which tributaries of the saphenous vein entered and where continuity between the perivascular and the subcutaneous adipose tissue was established.

II (*a*). *Frequency of occurrence of the fascial canal.* In 51 of the 60 lower limbs

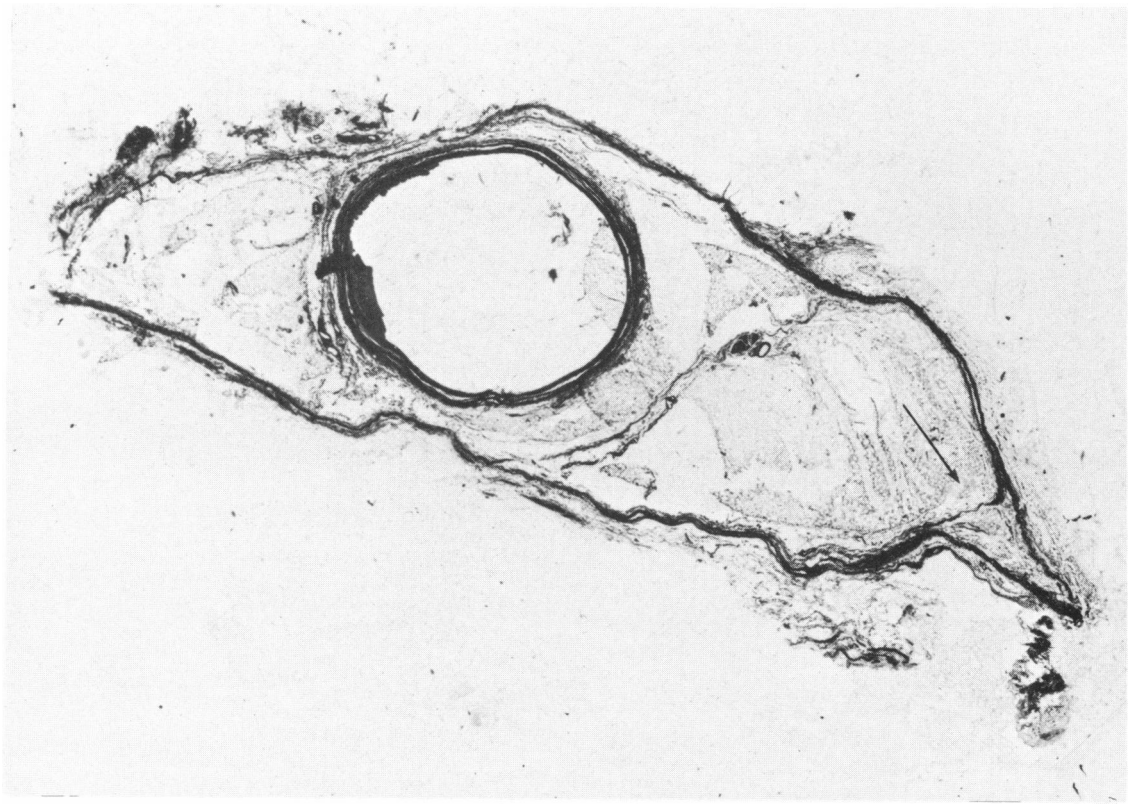

Fig. 4. Cross section of the great saphenous vein within its fascial sleeve at the upper quarter of the leg. Two fascial laminae surround the vein. The posterior lamina (bottom of the picture) is the deep fascia itself, while the anterior lamina derives from it. A thinner layer (arrow) derived from the deep fascia is reflected onto the inner surface of the anterior lamina. Fast green modification of Van Gieson stain. × 4.

examined, that is in 85 % of the cases, a fascial canal of variable length was found surrounding the great saphenous vein. The canal extended from the leg to the thigh in 58·3 % of the cases; it was restricted to the leg in 3·3 % and to the thigh in 23·3 % of the cases. Stated differently, the frequency of occurrence of the fascial canal in the thigh was 81·7 % and in the leg 61·7 %.

