

## SPECIAL COMMUNICATION

# Nomenclature of the veins of the lower limb: Extensions, refinements, and clinical application

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The relative deficiency of the official *Terminologia Anatomica* with regard to the veins of the lower limbs was responsible for a nonuniform anatomic nomenclature in the clinical literature. In 2001, an International Interdisciplinary Committee updated and refined the official *Terminologia Anatomica* regarding the veins of the lower limbs. Recommendations for terminology were included in an updating document that appeared in the *Journal of Vascular Surgery* (2002;36:416-22). To enhance further the use of a common scientific language, the committee worked on the present document, which includes (1) extensions and refinements regarding the veins of the lower limbs; (2) the nomenclature of the venous system of the pelvis; (3) the use of eponyms; and (4) the use of terms and adjectives of particular importance in clinical vascular anatomy. (*J Vasc Surg* 2005;41:719-24.)

In 2001, an International Interdisciplinary Committee was designated by the presidents of the International Union of Phlebology (IUP), Professor H. Partsch, and of the International Federation of Anatomical Association (IFAA), Professor P.M. Motta, to update the official *Terminologia Anatomica*, regarding the veins of the lower limbs. In fact, the relative deficiency of the official *Terminologia Anatomica*<sup>1</sup> with regard to the veins of the lower limbs was responsible for a nonuniform anatomic nomenclature in clinical literature. This caused difficulty in the international exchange of information and even in the inappropriate treatment of venous disease.<sup>2</sup>

The committee outlined a consensus document at a meeting held in Rome on September 8 and 9, 2001, on the occasion of the 14th World Congress of the IUP with the participation of members of the Federative International Committee for Anatomical Nomenclature (FICAT). The committee's recommendations for terminology were published in the *Journal of Vascular Surgery* in 2002.<sup>3</sup>

Since the publication of that article, the committee collected proposals, suggestions, and criticisms to refine and improve the proposed terminology and continued to work on adapting it to daily clinical practice. These were discussed in meetings of the International Union of Angiology (IUA), IUP, and the American Venous Forum.

The present consensus document was developed by the faculty of a meeting held in Rome on May 23, 2004, during the 21st World Congress of the IUA, under the auspices of the IUA, the IUP, the IFAA, and the FICAT. On this occasion, the committee developed a refinement of the nomenclature from 2002, focusing on new terms, on the veins of the pelvis, and on practical recommendations regarding the daily clinical use of the proposed terminology.

### DEEP VEINS

The nomenclature of the deep veins proposed in 2002 (Table I) was not criticized. The main terminology recommendations, such as the designation of the deep veins of the thigh as *common femoral*, *femoral*, and *deep femoral*, have been accepted and commended in important journals of several medical, surgical, and radiologic specialties.<sup>4,5</sup>

### SUPERFICIAL VEINS

In the consensus document of 2002,<sup>3</sup> main innovations regarding the nomenclature of the superficial veins regarded (1) the subdivision of the superficial veins according to their relationships to the saphenous fascia (Fig 1); (2) the designation of the saphenous veins as *great* and *small\** and, (3) the designation of nonsaphenous veins regarding their topography and path. The criticisms and suggestions the committee received were used to refine and extend the list of the superficial veins (Table II). In particular:

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Competition of interest: none.

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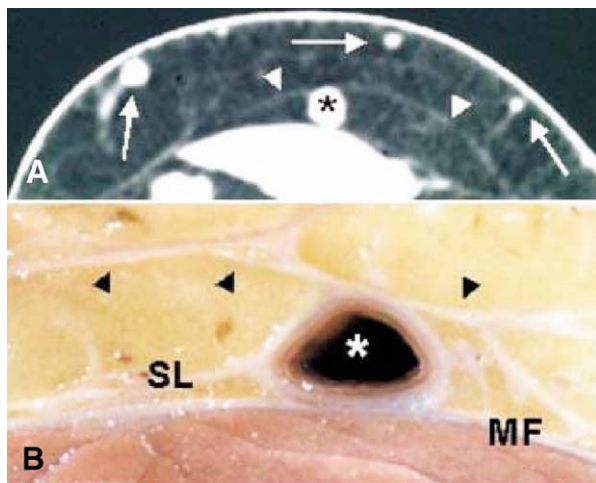
\*The term *great saphenous vein* was chosen to avoid confusion when abbreviations are used. In fact, LSV, the acronym of long saphenous vein, could be easily confused with lesser saphenous vein. In addition, it was pointed out that, in many limbs, the SSV is not "short",<sup>6</sup> nor is it "lesser".<sup>7</sup> In addition, the term *great saphenous vein* has largely replaced the previous term of *long saphenous vein*. In fact, the term *great saphenous* was used in 45% of articles referenced by Medline during the biennium 1999 to 2000, and in 71% during the period 2003 to 2004. The term *long saphenous* dropped from 55% (1999 to 2000) to 29% (2003 to 2004).

