

A Proposal for Classification of Ultrasonographic Anatomy of Saphenous Fascia

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Abstract

Objective: The aim of this retrospective study is to reveal the anatomical variations of the saphenous fascia and the relationship between vena saphena magna and saphenous fascia.

Methods: 123 patients who had venous insufficiency symptoms were evaluated retrospectively. Gray scale ultrasonography (US) with colour Doppler and spectral analysis is used for detecting anatomy. The lower limb is divided into five Regions. In all Regions the anatomy of the saphenous fascia and the relationship between the fascia and saphenous vein (inside the fascia or outside the fascia) is detected.

Results: Saphenous fascia is found in two different anatomical patterns: interrupted and continuous. The five Regions of the lower limb have different anatomical patterns of saphenous fascia. It was found that there was a significant relation between the uninterrupted formation of fascia and the presence of saphen vein in the saphenous fascia.

Conclusion: We propose that vena saphena magna has two different anatomical patterns. The saphen vein usually runs in the fascia in the Regions where saphenous fascia is continuous.

Introduction

We mostly use gray scale ultrasonography (US) for detecting anatomy gray scale US with colour Doppler and spectral analysis for the diagnosis of saphen vein insufficiency. Diagnosis of the insufficiency is the first step of the treatment so anatomic knowledge of long saphenous vein (VSM) is essential to improve the diagnosis and treatment of saphenous insufficiency.

One of the most important anatomic landmarks for saphen vein is the saphenous fascia [1]. It helps us to discriminate the large tributary veins ascending along a parallel path [2]. So it is important to understand the anatomy and variations of the fascia.

Saphenous eye sign is formed by two fascias, the muscular fascia and the saphenous fascia. The muscular fascia which forms the deep part of the saphenous eye surrounds the leg and calf muscles. Also, it is a landmark for separation of the superficial and deep compartments. The saphenous fascia is the membranous layer of the subcutaneous tissue which overlies the saphenous vein. Two fascias merge together and form a closed space. The two fascias and saphen vein in the middle form the Egyptian eye or ultrasonographic eye sign (Figure 1). But in some patients we don't see any Egyptian eye sign. The subcutaneous layer is not continuous at every part of the leg (Figure 2). The aim of this study is to assess the fascial anatomy and variations of the fascia of the VSM.

This is the first study about the saphenous fascia, and we propose a classification for the anatomic variations of the fascia. Also anatomy of the saphen vein, relationships of VSM and saphenous fascia are described in detail.

Methods

Patients

In a period of six months 246 limbs of 123 consecutive patients who had venous insufficiency symptoms of the leg were evaluated retrospectively. All patients were older than 18 years of age. They all applied to our clinic with venous insufficiency symptoms.

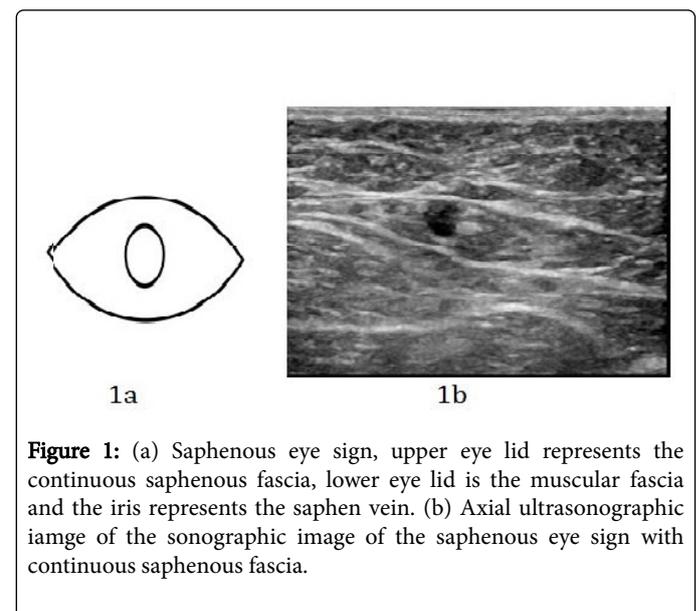


Figure 1: (a) Saphenous eye sign, upper eye lid represents the continuous saphenous fascia, lower eye lid is the muscular fascia and the iris represents the saphen vein. (b) Axial ultrasonographic image of the sonographic image of the saphenous eye sign with continuous saphenous fascia.