II (*b*). *Absolute and relative length of the fascial canal.* The length of the fascial canal was measured separately in the leg and the thigh and subsequently in its whole course and related to the corresponding lengths of the great saphenous vein. The results are summarised in Table 1.

II (*c*). *Site of the fascial canal.* By further analysis of the relative lengths of the fascial canal, its frequency of distribution in relation to quarters (fourths) of the great saphenous vein in the *leg*, the *thigh* and the *whole lower limb* may be determined (Tables 2, 3; Fig. 6). Thus: (*a*) relative length '0 (zero)' means absence of the fascial canal in the leg (38·3 %), in the thigh (18·3 %), or throughout the whole length of the great saphenous vein (15 %); (*b*) relative length '0·01 to 0·25' means fascial canal

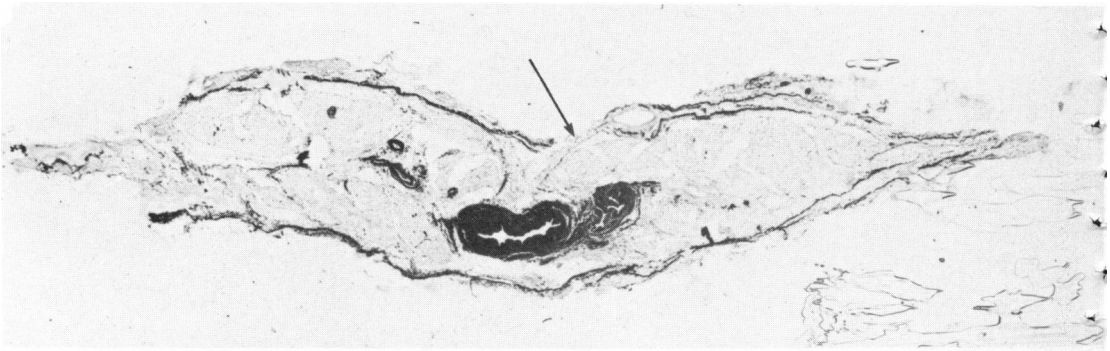

Fig. 5. Cross section of the great saphenous vein within its fascial sleeve in the lower thigh. Two fascial laminae surround the vein and one of its tributaries. The posterior layer (bottom of the picture) is the deep fascia itself. The anterior layer is partly deficient (arrow). Septa within the sheath separate the perivascular fat into loculi. Fast green modification of Van Gieson stain. ×4.

Table 1. *Absolute and relative length of the fascial canal*

Site of the fascial canal	Right lower limb		Left lower limb		Total of limbs	
	absolute in cm	relative	absolute in cm	relative	absolute in cm	relative
Thigh	5–32 (16·88)*	0·15–0·88 (0·49)*	8–30 (16·60)	0·23–0·81 (0·48)	5–32 (16·76)	0·15–0·88 (0·49)
Leg	4–20 (8·85)	0·11–0·59 (0·25)	5–20 (10·11)	0·11–0·54 (0·29)	4–20 (9·46)	0·11–0·59 (0·27)
Lower limb	5–42 (23·34)	0·07–0·61 (0·33)	5–40 (22·56)	0·07–0·59 (0·33)	5–42 (22·96)	0·07–0·61 (0·33)

* The mean value in brackets.

Table 2. *Frequency of distribution of the fascial canal*

Relative length	Right lower limb		Left lower limb		No. of lower limbs	
	No. of limbs	%	No. of limbs	%	No. of limbs	%
Thigh 0	4	13·3	7	23·3	11	18·3
0·01–0·25	2	6·6	1	3·3	3	5·0
0·26–0·50	11	36·6	12	40·0	23	38·3
0·51–0·75	12	40·0	9	30·0	21	35·0
0·76–1·00	1	3·3	1	3·3	2	3·3
Leg 0	11	36·6	12	40·0	23	38·3
0·01–0·25	11	36·6	8	26·6	19	31·6
0·26–0·50	7	23·3	9	30·0	16	26·7
0·51–0·75	1	3·3	1	3·3	2	3·3
0·76–1·00	—	—	—	—	—	—

restricted to a part or the whole of the upper quarter only of the vein in the leg (31·6 %), or of the lower quarter only of the vein in the thigh (5 %), or covering up to one fourth of the total length of the great saphenous vein (30·0 %); (*c*) relative length '0·26 to 0·50' means fascial canal restricted to the upper half of the vein in the leg (26·7 %), or to the lower half of the vein in the thigh (38·3 %), or covering more than

