

# ANNALI ITALIANI DI CHIRURGIA

Fondati da Giovanni Pascale nel 1922

DIRETTORE: NICOLA PICARDI

*Giornale Ufficiale delle*

- *Società Italiana dei Chirurghi Universitari (S.I.C.U.)*
- *Società Italiana di Chirurgia d'Urgenza e del Trauma (S.I.C.U.T.)*
- *Società Triveneta di Chirurgia*



«La rivista è presente in Pubmed, Medlars, Medline, ISI Master Journal List, Science Citation Index Expanded, ICMJE»

*Gli abstracts sono raggiungibili su INTERNET agli indirizzi:*

*www.annaliitalianidichirurgia.com; www.annitalchir.com;  
oppure su: www.pubmed.com; www.medlars.com;  
www.medline.cos.com*

Novembre - Dicembre 2011

## EDIZIONI LUIGI POZZI

# Surgical repair of popliteal artery aneurysms remains a safe treatment option in the endovascular era: a 10-year single-center study



Ann. Ital. Chir., 2011 82: 443-448

Umberto Marcello Bracale, Giuseppe Corte, Antonella Di Gregorio, Felice Pecoraro, Pietro Machì, Filippo Rusignuolo, Guido Bajardi

Department of Vascular and Endovascular Surgery, University of Palermo, Palermo, Italy

## Surgical repair of popliteal artery aneurysms remains a safe treatment option in the endovascular era. A 10-year single-center study

**INTRODUCTION:** Endovascular popliteal artery aneurysm repair has emerged recently as a feasible alternative to standard surgical repair. However, the evidence from the literature is still limited, with only case reports, case series and one small randomized trial. Currently, the available data suggests that stent-grafts should be used in patients at very high surgical risk. The purpose of this study is to present our surgical experience in popliteal artery aneurysm repair in an endovascular era.

**MATERIALS AND METHODS:** Data from 36 consecutive patients, who were admitted to our hospital from January 2000 to April 2010, was analyzed retrospectively. Twenty-six patients underwent surgical treatment through medial or posterior access. The posterior approach was used preferentially. The medial approach was adopted in patients with large aneurysms or aneurysms involving the superficial femoral artery.

**RESULTS:** Twelve patients (Group A; 46.1%) were operated on via medial access followed by femoropopliteal bypass. In the remaining fourteen patients (Group B; 53.9%) an interposition graft was performed via a posterior approach. The 30-day overall mortality rate was 3.8% (1/26). The 30-day amputation rate was 0% in both groups. The primary patency rate was 83.3% in Group A at 78.8-month average follow-up (range: 18-128 months) and was 100% in Group B at 46.3-month average follow-up (range: 5-121 months).

**CONCLUSION:** Notwithstanding the extensive use of stent-grafts worldwide, surgical repair remains the gold standard for the management of popliteal artery aneurysms. In our experience open repair using either a medial or posterior approach is associated with low mortality and morbidity rates.

**KEY WORDS:** Aneurysm, Popliteal artery, Open Repair, Outcome

## Introduction

The incidence of popliteal artery aneurysm (PAA) in the general population is estimated to be 0.1%-2.8%<sup>1,2</sup>. These aneurysms are found almost exclusively in men,

especially men 50-70 years old. The male-female ratio is 10:1 to 30:1<sup>3</sup>. Approximately 50% of PAA are bilateral<sup>4</sup>. Although PAA are frequently associated with abdominal aortic aneurysm (AAA), only 10-14% of AAA are associated with PAA<sup>5</sup>. Thirty to forty-five percent of PAA patients have chronic peripheral arterial disease and suffer from intermittent claudication<sup>6</sup>. Surgical treatment is considered appropriate for all symptomatic PAAs as well as those over 2 cm in diameter. In 1969 Edwards described proximal and distal ligation of the aneurysm sac followed by an autologous bypass graft using the great saphenous vein<sup>7</sup>. In recent years endovascular treat-

Pervenuto in Redazione Marzo 2011. Accettato per la pubblicazione Maggio 2011.