**Table I.** Nomenclature of the deep veins

THIGH	Common femoral vein
	Femoral vein
	Deep femoral vein
	Deep femoral communicating veins (accompanying veins of perforating arteries)
	Medial circumflex femoral vein
	Lateral circumflex femoral vein
KNEE	Sciatic vein
	Popliteal vein
	Genicular venous plexus
	Sural veins
	• Soleal veins
LEG	• Gastrocnemius veins
	Medial gastrocnemius veins
	Lateral gastrocnemius veins
	Intergemellar vein
FOOT	Anterior tibial veins.
	Posterior tibial veins
	Fibular or peroneal veins
	Medial plantar veins
	Lateral plantar veins
	Deep plantar venous arch
	Deep metatarsal veins (plantar and dorsal)
	Deep digital veins (plantar and dorsal)
	Pedal vein

**Table II.** Nomenclature of the superficial veins

Great saphenous vein
Sapheno-femoral Junction
Terminal valve
Preterminal Valve
External pudendal vein
Superficial circumflex iliac vein
Superficial epigastric vein
Superficial dorsal vein of clitoris or penis
Anterior labial veins
Anterior scrotal veins
Anterior accessory of the great saphenous vein
Posterior accessory of the great saphenous vein
Superficial accessory of the great saphenous vein
Small saphenous vein
Sapheno-popliteal junction
Terminal valve
Preterminal valve
Cranial extension of the small saphenous vein
Superficial accessory of the small saphenous vein
Anterior thigh circumflex vein
Posterior thigh circumflex vein
Intersaphenous veins
Lateral venous system
Dorsal venous network of the foot
Dorsal venous arch of the foot
Superficial metatarsal veins (dorsal and plantar)
Plantar venous subcutaneous network
Superficial digital veins (dorsal and plantar)
Lateral marginal vein
Medial marginal vein



**Fig 1.** A, Axial computed tomography scan of the thigh. The greater saphenous vein (\*) and the saphenous accessories (arrows) course in different planes, separated by the saphenous fascia (arrowheads). B, Axial section from a cadaveric limb showing the close relationships of the great saphenous vein (\*) with the saphenous fascia (arrowheads) and the underlying muscular fascia (MF). SL, Saphenous ligament.

**Sapheno-femoral junction, sapheno-popliteal junction.** The terms *sapheno-femoral junction* (SFJ) and *sapheno-popliteal junction* (SPJ) and their valves (Fig 2) have been included in the official nomenclature because they are anatomically correct, clinically appropriate, and not misleading. However, there is no agreement in the literature with regard to the anatomic extent of the SFJ and SPJ, because a clear anatomic definition is lacking. From the strict anatomic sense

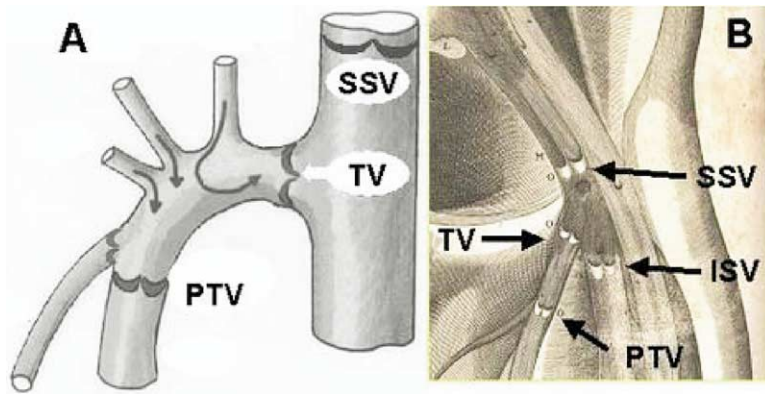
of the word *junction*, SFJ and SPJ would correspond only to the saphenous openings with the terminal valve<sup>†</sup> contained in them. The role of these valves is to prevent reflux from the femoral or popliteal veins, and they can also be located a few millimeters distal to the opening (subterminal location of the terminal valve).<sup>8</sup>

