Comparative assessment of radial distensibility and wall stiffness of the superficial femoral artery in healthy volunteers and patients after various types of its revascularization

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Informed consent

The patient's and healthy volunteers informed consents to use the records for medical purposes are obtained.

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Conflicts of interest

The authors declare no conflicts of interest.

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Abstract

Introduction. The study of the elastic properties of the arteries of the lower extremities is necessary for the development of methods for effective surgical treatment and the prediction of their complications.

Objective. The aim of our study was to compare the radial deformation properties (stiffness and radial extensibility of the vascular wall) of various segments of native arteries of the femoropopliteal segment and arteries after various reconstructive interventions under physiological conditions using ultrasound imaging.

Methods. A prospective cohort study ($n = 40$) was conducted. Four groups were formed: Group 1 ($n = 10$) – healthy volunteers; Group 2 – patients after semi-closed loop endarterectomy ($n = 10$); Group 3 – patients after endovascular recanalization of the superficial femoral artery using cut nitinol stents ($n = 10$); Group 4 – patients after endovascular recanalization of the superficial femoral artery using braided nitinol stents ($n = 10$). All participants underwent ultrasound measurement of the stiffness index and radial extensibility of the vascular wall at 5 points.

Results. Radial extensibility of the femoropopliteal artery wall in the supine position averages 10 %, with the exception of the Hunter's canal region, where it is almost 4 times lower (2.8 %, $p < 0.001$). In the supine position, the deobliterated superficial femoral artery after loop endarterectomy in the adductor canal of the femur has a 2-fold higher (5.6 %) radial extensibility of the vascular wall compared to the native artery. The stented superficial femoral artery demonstrates a significant decrease in radial distensibility of the vessel wall in both positions (0.6–0.7 %).

Conclusion. Radial distensibility of the superficial femoral artery wall under physiological conditions is nonuniform, with the lowest distensibility observed in the Hunter's canal. Semi-closed endarterectomy maintains acceptable arterial biomechanics, while stenting significantly increases wall stiffness, which may be one of the reasons for its unsatisfactory long-term results. The development of stents with properties similar to those of native arteries is necessary.

Keywords: atherosclerosis; biomimetics; peripheral arterial disease; radial distensibility of the vascular wall; stiffness index; ultrasonography

Сравнительная оценка радиальной растяжимости и жесткости стенки поверхностной бедренной артерии у здоровых добровольцев и пациентов после различных видов ее реваскуляризации

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Аннотация

Актуальность. Исследование упруго-эластических свойств артерий нижних конечностей необходимо для разработки методов эффективного хирургического лечения и прогнозирования их осложнений.

Цель. Целью нашего исследования было сравнение радиальных деформационных свойств (жесткости и радиальной растяжимости сосудистой стенки) различных сегментов нативных артерий бедренно-подколенного сегмента и артерий после различных реконструктивных вмешательств в физиологических условиях с помощью ультразвуковой визуализации.

Методы. Проведено проспективное когортное исследование ($n = 40$). Были сформированы 4 группы: 1-я группа ($n = 10$) – здоровые добровольцы; 2-я группа – пациенты после полузакрытой петлевой эндартерэктомии ($n = 10$); 3-я группа – пациенты после эндоваскулярной реканализации поверхностной бедренной артерии с использованием резаных нитиноловых стентов ($n = 10$); 4-я группа – пациенты после эндоваскулярной реканализации поверхностной бедренной артерии с использованием плетеных нитиноловых стентов ($n = 10$). Всем участникам проводилось ультразвуковое измерение индекса жесткости и радиальной растяжимости сосудистой стенки в 5 точках.