Correspondence to: Umberto Marcello Bracale, MD., Via Liborio Giuffrè 5, 90127 Palermo, Italy (e-mail: umbracale@unipa.it)

ment of PAA has emerged as a valid alternative to open surgery, and its use is becoming increasingly widespread even though sufficient long-term data regarding such treatment is not available. The aim of this study is to report our experience over the past 10 years in the surgical treatment of PAA.

## Materials and methods

From January 2000 to April 2010, 36 patients diagnosed with PAA were evaluated at the Vascular Surgery Unit of the Palermo University Hospital. Twenty-six of them underwent open repair. The demographic characteristics of the patients are shown in Table I. The diagnosis of PAA was made on the basis of the results of clinical examination as well as imaging studies. The dimensions of the artery, the extension of the aneurysm, and the distal run-off were evaluated with Duplex scan, CT-angiography, or arteriography of the lower limbs. Indications for repair of asymptomatic aneurysms were aneurysm diameter > 2.5 cm in men and > 2 cm in women.

For patients with symptomatic aneurysms indications for surgery were independent of aneurysm size. All patients were operated on under general anesthesia.

*Medial access:* The patient is placed on the operating table in the supine position. Two incisions are made: one above and one below the knee. The former incision is made anterior to the sartorius muscle and extends up to the medial condyle of the femur (Fig. 1) The great saphenous vein can be isolated for the entire length of the incision and then used as an autologous prosthesis. The incision made under the knee begins 2cm away from the medial condyle of the femur, and extends along the posterior edge of the tibia, where care must be taken not to injure the great saphenous vein which takes the same course. If the aneurysm is large it may be nec-

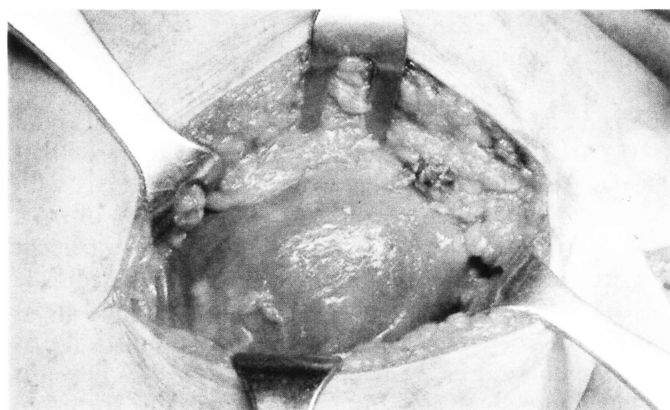


Fig. 1: Medial access: huge popliteal aneurysm involving distal superficial femoral artery.



Fig. 2: Posterior access: "S" shaped incision.

essary to disinsert the tendons that make up the "pes anserinus" (the conjoined tendons of the semitendinosus, gracilis, and sartorius muscles), while being careful not to cut the muscles. The advantages of this approach are good exposure of the entire popliteal arterial axis, and the ease with which the great saphenous vein can be harvested. The disadvantages are the double incision, and the occasional need to cut the "pes anserinus" tendons in order to have satisfactory control of the aneurysm. The medial approach is preferred if the aneurysm involves the superficial femoral artery because it provides adequate exposure of the proximal neck<sup>8</sup>.

*Posterior access:* The patient is placed on the operating table in the prone position. An S-shaped incision is made with a short horizontal segment at the level of the popliteal fossa (Fig. 2). The upper part of the incision extends along the medial border of the semimembranosus muscle. The lower part, is made between the medial and lateral heads of the gastrocnemius muscle. The advantages of this approach are that no cutting of tendons/muscles is involved, exploration of the popliteal artery at the level of the knee joint is easy, the collat-

eral vessels can be isolated and ligated and the aneurysm can be completely resected. In fact some studies have shown that patency of collateral branches can result in filling of the aneurysm sac after surgery, mimicking a type II endoleak<sup>9</sup>. Careful surveillance of the aneurysm sac after exclusion is extremely important since it has been demonstrated that in patients with no flow on post-operative Duplex scan examination there is less expansion of the residual aneurysm<sup>10</sup>. The disadvantages of this approach are the difficulty in harvesting the great saphenous vein and isolating the superficial femoral artery above the adductor canal, and the high incidence of neurological complications due to damage of the tibial nerve.