During the doppler ultrasound examination for venous insufficiency, we noted the relationship of vena saphena magna with the fascia and we examined the anatomy of the saphen vein to deliver a more accurate therapy. 21 patients who had superficial or deep vein thrombosis, vascular malformations, previous varicose vein treatment, trauma or surgery were excluded. Because the veins could be damaged and it would not be possible to detect the anatomy.

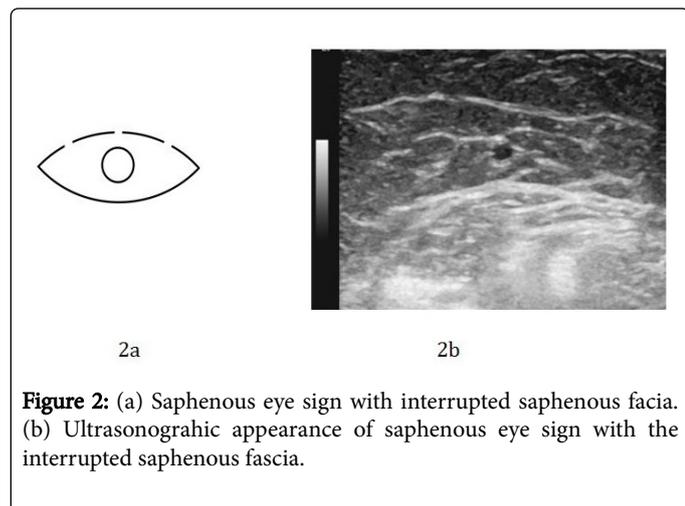


Figure 2: (a) Saphenous eye sign with interrupted saphenous fascia. (b) Ultrasonographic appearance of saphenous eye sign with the interrupted saphenous fascia.

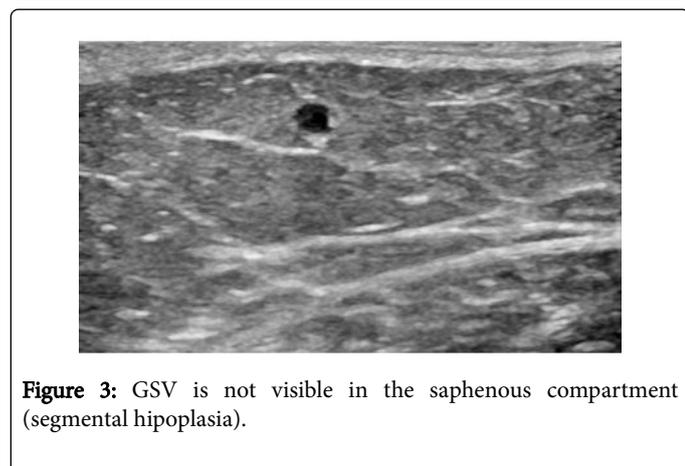


Figure 3: GSV is not visible in the saphenous compartment (segmental hipoplasia).

The classification was designed by the author following analysis of 150 duplex US examinations for the lower extremity veins within a year. All subjects were investigated by using duplex US (Logic E9 XDclear 2.0, GE healthcare, US) using 9-MHz or 13 Mhz multifrequency transducers if not the patient was very obese. All the examinations were performed by the same radiologist (I.Y). Whole course of saphen vein in both lower extremities were detected by using gray scale and doppler ultrasound with the patient in a standing position. Reflux was assessed by squeezing and releasing calves and Valsalva maneuvers all along the vein. Reflux longer than 0.5 sn was considered as venous insufficiency. The great saphen vein and small saphen vein were examined by their relations with the fascial compartment as a part of the routine examination for the treatment of venous insufficiency. Great saphen vein was detected in five Regions; groin, femoral Region, knee Region, leg and ankle. We classified saphenous fascial anatomy as continuous (Figure 1a and 1b) and interrupted (Figure 2).

We observed saphen vein in three different conditions: a) in the fascia (Figure 1b and 2b), GSV was not visible in the saphenous compartment (segmental hipoplasia) (Figure 3), third condition we observed was duplication of the saphen vein (Figure 4) in which VSM runs the fascial compartment and another vein running parallel but outside the compartment and then joins the VSM (1,2).