Результаты. Радиальная растяжимость стенки бедренно-подколенных артерий в положении лежа составляет в среднем 10 %, за исключением области Гунтерова (приводящего) канала, где она почти в 4 раза меньше (2,8 %; $p < 0{,}001$). В положении лежа дезоблитерированная поверхностная бедренная артерия после петлевой эндартерэктомии в приводящем канале бедра имеет в 2 раза большую (5,6 %) радиальную растяжимость сосудистой стенки по сравнению с нативной артерией. Стентированная поверхностная бедренная артерия демонстрирует значительное снижение радиальной растяжимости сосудистой стенки в обоих положениях (0,6–0,7 %).

Заключение. Радиальная растяжимость стенки поверхностной бедренной артерии в физиологических условиях неоднородна, при этом наименьшая растяжимость отмечается в области Гунтерова канала. Полузакрытая эндартерэктомия сохраняет приемлемую биомеханику артерии, в то время как стентирование значительно увеличивает жесткость стенки, что может являться одной из причин его неудовлетворительных отдаленных результатов. Необходима разработка стентов со свойствами, близкими к свойствам нативных артерий.

Ключевые слова: атеросклероз; биомиметика; заболевание периферических артерий; индекс жесткости; радиальная растяжимость сосудистой стенки; ультрасонография

Introduction

The arteries of the femoropopliteal segment are most frequently affected by atherosclerosis, and their reconstruction is associated with a high rate of restenosis and reinterventions [1–3]. This is possibly due to the fact that the arteries of this segment undergo various deformations during physiological movements in the joints and are also susceptible to the influence of surrounding structures, for example, the muscular-fascial sheath of the adductor (Hunter's) canal of the thigh [4]. Among the infrainguinal arteries, the superficial femoral artery (SFA) is most commonly affected by atherosclerosis, which ultimately leads to its occlusion and, consequently, to the development of chronic limb-threatening ischemia (CLTI) with a significant reduction in quality of life and disability in case of limb loss [5]. In this regard, understanding the biomechanical features of arteries in various segments, as well as the devices used for revascularization, may help explain unsatisfactory long-term treatment outcomes and improve them. Biomechanics of arteries is a scientific field that studies the mechanical properties and response of arteries to various forces and stresses, as well as their influence on the normal functioning and development of pathologies of the vascular system. This field combines knowledge from the areas of mechanics, biology, and medicine to understand how arteries deform, contract, and respond to hemodynamic factors, such as blood pressure and blood flow volume [6]. The basis of arterial function lies in the elastic properties of the arterial wall – its radial deformation allows arteries to act as a hydraulic damper, while pulsatile activity is important both for overall hemodynamics and maintaining sufficient blood flow during diastole (the elastic wall absorbs energy during systole, releasing it during diastole) and for ensuring endothelial function and vessel wall nourishment [7; 8].

However, data on the biomechanics, particularly the features of radial deformation, of the arteries of the femoropopliteal segment remain limited [9]. The issue of non-radial deformations of the SFA is most frequently raised in the literature [10–13]. Primarily, the understanding of the deformation properties of lower limb arteries has been obtained through experimental studies on static models (experimental test benches, cadaveric material, contrast-enhanced computed tomography data). Studies on the biomechanics of the SFA under physiological conditions are quite scarce [14].

The main non-invasive method for studying the elastic properties of arteries under physiological conditions is ultrasound examination. It allows for the measurement of stiffness, compliance, and deformation of the arterial wall in various body positions in space [15].

The aim of our study was to assess the stiffness index (SI) and radial strain of the vascular wall (RSVW) of various segments of native infrainguinal arteries, as well as implanted devices, in patients with atherosclerosis of the lower limb arteries after various reconstructive interventions on the infrainguinal arterial segment (semi-closed loop endarterectomy of the SFA, stenting using laser-cut and braided nitinol stents) under physiological conditions using ultrasound imaging.