The aim of this study was to analyze the outcome of patients who underwent PAA repair with a medial approach (Group A) to those who underwent PAA repair with a posterior approach (Group B).

*Statistical analysis* Fisher's exact test was used to investigate the relationship between qualitative variables in the 2 groups. The Mann-Whitney test was used for quantitative variables. Kaplan-Meier survival analysis was performed. A p-value <0.05 was considered significant.

## Results

Twelve patients were treated via medial access (Group A: 46.1%), and 14 via posterior access (Group B: 53.9%). The average diameter of the aneurysms treated was 3.16 cm (range: 23-46 cm). There was no difference between the 2 groups as regards risk factors except for a larger number of patients with dyslipidemia in Group B (16.7% vs. 57.1%, p=0.051).

There was a significant difference between the 2 groups in the incidence of symptoms at admission (p=0.015). Ischemic patients had a lower run-off score than asymptomatic patients. Medial access was preferred if aneurysms were large or if they extended above the adductor canal, involving the superficial femoral artery. The difference between the 2 groups in aneurysm diameter was statistically significant (p=0.006) (Table I). In 75% of the procedures in Group A the great saphenous vein was used, and an expanded polytetrafluorethylene (ePTFE) prosthesis or a Dacron prosthesis was used in the remaining 25 %.

In Group B, the posterior approach was used for placement of a prosthetic graft in 50% of cases and a great saphenous vein graft in the others. The small saphenous vein was never used.

In our series there was only one case of postoperative mortality (1/26 patients, 3.8%). The patient had presented with acute lower limb ischemia caused by thrombosis of a PAA and died of a myocardial infarction on postoperative day 2.

Postoperative complications are listed in Table II.

The average length of follow-up in Group A was 78.8

TABLE I - Patient demographics and clinical presentations.

	Group A (n =12)	Group B (n = 14)	p
Age (mean, range)	69.25 (59-78)	69.93 (54-87)	.938
Associated aneurysms	3 (25) n (%)	6 (42.8) n (%)	.831
Risk factors			
Hypertension	8 (66.6)	11 (78.6)	1
Smoke	7 (58.3)	12 (85.7)	.19
Diabetes	0 ( 0 )	2 (14.3)	.483
Dyslipidemia	2 (16.7)	8 (57.1)	.051
CAD*	2 (16.7)	6 (42.8)	.216
Symptoms at presentation			
Asymptomatic	2 (16.7)	9 (64.3)	.015
Acute ischemia	8 (66.6)	5 (35.7)	
Chronic ischemia	2 (16.7)	0 (0)	
Absolute diameter			
PAA (mm, median)	35.1	28.7	.006

\*coronary artery disease

TABLE II - Thirty-day postoperative complications

	Group A n (%)	Group B n (%)	p
Fasciotomy	1 (7,1)	2 (14,2)	ns
Nerve injuries	0 (0)	1 (7,1)	ns
Perioperative mortality	0 (0)	1 (7,1)	ns

months (range: 18-128 months). None of the patients required major amputations in the postoperative period (30 days), but one patient (3.8%) underwent a thigh amputation 34 months after PAA repair. A patient with a prosthetic bypass was found to have asymptomatic bypass occlusion 18 months after surgery. Follow-up CT angiography revealed filling of the residual aneurysm sac by one of the genicular branches of the popliteal artery which, however did not cause the excluded sac to increase in size (Fig. 3). As a result, there was 83.3% primary patency in Group A.