However, since the terms SFJ and SPJ have been introduced,<sup>9</sup> they have been considered to be more extended than indicated by the anatomic concept of “junction” (Fig 1). From classic<sup>9-11</sup> and more recent papers on the anatomy, physiology, and pathophysiology of these junctions,<sup>12-15</sup> it can be determined that both the SFJ and the SPJ extend distally along the saphenous trunks to the penultimate preterminal valve.<sup>‡</sup> This valve is located 3 to 5 cm below the terminal valve—distal to the termination of the saphenous junctional tributaries—to prevent reflux from these veins into the saphenous trunk when the terminal valve is closed.<sup>12,13</sup>

The proximal level of the SFJ and SPJ corresponds to the valve located proximal to the saphenous opening (suprasaphenic valve), because it has a pivotal role in junctional hemodynamics.<sup>16</sup> The distal limit of the SFJ and SPJ has never been established, but it was proposed that it corresponds to the valve placed distal to the saphenous opening (infrasaphenic valve),<sup>17</sup> whose possible hemodynamic role is still to be defined.

<sup>†</sup>We do not recommend to use of the terms *ostial* and *junctional* valve, even if anatomically correct.

<sup>‡</sup>We do not recommend use of the terms *subostial*, *preostial*, *prejunctional*, or *subterminal* valve, even if anatomically correct.



**Fig 2.** A, Schematic representation of the hemodynamic role of the sapheno-femoral junction (SFJ) valves (modified from Pieri et al, 1995). B, The first exhaustive representation of the SFJ with its valves. Modified from the *De Venarum Ostiolis*, of Jeronimus Fabricius Ab Acquapendente, Venice, 1603. TV, Terminal valve; PTV, preterminal valve; SSV, suprasaphenic valve; ISV, infrasaphenic valve.

The anatomic-clinical concept of SFJ and SPJ includes the terminations of the tributaries (with their own terminal valves), which join the saphenous trunks between the terminal and preterminal valves.<sup>8</sup>

**Anterior accessory of the GSV.** In the first document on terminology,<sup>3</sup> it was stated as a general rule that “. . .saphenous accessories lie out of the saphenous compartment. . .and run more superficial with respect to the main trunk. . .” In contrast to this general rule, the anterior accessory of the GSV (AAGSV) at the upper thigh, courses deeply (superficial to the muscular fascia, like the GSV) to a hyperechoic fascia that resembles the GSV covering (Fig 3, A). However, the AAGSV can be easily identified, because it courses more anteriorly with respect to the GSV, with a path corresponding to that of the underlying femoral artery and veins.

**PERFORATING VEINS**

The subdivision of perforating veins proposed in 2002 (Table III) by their topography was not criticized and was even adopted a recent and complete review on the perforating veins in 2004.<sup>18</sup>

**PELVIC VEINS**

Pelvic veins are of great clinical importance because of their role in venous thromboembolism, pelvic congestive syndromes, and primary and recurrent varicose veins of the distal trunk and lower extremities. Pelvic venous anatomy is extremely complex because of the presence of many veins and plexuses that show variable pathways, size, and connections. The terminology proposed is reported in Table IV. In particular:

- Ovarian and testicular veins (#2, 3). Accepted synonyms: gonadal veins, spermatic veins.
- Rectal plexuses and rectal veins (#11 to 16). The rectal plexus has two parts, the internal plexus (in the sub-

<sup>8</sup>This segment of the saphenous trunk corresponds to the French term “crosse”.

**Table III.** Nomenclature of the perforating veins

Foot perforators	Dorsal foot PV or intercapitular veins Medial foot PV Lateral foot PV Plantar foot PV
Ankle perforators	Medial ankle PV Anterior ankle PV Lateral ankle PV Medial leg PV • Paratibial PV • Posterior tibial PV (Cockett PV)
Leg perforators	Anterior leg PV Lateral leg PV Posterior leg PV Medial gastrocnemius PV Lateral gastrocnemius PV Intergemellar PV Para-Achillean PV
Knee perforators	Medial knee PV Suprapatellar PV Lateral knee PV Infrapatellar PV Popliteal fossa PV Medial thigh PV • PV of the femoral canal • Inguinal PV
Thigh perforators	Anterior thigh PV Lateral thigh PV Posterior thigh PV • Postero-medial • Sciatic PV • Posterolateral
Gluteal perforators	Pudendal PV Superior gluteal PV Midgluteal PV Lower gluteal PV