Methods

Study Design

A prospective cohort pilot study of volunteers without atherosclerotic lesions of the infrainguinal arteries and patients with atherosclerosis of the lower limb arteries after various reconstructive interventions on the infrainguinal arterial segment (semi-closed loop endarterectomy of the SFA, stenting using laser-cut and braided nitinol stents) was conducted in accordance with the principles of the Helsinki Declaration and Good Clinical Practice guidelines. The study was approved by the Local Ethics Committee (protocol code – 23-75-10047, approval date – August 14, 2023).

Four study groups were formed (Fig. 1): Group 1 – healthy volunteers; Group 2 – patients after semi-closed loop endarterectomy of the SFA; Group 3 – patients after endovascular recanalization of the SFA using laser-cut nitinol stents; Group 4 – patients after endovascular recanalization of the SFA using braided nitinol stents. The study included 40 individuals, with 10 people in each group.

Selection of Healthy Volunteers

Inclusion criteria: Male volunteers aged 18–35 years without symptoms or signs of atherosclerotic peripheral artery disease according to lower limb artery ultrasound; signed voluntary informed consent of the study participant; BMI – 18.5–30 kg/m^2.

Exclusion criteria: Significant allergic history; presence of chronic and acute pathology of the cardiovascular, respiratory, urinary, intestinal, and endocrine systems; lesions of the central and peripheral nervous systems; musculoskeletal disorders; injuries and/or surgeries on the lower limbs; skin lesions of the lower limbs; acute infectious diseases less than 4 weeks before the start of the study; use of medications with a pronounced effect on hemodynamics; blood donation (450 ml of blood or plasma or more) less than 2 months before the start of the study; medical history of alcoholism, drug addiction, or drug abuse; smoking; professional athletes.

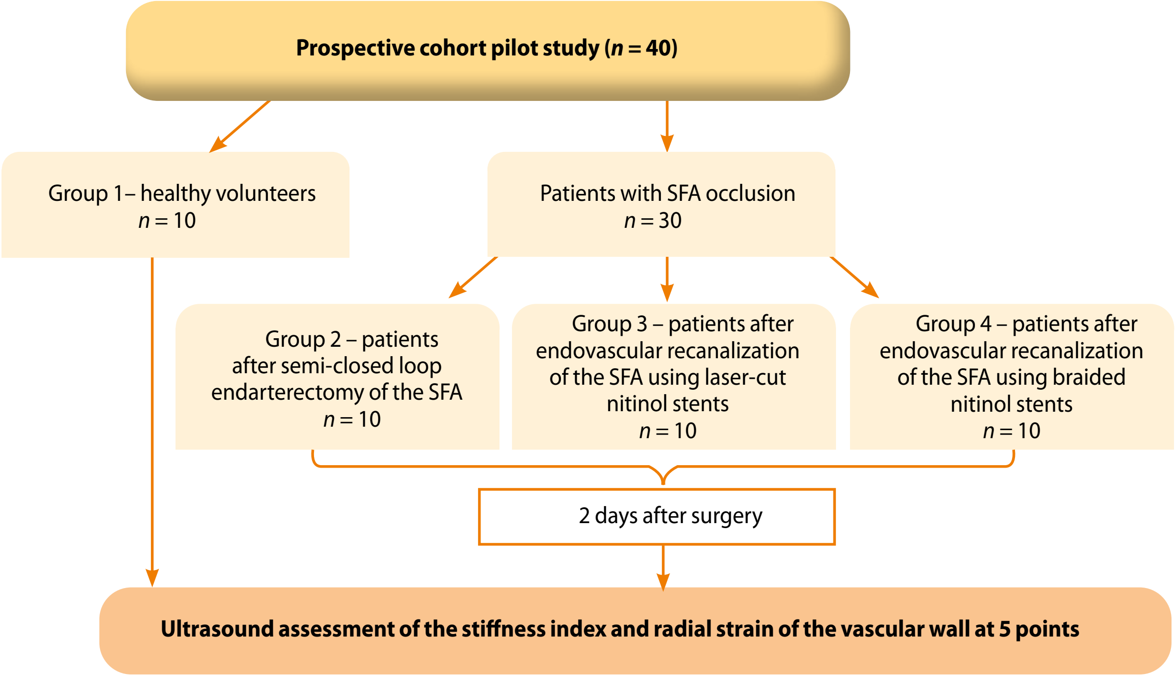

Fig. 1. Study Design

Note. SFA – superficial femoral artery.