The average length of follow-up in Group B was 46.3 months (range: 5-121 months). None of the patients required a major amputation or developed graft occlusion.

The Kaplan -Meier survival curves of the 2 groups are shown in Figure 4.

## Discussion

There is still a great deal of controversy about surgical management of PAA, especially those that are asymptomatic.

Although it is generally agreed that symptomatic PAA



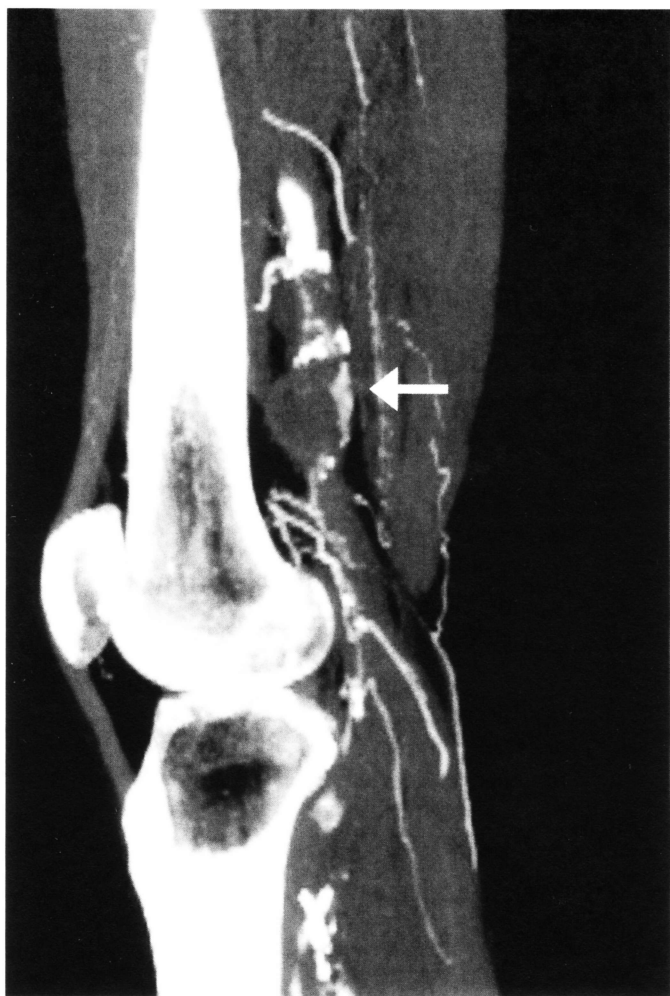


Fig. 3: Follow-up 2D reconstruction CT-scan showing bypass occlusion and filling of the residual aneurysm sac by one of the genicular branches of the popliteal artery (arrow).

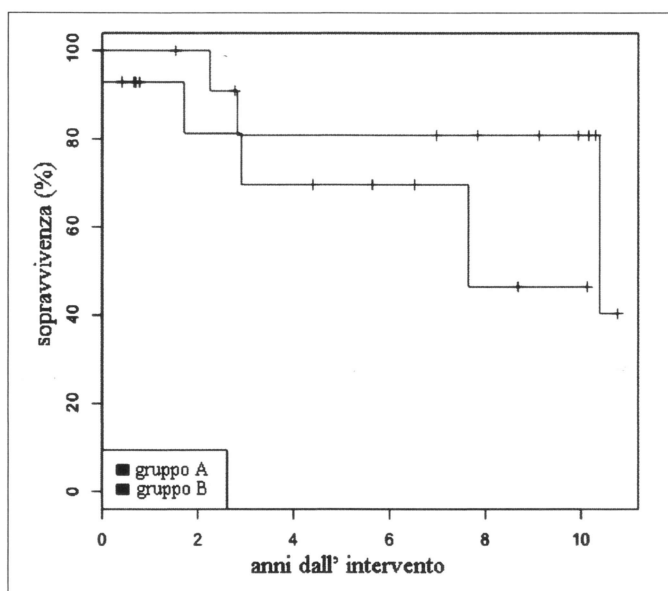


Fig. 4: Kaplan-Meier survival curves.