PV, Perforating veins

mucosa) and the external (outside the muscular coat). The term *hemorrhoidal* (or haemorrhoidal) is a correct synonym for the internal plexus. The term *rectal* is to be preferred for the external plexus as well as for the

**Table IV.** Nomenclature of the pelvic veins

Plexus and peripheral veins		Draining veins		Main collectors	
1	Pampiniform plexus	2	Ovarian veins	4	Inferior vena cava
		3	Testicular veins		
5	Sacral Venous plexus	6	Median sacral vein	10	Common iliac vein
		7	Iliolumbar vein		
		8	Internal iliac (Hypogastric)		
		8	External iliac		
11	● External rectal plexus	13	Superior rectal vein	14	Inferior Mesenteric vein
	● Internal rectal plexus	15	Middle rectal veins		
12	(Hemorrhoidal)	16	Inferior rectal veins		
		17	Superior gluteal veins		
		18	Inferior gluteal veins		
		19	Lateral sacral veins		
20	Deep perineal veins			38	Internal iliac vein (hypogastric)
21	Superficial perineal veins				
22	Deep dorsal veins of clitoris				
23	Deep veins of clitoris	27	Internal pudendal vein		
24	Deep dorsal veins of penis				
25	Deep veins of penis				
26	Urethral bulb veins				
		28	Obturator veins		
29	Pudendal plexus				
30	● Vesical plexus	35	Vesical veins		
31	● Prostatic plexus				
32	Uterine plexus	36	Uterine veins		
33	Vein of the broad ligament				
34	Vaginal plexus	37	Vaginal veins		
		39	Pubic veins (accessory obturator veins)	43	External iliac vein
		40	Sovrapubic veins		
		41	Inferior epigastric vein		
		42	Deep circumflex iliac vein		

veins merging into it. The term *hemorrhoidal* for these vessels should not be used.

- Middle rectal veins (#15). The middle rectal veins do not arise from the rectal plexus but mainly from the neighboring organs (seminal vesicles, bladder, prostate, uterus, and vagina).
- Inferior gluteal veins (#18). This term should not be confused with the term *sciatic vein*, which is used to designate the satellite vein of the great sciatic nerve. The latter is situated between the deep veins of the lower limb and is the main root of the inferior gluteal veins.
- Perineal veins (#20, 21). This term is commonly used in clinical literature, but it lacks a clear definition. The deep perineal veins correspond to the portion of the pudendal plexus lying above the internal face of the perineum. The superficial perineal veins are the network of subcutaneous veins of the urogenital region (posterior labial or scrotal veins, drained by the GSV) and of the perianal region (drained by the hemorrhoidal plexus).
- Pudendal plexus (#29). This lies behind the *symphysis pubis* and is connected with the vesical and prostatic plexuses. Correct synonyms: vesico-prostatic plexus and retropubic plexus (of Santorini).
- Deep veins of the clitoris and of the penis (#22 to 25). These are tributaries to the internal pudendal vein. The

correspondent superficial veins are tributaries to the GSV by way of the superficial external pudendal vein.

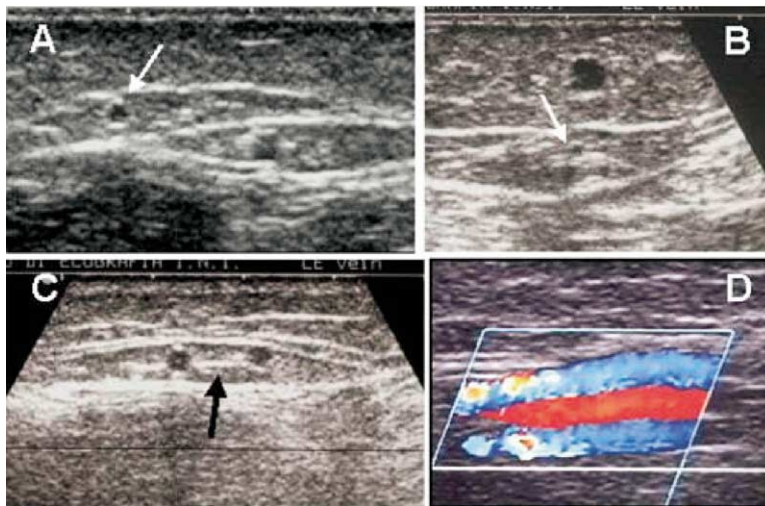
- Veins of the broad ligament (#33). These connect the uterine plexus with the inguinal superficial veins. They represent an important pathway for the transfer of transfer venous hypertension from the pelvic district to the anterior abdominal wall and to the lower limb.<sup>19</sup>
- Pubic veins (#39). These ascend on the back of the pubis to connect the obturator veins with the external iliac.
- Suprapubic veins (#40). These are a network of superficial veins that connect the left and right inferior epigastric veins.