Selection of Patients

Inclusion criteria: Adult patients with occlusive atherosclerotic lesions of the SFA, symptoms of intermittent claudication with a pain-free walking distance of less than 200 m or rest pain (stage of chronic limb-threatening ischemia – 2B and 3 according to A.V. Pokrovsky classification) after a successfully performed revascularization procedure above the knee joint space (semi-closed loop endarterectomy of the SFA, stenting using laser-cut and braided nitinol stents without the distal end of the stent extending into the P1 segment of the popliteal artery) in the early postoperative period (3–7 days after surgery).

Exclusion criteria: Ipsilateral iliac artery lesions; previous surgeries on ipsilateral arteries; patients with aortic aneurysm; patients who have undergone aortic aneurysm reconstruction.

Methods for Assessing Vascular Wall Stiffness and Radial Strain Compliance

All participants underwent ultrasound examination in M-mode and B-mode of the femoropopliteal arteries in the supine and standing positions. For participants in groups 2–4, the examination was performed on the 2nd day after the surgical intervention. Measurements were taken simultaneously by two experienced ultrasound specialists who made decisions collegially. The examination was performed using a GE Vivid IQ ultrasound machine (GE Healthcare, USA) with a linear transducer (L-9). In M-mode, the systolic (SD) and diastolic (DD) diameters of the arteries were measured over 2–4 cardiac cycles with simultaneous measurement of blood pressure (Fig. 2) [14].

The stiffness index (SI) and radial strain of the vascular wall (RSVW) in M-mode were calculated using the following formulas:

$$SI = \ln (SBP - DBP) / [(SD - DD) / DD],$$

where SBP is systolic blood pressure; DBP is diastolic blood pressure;

$$RSVW = (SD - DD) / DD.$$

Diastolic and systolic diameters were measured at 5 points: point No. 1 – common femoral artery (CFA); point No. 2 – proximal part of the deep femoral artery (origin of the DFA); point No. 3 – origin of the superficial femoral artery (SFA); point No. 4 – SFA in the adductor canal of the thigh; point No. 5 – segment P1 of the popliteal artery (Fig. 3).

Statistical Analysis

The Shapiro – Wilk *W* test was used to assess the normality of distribution for quantitative data. Quantitative

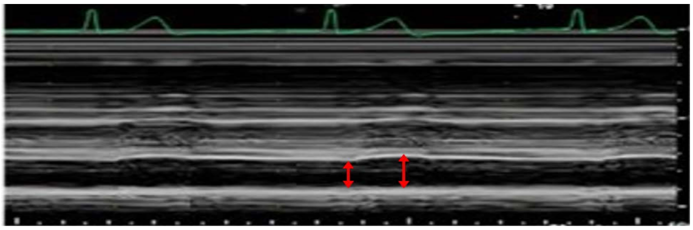

Fig. 2. M-mode ultrasound display of an artery for measuring diastolic and systolic diameters

Fig. 3. Points for ultrasound measurements

data with normal distribution are presented as mean ± standard deviation, while data with non-normal distribution are presented as median with interquartile range. Statistically significant differences between independent quantitative variables were determined using the Mann – Whitney *U* test. Differences between dependent quantitative variables were determined using the Wilcoxon signed-rank test. Statistically significant differences among multiple independent quantitative and qualitative variables were determined using the Kruskal – Wallis test. Statistically significant differences between qualitative variables were determined using Fisher's exact two-tailed test. All calculations were performed using Statistica 12 software (StatSoft, USA). Values of $p < 0.05$ were considered statistically significant.