should be repaired, and repaired as quickly as possible, there are many discordant opinions in the literature about how and when to treat asymptomatic PAA. In a recent study, Ascher and colleagues<sup>11</sup> concluded that small PAA (<2cm in diameter) are associated with a high incidence of thrombosis, clinical symptoms, and distal embolization. Lowell and colleagues<sup>12</sup> reported that aneurysm size >2cm, presence of thrombi, and poor run-off led to a high rate of complications in patients with asymptomatic aneurysms. Galland and Magee<sup>13</sup> stated that PAA <3cm in diameter with insignificant tortuosities could be monitored without excessive risk of acute thrombosis. This data shows that there are very different opinions about when to treat PAA, even though in the most recent guidelines of the American Association for Vascular Surgery a diameter of 2 cm is the threshold for surveillance/treatment<sup>2</sup>.

Another important question is how to treat asymptomatic PAA, considering that in the past few years endovascular treatment has been adopted as a valid alternative to traditional surgery. Compared to open surgery, endovascular treatment has numerous advantages; the minimally invasive nature of the procedure together with the use of local anesthesia, less blood loss, and a shorter hospital stay leading to more rapid recovery. This treatment was first described in 1994 by Marin, who used 2 Palmaz stents and an endovascular technique to secure a ePTFE prosthesis to the vessel walls<sup>14</sup>.

Since then much progress has been made in developing materials used for endovascular procedures, and various studies in the literature, (mostly retrospective studies), report the results of endovascular treatment, which seem, in selected cases, to be comparable to the results of traditional surgery<sup>11,12</sup>.

These encouraging results are probably the consequence of careful patient selection based on very precise indications. A proximal or distal neck < 1 cm, poor run-off, and excessive vessel tortuosity<sup>15</sup>, are factors that can have a negative effect on endovascular treatment results<sup>16,17</sup>.

Popliteal artery aneurysm exclusion by implanting endoprosthesis is a feasible and effective technique, which, in selected cases, can give the same results as traditional surgery, and has more advantages than minimally invasive treatment. Tielliu and colleagues<sup>18</sup> recently reported the results of their study on 64 patients with PAA who underwent endovascular repair via a Hemobahn/Viabahn® (W.L.Gore Associates, Flagstaff, AZ, USA) stent-graft. Mean length of follow-up was 50 months. There was a 17% incidence of stent fractures. This led to vessel occlusion in 5 patients (5/13; 38.5%). All stent fractures occurred in the inferior segment of the popliteal artery. Due to these results the authors concluded by recommending careful evaluation of the indications for endovascular treatment of aneurysms confined to the inferior segment of the popliteal artery and those in young patients who were still physically active.

In traditional PAA repair, the approach used depends on the extension of the aneurysm<sup>19</sup>. Popliteal artery aneurysms which extend beyond the adductor canal, and those associated with stenotic/obstructive disease of the superficial femoral artery, should be treated using a medial approach. On the other hand, PAA, which do not extend that far, should be treated with a posterior approach. Some authors have shown using posterior access results in a large increase in graft patency at 5 and 8 years<sup>19,20</sup>. These results could be due to the length of the graft since shorter grafts are used with the posterior approach. There is ongoing debate about what percentage of patients can be operated on via posterior approach. In our experience it was 53.9%.

## Conclusions

Our study demonstrated that surgical PAA repair is effective and associated with low mortality and morbidity rates. Surgical treatment was effective even in the medium to long term and guaranteed 96% limb salvage at an average follow-up of 61.9 months. The posterior approach to the popliteal fossa was found to be especially suitable treatment for PAA that do not involve the superficial femoral artery and the origin of the tibial arteries. A review of the literature confirmed that surgical repair is still the gold standard for the treatment of PAA.