#### EPONYMS

As a general rule, the use of eponyms is discouraged. In the first consensus document,<sup>3</sup> the committee reported the only eponyms that were correct from the historical and anatomic points of view. A thorough survey of the more recent literature demonstrated that only the following eponyms and synonyms are correctly used in journals with worldwide circulation:

- *Giacomini's vein* designates the medial thigh anastomosis between the SSV with the GSV. Giacomini's vein corresponds to the posterior thigh circumflex vein, which may originate from the SSV or from its





**Fig 3.** *A*, At the groin, the anterior accessory of the great saphenous vein (GSV) (arrow) courses deeply in the subcutaneous layer, and below a hyperechoic fascia that resembles the GSV covering. *B*, The small lumen of a hypoplastic GSV as seen by duplex scan. Note the compensatory enlargement of the overlying saphenous accessory. *C*, Real double GSV. The two veins course within the saphenous compartment and are connected by the saphenous ligament (arrow). *D*, Real double femoral vein. The two veins (in blue) course close to the femoral artery (in red).

thigh extension and ends in the GSV or its posterior accessory.

- *Posterior arch vein* designates the vein that lies on the medial surface of the leg, posterior and parallel to the GSV. It corresponds to the leg portion of the posterior accessory of the GSV.
- *Cockett's perforating veins* correspond to the posterior tibial perforators that connect the posterior arch vein with the posterior tibial veins.
- *Santorini's plexus* is an extremely popular term and commonly used by urologists<sup>20</sup> to indicate the retro-pubic vesico-prostatic plexus.

### GENERAL TERMINOLOGY

The calibers of the veins of the lower limbs show a great interindividual variability. In addition, developmental abnormalities may cause segmental intraindividual variations. The terminology used to indicate caliber variations of veins is not uniform because of the subtle differences in interpretation of the correct terms and adjectives that are used to describe different degrees of development of an organ. According to main medical dictionaries<sup>21</sup>:

- *Agensis* indicates the complete absence of a vein or of a segment of a vein.
- *Aplasia* indicates the lack of development of a vein or of a segment of a vein. The vein is present but diminutive in size and its structure is similar to that in the embryo.
- *Hypoplasia* indicates the incomplete development of a vein or of a segment of a vein. It is less severe in degree than aplasia, and the hypoplastic vein has a reduced caliber with a normal structure (Fig 3, B).

In daily clinical practice, these terms could be pragmatically used on the basis of duplex findings. The absence of a vein or of a segment of a vein at routine duplex scanning (8- to 10-MHz probes for superficial veins, 3.5- to 5-MHz probe for deep veins) indicates aplasia, whereas a caliber <50% of normal values indicates hypoplasia.

- *Dysplasia* indicates a complex abnormality of development of a vein or of a group of veins that greatly differs from the normal conditions in size, structure, and connections.
- *Atrophy* indicates a decrease in size or wasting away of a normally developed vein or segment of a vein, following a degenerative process. Wall changes are different, according to the nature of the degenerative process.
- *Venous aneurysm* indicates a localized dilation of a venous segment, with a caliber increase >50% compared with normal.
- *Venomegalia* designates diffuse dilation of one or more veins with a caliber increase >50% compared with normal.

**Adjectives distal and proximal.** These adjectives are not uniformly used in the clinical literature when referred to venous structures. A thorough review of the current literature on venous medicine and surgery indicates that *distal* is actually used to indicate the part of the vein away from the heart, whereas *proximal* is towards the heart.

**The correct meaning of the term double.** Real anatomic doubling of a vein occurs only when the two veins show the same path, topography, and relationships, such as the tibial or peroneal veins (Figs 3, C and D). When one or more vessels course parallel with respect to the main vein

but in different planes or compartments of the limb (Fig 1, A), the main vein cannot be considered double but only functionally duplicated, such as the femoral vein and an axial transformation of the deep femoral vein.<sup>22</sup>

## CONCLUSION

Anatomic terminology is the foundation of medical communication. Effective exchange of information is possible only if a common terminology is used. The nomenclature proposed in 2002 by the International Interdisciplinary Committee,<sup>3</sup> has now been extended and further refined, taking into account recent improvements in the knowledge of venous clinical, radiologic, and surgical anatomy. This report represents the final summation of this committee's work. Adoption of the present terminology recommendations will contribute to making the language more uniform, the diagnosis more accurate and the treatment of venous disorders more correct.