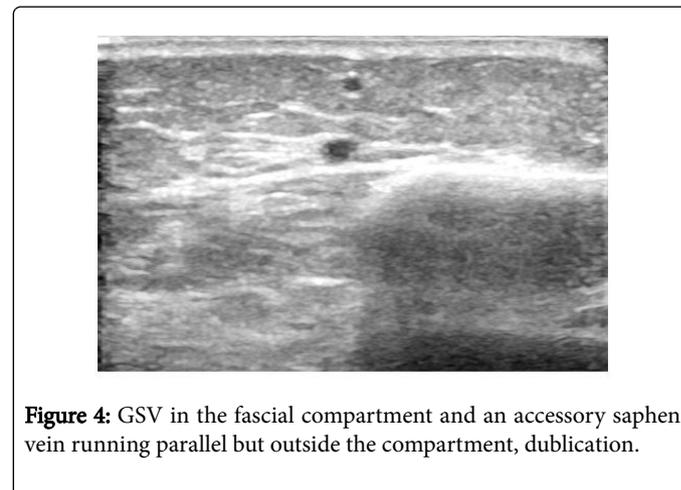


Figure 4: GSV in the fascial compartment and an accessory saphen vein running parallel but outside the compartment, duplication.

Statistical Analysis

Data was given as the mean \pm standard deviation for continuous variables and percentages for categorical variables. P value <0.5 was considered to indicate statistical significance. Statistical analysis was performed by using software (SPSS, version 17.0, SPSS, Chicago,IL)

Results

Saphen vein fascia was investigated in 101 patients and 202 limbs. We examined five Regions for each extremity, a total of 1010 Regions. In 1010 Regions, we found that saphenous fascia was interrupted in 283 Regions and continuous in 727 Regions.

The saphenous fascia is found interrupted %0 in the groin (Region 1) and ankle (Region 5), 34.8% in the femoral Region (Region 2) 73% around the knee (Region 3), 58,3% in the leg (Region 4) (Table1)

. Vena saphena is found outside the fascia 0% in the groin (Region 1) and ankle (Region 5), 19.1% in the femoral Region (Region 2) 29.6% around the knee (Region 3), 22.5% in the leg (Region 4) (Table 2).

We found out that in the Regions where saphenous fascia is interrupted VSM is located mostly outside the fascia. The relationship between these conditions is statistically significant ($p<0.01$).

	Continuous	Interrupted
Groin	100%	0%
Femoral region	65.20%	34.80%
Knee	27%	73%
Leg	41.70%	58.30%
Ankle	100%	0%

Table1: Superficial fascial anatomy in five regions of lower extremity.

	In the fascia	Outside the fascia	Duplication
Groin	100%	0%	0%
Femoral region	77.40%	19.10%	3.50%
Knee	64.30%	29.60%	6.10%
Leg	73.20%	22.50%	5.30%
Ankle	100%	0%	0%

Table 2: Vena Saphena Magna-Saphenous Fascia Relationship.

Five Regions have significantly different fascial anatomy and relationship of VSM and fascia. Non-parametric Kruskal-Wallis test is used (chi-square: $\chi^2=90.187$; $p<0.01$).

For all Regions 81.4% VSM is in the fascia, 14.6% outside the fascia and in 4% there is duplication of saphen vein.

	Groin		Leg		Knee		Leg		Ankle	
	Int	Cont	Int	Cont	Int	Cont	Int	Cont	Int	Cont
Inside %	100	100	14.7	27.5	12.9	59.5	61.2	14.6	96.3	100
Outside %	0	0	80	72.5	72.4	37.5	31.3	72.9	0	0
Duplic. %	0	0	5.3	0	9.7	7.5	7.5	12.5	3.7	0

Table 3: Interrupted (int) and continuous (cont) fascia and presentation of saphen vein according to the fascia in five regions.

Hypoplasia Regions: 0%, Region 1, 26.2%, Region 2, 40.5%, Region 3, 33.3%, Region 4, 0%, Region 5. Regions were statistically different from each other ($p<0.01$).