## Riassunto

**INTRODUZIONE:** Il trattamento endovascolare degli aneurismi dell'arteria poplitea è recentemente emerso come valida alternativa alla chirurgia open. Con il miglioramento delle tecniche e dei materiali, gli stent-graft sono impiegati in misura crescente, sebbene le evidenze dalla letteratura siano limitate a serie cliniche ed ad un piccolo studio randomizzato. Lo scopo di questo studio è quello di presentare, nell'era dell'endovascolare, la nostra esperienza nel trattamento chirurgico degli aneurismi dell'arteria poplitea.

**MATERIALI E METODI:** Tra gennaio 2000 ed aprile 2010, 36 pazienti sono stati ricoverati presso la nostra Unità Operativa per la valutazione di un aneurisma dell'arteria poplitea. I dati di 26 pazienti sottoposti a trattamento chirurgico attraverso un accesso mediale o posteriore, sono stati analizzati retrospettivamente. L'approccio posteriore è stato utilizzato preferenzialmente. L'accesso mediale è stato adottato in caso di aneurisma coinvolgente l'arteria femorale superficiale o per aneurismi di grandi dimensioni.

**RISULTATI:** Dodici pazienti (gruppo A, 46,1%) sono stati trattati mediante accesso mediale e confezionamento di bypass femoro-popliteo. Nei restanti quattordici pazienti (gruppo B; 53,9%) è stata effettuata, attraverso

approccio posteriore, l'interposizione di un innesto. La mortalità a 30 giorni è stata del 3,8% (1/26). Il tasso di amputazione a 30 giorni è stato nullo in entrambi i gruppi; il tasso di pervietà primaria è stato del 83,3% nel gruppo A ad un follow-up medio di 78,8 mesi (range 18-128 mesi) e del 100% nel gruppo B, ad un di follow-up medio di 46,3 mesi (range 5-121 mesi).

**CONCLUSIONE:** Nonostante il crescente utilizzo di stent-graft in tutto il mondo, la chirurgia open rimane il *gold standard* per la gestione terapeutica degli aneurismi dell'arteria poplitea. Nella nostra esperienza, questa procedura sia attraverso un accesso mediale che posteriore, è associata ad un basso tasso di mortalità e di morbilità.

## References

- 1) Dawson I, Sie RB, Van Bockel JH: *Atherosclerotic popliteal aneurysm*. Br J Surg, 1997; 84:293-99.
- 2) Hirsch AT, Haskal ZJ, Hertzner NR, Bakal CW, Creager MA, Halperin JL, Hiratzka LF, Murphy WR, Olin JW, Puschett JB, Rosenfield KA, Sacks D, Stanley JC, Taylor LM Jr, White CJ, White J, White RA, Antman EM, Smith SC Jr, Adams CD, Anderson JL, Faxon DP, Fuster V, Gibbons RJ, Hunt SA, Jacobs AK, Nishimura R, Ornato JP, Page RL, Riegel B. ACC/AHA: *Guidelines for the Management of Patients with Peripheral arterial disease (Lower Extremity, Renal, Mesenteric, and Abdominal Aortic) A Collaborative Report from the American Association for Vascular Surgery, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, Society of International Radiology, and the ACC/AHA Task Force on Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Patients with Peripheral Arterial Disease)*. Summary of recommendation. Circulation, 2006; 113:463-54.
- 3) Diwan A, Sarkar R, Stanley JC, Zelenok GB, Wakefield TW: *Incidence of femoral and popliteal artery aneurysms in patients with abdominal aortic aneurysm*. J Vasc Surg, 2000; 31:863-69.
- 4) Ritucci V, Magnacca F, Ipri D, Russo A, Leombruni E, Picardi N: *Bilateral aneurysms of the popliteal artery*. Ann Ital Chir, 1996; 67:683-86.
- 5) Wright LB, Matchett WJ, Cruz CP, James CA, Culp WC, Eidt JF, McCowan TC: *Popliteal artery disease: Diagnosis and treatment*. Radiographics, 2004; 24:467-79.
- 6) Marin MT, Belkin M: *Aneurismi periferici*. Hallet J, Mills J, Earnshaw JJ, Reekers JA Elsevier In: *Compendio di chirurgia vascolare ed endovascolare*. Amsterdam, 2004: 479-90.
- 7) Edwards WS: *Exclusion and saphenous vein bypass of popliteal aneurysm*. Surg Gynecol Obstet, 1969; 128:829-30.
- 8) Bellosta R, Sarcina A, Luzzani L, Carugati C, Cossu L: *Fate of popliteal artery aneurysms after exclusion and bypass*. Ann Vasc Surg, 2010; 24:885-89.
- 9) Mehta M, Champagne B, Darling RC 3rd, Roddy SP, Kreienberg PB, Ozsvath KJ, Paty PS, Chang BB, Shah DM: *Outcome of popliteal artery aneurysms after exclusion and bypass: significance of residual patent branches mimicking type II endoleaks*. J Vasc Surg, 2004; 40:886-90.