Results

Results in Group 1 (Healthy Volunteers)

The main biomechanical properties of the arteries of the femoropopliteal segment at 5 points and in different body positions are presented in Table 1.

The median RSVW in the supine position averaged 10 %, except for Hunter's canal, where it was almost 4 times lower and equaled 2.8% ($p = 0.0006$). In the standing position, the radial strain of the vascular wall decreased by 2–4 times at all points except the adductor canal of the thigh, where it decreased by only 28.5 % and amounted to 2.0 % ($p = 0.009$). Accordingly, the stiffness index changed inversely proportional to the RSVW.

Results in Patient Groups After Intraluminal Recanalization of the SFA

The baseline characteristics of patients with infrainguinal artery lesions after undergoing revascularization procedures are presented in Table 2. The patients did not differ statistically significantly in terms of sex, age, and the presence of comorbidities. Moderate to severe intermittent claudication (pain-free walking distance – less than 200 m) was present in 70% of patients (CLTI stage 2B according to A.V. Pokrovsky), and 30% of patients had rest pain (CLTI stage 3 according to A.V. Pokrovsky).

Results in Group 2 (Patients After Semi-Closed Loop Endarterectomy of the SFA)

The main biomechanical properties of the arteries of the femoropopliteal segment in different body positions in patients who underwent semi-closed loop endarterectomy are presented in Table 3.

In the supine position, a moderate decrease in the radial strain of the vascular wall was observed in the CFA, and at the origins of the DFA and SFA by 20 % compared to native arteries in healthy volunteers. At the same time, the endarterectomized SFA in the adductor canal of the thigh showed a 2 times higher RSVW (5.6 %) compared to the native artery (2.8 %) ($p < 0.001$).

In the standing position, the endarterectomized SFA in Hunter's canal demonstrated a 30% higher RSVW compared to the native artery (2.6 % and 2.0 %, respectively; $p = 0.13$). As with native arteries, a statistically significant increase in SI and decrease in RSVW were observed in the standing position.

Table 1. Stiffness Index and Radial Strain of the Vascular Wall in M-mode for Native Arteries of the Femoropopliteal Segment in Different Body Positions

Measurement Point	Supine Position	Standing Position	*p*-value
Stiffness Index			
CFA	6.022 [5.962; 6.241]	7.180 [6.724; 8.071]	0.001
DFA Origin	5.837 [5.768; 6.397]	6.440 [6.284; 7.123]	0.004
SFA Origin	5.973 [5.789; 6.477]	6.941 [6.430; 7.155]	0.002
SFA in Hunter's Canal Region	7.258 [7.151; 7.633]	7.601 [7.200; 7.800]	0.382
Popliteal Artery Segment P1	6.380 [6.231; 6.427]	6.749 [6.402; 7.378]	0.001
Radial Strain of the Vascular Wall			
CFA	0.103 [0.078; 0.113]	0.027 [0.013; 0.054]	0.001
DFA Origin	0.115 [0.081; 0.125]	0.065 [0.032; 0.083]	0.004
SFA Origin	0.100 [0.062; 0.127]	0.048 [0.031; 0.081]	0.002
SFA in Hunter's Canal Region	0.028 [0.017; 0.039]	0.020 [0.016; 0.030]	0.463
Popliteal Artery Segment P1	0.068 [0.060; 0.089]	0.047 [0.025; 0.071]	0.001

Note. DFA – deep femoral artery; CFA – common femoral artery; SFA – superficial femoral artery.

Results in Groups 3 and 4 (Patients After Stenting of the SFA with Laser-Cut Nitinol Stents or Braided Nitinol Stents, Respectively)

The main biomechanical properties of the arteries of the femoropopliteal segment in different body positions in patients after stenting of the SFA with laser-cut or braided nitinol stents are presented in Tables 4 and 5, respectively. A high SI and low RSVW (0.6–0.7 %) can be noted for the stented SFA in the adductor canal of the thigh in both positions.