## REFERENCES

1. Federative International Committee for Anatomical Terminology. *Terminologia Anatomica*. Stuttgart: George Thieme Verlag, 1998.
2. Bundens WP, Bergan JJ, Halasz NA, Murray J, Drehobl M. The superficial femoral vein: a potentially lethal misnomer. *JAMA* 1995; 274:1296-98.
3. Caggiati A, Bergan JJ, Gloviczki P, Jantet G, Wendell-Smith CP, Partsch H; International Interdisciplinary Consensus Committee on Venous Anatomical Terminology. Nomenclature of the veins of the lower limbs: an international interdisciplinary consensus statement. *J Vasc Surg* 2002;36: 416-22.
4. Hammond I. The superficial femoral vein. *Radiology* 2003;229:604-6.
5. Caggiati A. The femoral vein is not superficial—nor is the saphenous vein. *Radiology Online*, 3 Dec 2003. Available at <http://radiology.rsna.org/cgi/letters/229/2/604>
6. Van der Stricht J. Does the Short saphenous Vein exist? 14<sup>th</sup> World Congress of the International Union of Phlebology, Rome 2001, Abstract book, p 23.
7. Lin JC, Iafrati MD, O'Donnell TF Jr, Estes JM, Mackey WC. Correlation of duplex ultrasound scanning—derived valve closure time and clinical classification in patients with small saphenous vein reflux: is lesser saphenous vein truly lesser? *J Vasc Surg* 2004;39:1053-1058.
8. Lemasle P, Uhl JF. *Atlas d'écho-anatomie veineuse superficielle*. Paris: Ipsen Ed, 2004.
9. Glasser ST. Variations of the tributaries of the saphena magna at the sapheno-femoral junction. *Anat Rec* 1942; 82: 93-102.
10. Haeger K. The surgical anatomy of the sapheno-femoral and the sapheno-popliteal junctions. *J Cardiovasc Surg* 1952;3:420-27
11. Mansberger AR, Yeager GH, Smelser M, Brumback FM. Sapheno-femoral junction anomalies. *Surg Gynec Obstet* 1950;91:533.
12. Pieri A, Vannuzzi A, Duranti A, Vin F, Caillard Ph, Benelli L, Michelagnoli S, De Saint-Pierre G. Rôle central de la valvule pré-ostiale de la veine saphène interne dans la genèse des varices tronculaires des membres inférieurs. *Phlébologie* 1995;48:227-9.
13. Pieri A, Vannuzzi A, Duranti A, Michelagnoli S, Marcelli F, Santini M et coll. La Valvule préostiale de la veine saphène externe. *Phlebologie* 1997;50:343-50
14. De Maeseneer MG, Vandenbroeck CP, Van Schil PE. Silicone patch saphenoplasty to prevent repeat recurrence after surgery to treat recurrent saphenofemoral incompetence: long-term follow-up study. *J Vasc Surg* 2004;40:98-105.
15. Pichot O, Sessa C, Bosson JL. Duplex imaging analysis of the long saphenous vein reflux: basis for strategy of endovenous obliteration treatment. *Int Angiol* 2002;21:333-6.
16. Cappelli M, Molino Lova R, Ermini S, Zamboni P. Hemodynamics of the sapheno-femoral junction. Patterns of reflux and their clinical implications. *Int Angiol* 2004;23:25-8.
17. Caggiati A. Anatomy of the sapheno-femoral junction. 21<sup>st</sup> World Congress of the International Union of Angiology, Rome, May 22-26, 2004.
18. van Neer PA, Veraart JC, Neumann HA. Venae perforantes: a clinical review. *Dermatol Surg* 2003;29:931-42.
19. Franceschi C, Bahnini A. Points de fuite pelviens viscéraux et varices des membres inférieurs. *Phlebologie* 2004;57:37-42.
20. Stolzenburg JU, Do M, Rabenalt R, Pfeiffer H, Horn L, Truss MC, Jonas U, Dorschner W. Endoscopic extraperitoneal radical prostatectomy: initial experience after 70 procedures. *J Urol* 2003;169:2066-71.
21. Churchill's Medical Illustrated Dictionary. New York: Churchill Livingstone Inc, 1994.
22. Raju S, Fountain T, Neglen P, Devidas M. Axial transformation of the profunda femoris vein. *J Vasc Surg* 1998; 27:651-9.; accepted Jan 13, 2005.