Discussion

We propose to classify the saphenous fascia as interrupted and continuous. We found out that saphenous fascia is always continuous in the groin and ankle. In groin and ankle vena saphena magna always runs in the saphenous fascia. Interrupted fascia is found mostly in the knee Region. In the Regions having interrupted fascia vena saphena magna runs outside the saphenous fascia more often.

Lower extremity veins consist of three systems (the superficial veins 2 the deep veins and 3) perforating veins

Superficial veins run in the subcutaneous, superficial compartment and drain the microcirculation. Superficial compartment is above the deep (muscular) fascia. Deep veins run within the muscular compartment beneath the muscular fascia and drain the lower extremity muscles. Perforating veins pass through the deep fascia and connect the superficial system with the deep venous system.

To diagnose the diseases it is important to identify the veins correctly. Saphenous vein is the most common cause of the superficial venous diseases. Venous anatomy so is saphen vein has many variations. For the saphen vein some landmarks are identified [3].

Egyptian or saphenous eye sign is one of the most important markers for distinguishing saphen vein from the tributaries [3,4].

Saphenous eye sign is formed by superficial fascia, muscular fascia and saphen vein. On the transvers US scan, upper lid is formed by superficial fascia, lower lid by muscular fascia, and saphen vein resembles iris (Figure 1). We classified saphenous fascia in two different forms. Continuous and interrupted. We examined VSM and saphenous fascia in five Regions and we found out that each Region had different anatomical forms. We also found out a strong relationship with the interrupted fascia and hypoplasia of the VSM ($p<0.01$).

The saphenous fascia is reported to be well formed in the upper thigh [3,4]. The fascia is well formed in the lower leg, as well. These findings are similar in our study.

The tibio-gastrocnemius angle sign is an important landmark for identifying GSV in the knee Region [3,5]. The sign is defined as VSM presenting tibio-gastrocnemius angle or triangle. The triangle consists of tibia and the medial gastrocnemius muscle on medial and lateral sides and fascial sheath superficially [3]. It is said that this sign helps us to be distinguishing the saphen vein from a tributary [3]. In our study we found that in the knee Region VSM was 64.3% in the fascia and in 29.6% of patients, VSM was outside the saphenous fascia. Also it is important to know that in the knee Region the fascia was interrupted around 73%. So we think that when a radiologist searches for the gastrocnemius sign as a landmark for vena saphena magna, he must consider that in this Region only 64% is found in the fascial compartment, 16% of all subjects seem to have a saphen vein continuous fascia 48% have an interrupted superficial fascia.

It is reported that Egyptian eye sign almost always present in the groin which means GSV presents in the fascial compartment in the upper thigh and lower leg [2,3,6]. Our results are similar for the groin (Region 1) and ankle (Region 5).

The GSV may be diminished in caliber or not cannot be visualized at all segments along the saphenous compartment and the situation is called segmental hypoplasia [6,7]. Hypoplasia is found in thigh and knee mostly.

We found out a statistically significant relationship between interrupted fascia and hypoplasia ($p<0.01$). This means when a radiologist searches for the saphen vein in the knee Region he must know that he may not find a continuous fascia and Egyptian eye sign in thigh and knee.

Duplication of the great saphen vein; true duplication of the great saphen vein occurs when there are two venous trunks running parallel to each other within the same saphenous compartment. Recent studies showed that true duplication of the great saphen vein is observed in 1% of the population. In our study we found that 4%. Duplication is observed always in the thigh [8]. In our study we found the duplication mostly in thigh (Region 1) and knee (Region 3) Region.

This study is the first study about the anatomical variations of saphenous fascia. This classification and all the examinations are done by the same radiologist. If the same patients could be examined by different radiologists and there was a consensus about the anatomy it would be better. More researches supporting this classification are needed.

Conclusion

Since the anatomy and variations of the saphen vein is defined according to the saphenous fascia it is very important to understand

the anatomy and variations of the saphenous fascia. The anatomic patterns of the saphenous fascia have not been explained in detail before. We propose to classify the saphenous fascia as interrupted and continuous. Since there is a strong relationship between the anatomical pattern of the fascia and VSM running outside the fascia, knowing the classification will make it easier to understand the variations of the saphen vein.

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