The median wall strain of the SFA in Hunter's canal for healthy volunteers and after intraluminal recanalization of the SFA in the projection of the adductor canal of the thigh is presented in Fig. 4.

Discussion

In this prospective pilot study, values for the SI and RSVW were obtained under physiological conditions using M-mode ultrasound imaging in healthy volunteers and in patients with SFA occlusion after infrainguinal open or endovascular revascularization [16; 17]. The selection of these specific parameters was based on their relative accessibility and their ability to reflect different aspects of arterial wall stiffness.

The Stiffness Index, calculated based on pulse pressure and arterial diameter, reflects the elastic properties of the vascular wall. Its advantage lies in its simplicity and non-invasive measurement, but it is dependent on blood pressure, which can distort its results with fluctuations. Radial strain of the vascular wall in M-mode is a more direct indicator of elasticity, which is also less dependent on pressure; however, unlike SI, it requires a highly skilled operator and standardized scanning protocols.

In healthy volunteers with native arteries of the femoropopliteal segment in the standing position, SI and RSVW showed statistically significant differences at all studied points, except for the region of the adductor canal of the thigh. This is associated with the effect of

Table 2. Baseline Characteristics of Included Patients with SFA Occlusion After Infrainguinal Revascularization

Indicator	Endarterectomy (LE) *n* = 10	Laser-Cut Stent (LCS) *n* = 10	Braided Stent (BS) *n* = 10	*p*-value
Age, years	65.2 ± 7.1	64.8 ± 4.3	67.3 ± 5.2	0.82
Smoking, *n* (%)	6 (60)	6 (60)	8 (80)	1.00
Hypertension, *n* (%)	8 (80)	8 (80)	7 (70)	1.00
Ischemic Heart Disease, *n* (%)	8 (80)	8 (80)	7 (70)	1.00
Chronic Heart Failure, *n* (%)	8 (80)	8 (80)	7 (70)	1.00
Chronic Kidney Disease, *n* (%)	1 (10)	3 (30)	2 (20)	0.72
Diabetes Mellitus, *n* (%)	2 (20)	2 (20)	1 (10)	0.62
Intermittent Claudication <200 m, *n* (%)	7 (70)	7 (70)	7 (70)	1.0
Rest Pain, *n* (%)	3 (30)	3 (30)	3 (30)	1.0

Note. BS – braided nitinol stent; LE – loop endarterectomy; LCS – laser-cut nitinol stent.

Table 3. Stiffness Index and Radial Strain of the Vascular Wall of Femoropopliteal Segment Arteries After Semi-Closed Loop Endarterectomy of the SFA in Different Body Positions

Measurement Point	Supine Position	Standing Position	*p*-value
	Stiffness Index		
CFA	6.253 [5.949; 6.423]	6.934 [6.592; 7.187]	0.005
DFA Origin	6.250 [6.112; 6.967]	6.754 [6.441; 6.872]	0.028
SFA Origin	6.646 [6.283; 6.854]	6.933 [6.490; 7.604]	0.005
SFA in Hunter’s Canal Region	6.700 [6.62; 6.778]	7.454 [6.509; 7.626]	0.028
Popliteal Artery Segment P1	7.287 [6.704; 8.691]	6.508 [6.484; 8.022]	0.005
	Radial Strain of the Vascular Wall		
CFA	0.086 [0.081; 0.102]	0.048 [0.030; 0.061]	0.005
DFA Origin	0.077 [0.047; 0.099]	0.052 [0.051; 0.063]	0.028
SFA Origin	0.051 [0.047; 0.093]	0.038 [0.022; 0.075]	0.005
SFA in Hunter’s Canal Region	0.056 [0.055; 0.093]	0.026 [0.019; 0.074]	0.028
Popliteal Artery Segment P1	0.067 [0.008; 0.055]	0.039 [0.016; 0.068]	0.045

Note. DFA – deep femoral artery; CFA – common femoral artery; SFA – superficial femoral artery.

gravity [18]. In the standing position, hydrostatic blood pressure in the lower limbs increases, leading to vessel distension and, consequently, increased stiffness of the arterial walls. In the supine position, gravitational effects on blood flow are minimized, and hydrostatic pressure is distributed more evenly – this reduces stress in the arteries and lowers their stiffness. Thus, the difference in arterial wall stiffness is due to changes in the distribution of arterial pressure depending on body position.