- 10) Jones WT, Hagino RT, Chiou AC, Decaprio JD, Franklin KS, Kashyap VS: *Graft patency is not the only clinical predictor of success after exclusion and bypass of popliteal artery aneurysms.* J Vasc Surg, 2003; 37:392-400.
- 11) Ascher E, Markevich N, Schutzer RW, Kallakuri S, Jacob T, Hingorani A: *Small popliteal artery aneurysms: Are they clinically significant?* J Vasc Surg, 2003; 37:755-60.
- 12) Lowell RC, Gloviczki P, Hallett JV, Naessens JM, Maus TP, Cherry KJ Jr, Bower TC, Pairolero PC: *Popliteal artery aneurysms: The risk of nonoperative management.* Ann Vasc Surg, 1994; 8:14-23.
- 13) Galland RB, Magee TR: *Popliteal aneurysms: Distorsion and size related to symptoms.* Eur J Vasc Endovasc Surg, 2005; 30:534-38.
- 14) Marin ML, Veith FJ, Panetta TF, Cynamon J, Bakal CW, Suggs WD, Wengerter KR, Baronè HD, Schonholz C, Parodi JC: *Transfemoral endoluminal stented graft repair of a popliteal artery aneurysm.* J Vasc Surg, 1994; 19:754-57.
- 15) Wensing PJ, Scholten FG, Buijs PC, Hartkamp MJ, Mali WP, Hillen B: *Arterial tortuosity in the femoropopliteal region during knee flexion: A magnetic resonance angiography study.* J Anat, 1995; 187:133-39.
- 16) Nelson PR, Anthony Lee W: *Endovascular treatment of popliteal artery aneurysms.* Vascular, 2006; 14:297-304.
- 17) Tielliu IF, Verhoven EL, Zeebregts CJ, Prins TR, Spann MM, van den Dungen JJ: *Endovascular treatment of popliteal artery aneurysms: Result of a prospective cohort study.* J Vasc Surg, 2005; 41:561-66.
- 18) Tielliu IF, Zeebregts CJ, Vourliotakis G, Bekkema F, van den Dungen JJ, Prins TR, Verhoeven EL: *Stent fractures in the Hemobahn/Viabahn stent graft after endovascular popliteal aneurysm repair.* J Vasc Surg, 2010; 51:1413-418.
- 19) Zaraca F, Ponzoni A, Stringari C, Ebner JA, Giovannetti R, Ebner H: *The posterior approach in the treatment of popliteal artery aneurysm: Feasibility and analysis outcome.* Ann Vasc Surg, 2010; 24: 863-70.
- 20) Pulli R, Dorigo W, Troisi N, Innocenti AA, Pratesi G, Azas L, Pratesi C: *Surgical management of popliteal artery aneurysms: Which factors affect outcomes?* J Vasc Surg, 2006; 43:481-87.