Table 3. *Frequency of distribution of the fascial canal (total length of great saphenous vein)*

	Right lower limb		Left lower limb		No. of lower limbs	
Relative length	No. of limbs	%	No. of limbs	%	No. of limbs	%
0	4	13·3	5	16·6	9	15
0·01–0·25	7	23·3	11	36·7	18	30
0·26–0·50	17	56·7	10	33·3	27	45
0·51–0·75	2	6·7	4	13·3	6	10
0·76–1·00	—	—	—	—	—	—

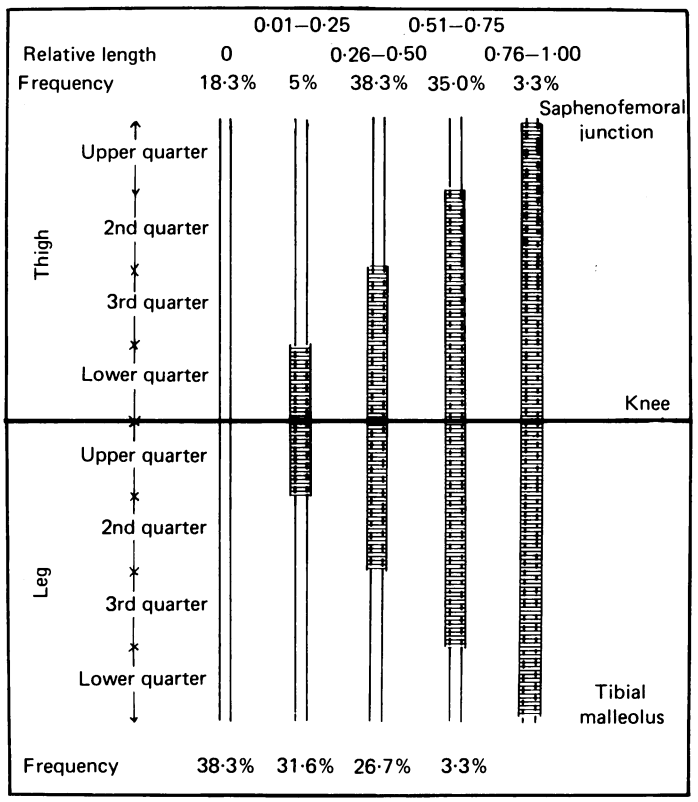

Fig. 6. Schematic representation of the distribution of the fascial canal per quarter of the vein in the leg and the thigh. The white column represents the great saphenous vein and the shadowed one the relative length of the fascial canal. The thick horizontal line represents the transverse plane through the medial femoral epicondyle.

one fourth up to one half of the total length of the great saphenous vein (45%); (*d*) relative length '0·51 to 0·75' means fascial canal restricted to the upper three quarters of the vein in the leg (3·3%), or to the lower three quarters of the vein in the thigh (35·0%), or surrounding more than one half and up to three quarters of the total length of the great saphenous vein (10.0 %); (*e*) relative length 'greater than 0·75 (actually up to 0·88)', means fascial canal which, found only in the thigh (3·3%), surrounded the three lower quarters of the vein plus the corresponding part of the upper quarter of the vein in the thigh.