In Hunter’s canal, regardless of body position, high SI and low RSVW values were observed compared to other measurement points. This phenomenon may be related to the compressive effect on the neurovascular bundle by the muscular-fascial structures of the adductor canal of the thigh, as well as the high mechanical load from multidirectional forces arising from twisting caused by limb flexion [19–22].

Table 4. Stiffness Index and Radial Strain of the Vascular Wall of Femoropopliteal Segment Arteries After Stenting of the SFA with Laser-Cut Nitinol Stents in Different Body Positions

Measurement Point	Supine Position	Standing Position	*p*-value
	Stiffness Index		
CFA	6.315 [6.079; 6.483]	6.487 [6.363; 7.215]	0.044
DFA Origin	6.434 [5.995; 6.612]	6.551 [6.395; 6.889]	0.023
SFA Origin	6.503 [6.386; 6.613]	6.746 [6.490; 7.002]	0.074
Stented SFA Segment in Hunter’s Canal Region	8.954 [8.771; 9.082]	8.940 [8.753; 9.066]	0.673
Popliteal Artery Segment P1	6.448 [6.225; 6.601]	6.573 [6.362; 7.000]	0.332
	Radial Strain of the Vascular Wall		
CFA	0.089 [0.078; 0.114]	0.065 [0.044; 0.081]	0.039
DFA Origin	0.076 [0.067; 0.102]	0.071 [0.050; 0.080]	0.023
SFA Origin	0.072 [0.059; 0.083]	0.052 [0.037; 0.075]	0.092
Stented SFA Segment in Hunter’s Canal Region	0.006 [0.006; 0.007]	0.007 [0.006; 0.008]	0.673
Popliteal Artery Segment P1	0.079 [0.066; 0.096]	0.068 [0.027; 0.085]	0.284

Note. DFA – deep femoral artery; CFA – common femoral artery; SFA – superficial femoral artery.

Table 5. Stiffness Index and Radial Strain of the Vascular Wall of Femoropopliteal Segment Arteries After Stenting of the SFA with Braided Nitinol Stents in Different Body Positions

Measurement Point	Supine Position	Standing Position	*p*-value
	Stiffness Index		
CFA	6.320 [5.955; 6.951]	6.725 [6.290; 6.984]	0.021
DFA Origin	5.986 [5.695; 6.314]	6.393 [5.825; 6.447]	0.038
SFA Origin	6.608 [6.431; 6.780]	6.709 [6.577; 7.055]	0.046
Stented SFA Segment in Hunter's Canal Region	8.947 [8.856; 9.061]	8.991 [8.877; 9.128]	0.332
Popliteal Artery Segment P1	6.476 [6.148; 6.681]	6.528 [6.378; 6.833]	0.241
	Radial Strain of the Vascular Wall		
CFA	0.095 [0.052; 0.114]	0.071 [0.056; 0.096]	0.021
DFA Origin	0.127 [0.094; 0.167]	0.107 [0.085; 0.131]	0.038
SFA Origin	0.066 [0.056; 0.077]	0.056 [0.043; 0.066]	0.036
Stented SFA Segment in Hunter's Canal Region	0.006 [0.005; 0.007]	0.006 [0.005; 0.006]	0.386
Popliteal Artery Segment P1	0.080 [0.058; 0.103]	0.071 [0.059; 0.093]	0.241

Note. DFA – deep femoral artery; CFA – common femoral artery; SFA – superficial femoral artery.