DISCUSSION

A course of the great saphenous vein within a fascial compartment derived from the deep fascia of the lower limb is not mentioned in any classical textbook of anatomy nor has it been studied separately and in detail. Previous workers (Sherman, 1949, 1964; Anson & McVay, 1971) mentioned only that a part, not defined, of the great saphenous vein is covered by a 'lamina' derived from a thickening of the superficial or deep fascia of the lower limb, whereas Thomson (1979) found the great saphenous vein enclosed in a loose compartment of fat and areolar tissue by a thin, glistening sheet of transversely disposed fibrous tissue arching over it from the deep fascia on either side.

From the present study, which largely confirms the above findings, it is assumed that the great saphenous vein runs throughout its length in the superficial tissues in only 15% of the cases studied. In 85% of the cases, however, a part of the vein, of different lengths, was seen by the naked eye to be surrounded by a fascial canal apparently derived from the deep fascia of the lower limb. This thin, but, in most of the cases, well formed covering is continuous from leg to thigh; but it diminishes somewhat abruptly and vanishes in the loose areolar tissue of the lower leg and the upper thigh. At these sites the great saphenous vein always courses in the superficial tissues. This fascial canal for the great saphenous vein differs topographically from the fascial canal for the small saphenous vein, described by Moosman & Hartwell (1964) and by Shah & Srivastava (1966), in that the latter is subfascial.

The fascial canal for the great saphenous vein is almost always absent along the upper quarter of the vein in the thigh (96·7%), and always absent in the lower quarter of the vein in the leg (100%). Elsewhere in the thigh the vein courses in the canal in its lower quarter in 81·6%, in its lower half in 76·6%, in its lower three quarters in 38·3% and, moreover, in a part of its upper quarter in 3·3% of the cases.

In the leg the vein courses in the canal in its upper quarter in 61·6%, in its upper half in 30·0% and in its upper three quarters in 3·3% of the cases.

In the lower limb as a whole a fascial canal was not found in 15% or was restricted to one fourth of the length of the vein in 30% of the cases. A fascial canal covered up to half of the vein in 45% or up to three quarters of the vein in 10% of the cases. It is obvious that in addition to the 15% of the cases examined that lacked a fascial canal, in the remaining cases more than one fourth of the vein lacked a fascial canal. In the authors' opinion the length and site of the fascial canal may influence the haemodynamics of the great saphenous vein.

It should be noted that the relative length of the fascial canal is greater in the thigh than in the leg in a proportion of approximately 2:1 (0·49:0·27 for the mean relative lengths). In relation to the mean values of Table 1, the fascial canal surrounds approximately one third (0·33) of the total length of the vein, approximately half of its length in the thigh and approximately one quarter of its length in the leg. Consequently, and as there was no statistical difference between the two sexes and the two limbs, it has been concluded that the great saphenous vein in the thigh is in a greater proportion and over a greater length covered and protected by its fascial sheath. This fascial canal gives to the wall of the vein more resistance to the hydrostatic pressure of the blood, so that its greater length within the canal might reduce the possibility of development of varicosities of the vein, especially if no other factors, such as incompetent valves or deep thrombosis, were present.

CONCLUSION

The length and the site of the fascial canal for the great saphenous vein may influence the haemodynamics and the resistance of the vein to the hydrostatic pressure of the blood. Its absence in 15% of the cases or its short length (only up to one fourth of the length of the vein), especially below the knee, might be an additional aetiologic or aggravating factor in the pathogenesis of varicosities of the great saphenous vein and of their complications.

SUMMARY

The course of the great saphenous vein in a fascial canal derived from the deep fascia of the lower extremity is described. The fascial canal is absent in 15% of the cases. In 85% of the cases, the sheath surrounding the great saphenous vein is continuous from the thigh to the leg and supports the vein from the hydrostatic pressure of the blood, being absent only in the uppermost and the lowermost quarters of the vein in the thigh and the leg, respectively. Thus, up to one quarter of the vein is ensheathed in 30%, up to one half in 45% and up to three quarters in 10% of the cases studied.

The absence of this fascial envelope of the vein, in whole or in part, may be involved in the pathogenesis or the complications of the varicosities of the great saphenous vein along with the well-known aggravating factors.

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