The high radial strain of the vascular wall of the SFA in Hunter's canal after semi-closed loop endarterectomy, compared to the native artery at the same point, may be explained by the thinning of the arterial wall after removal of the intima and part of the media.

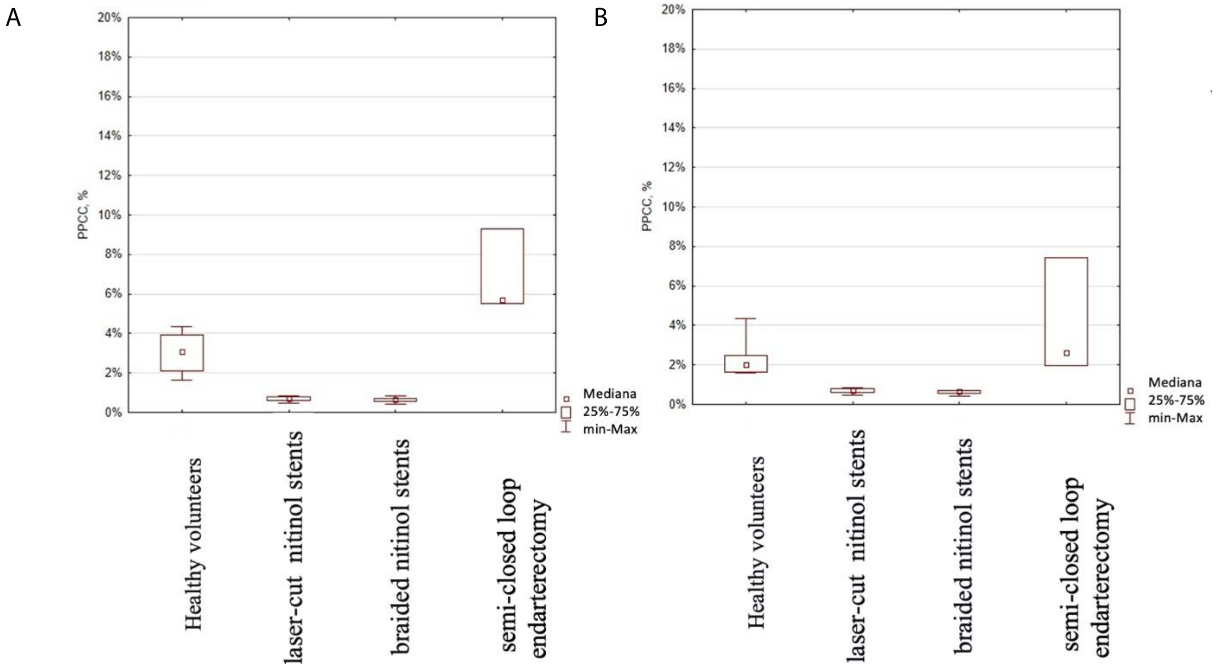

Fig. 4. M-mode of radial strain of the vascular wall of the superficial femoral artery in Hunter's canal for healthy volunteers, patients after stenting, and semi-closed loop endarterectomy in the projection of the adductor canal of the thigh: A – supine position; B – standing position
Note. RSVW – radial strain of the vascular wall.

The low RSVW and high SI of the stented SFA segment may be a cause of unsatisfactory treatment outcomes, for which long-term results are significantly influenced by both the compressive effect on the neurovascular bundle from the muscular-fascial structures of the adductor canal of the thigh and the stent design itself. Previous studies have shown that stenting of the SFA in the region of Hunter's canal is associated with a high risk of stent fracture, which can be reduced by dissecting the lamina vastoadductoria, thereby positively impacting long-term patency [23; 24].

The rigid nitinol stent frame blocks pulse wave propagation and increases the risk of restenosis and/or re-occlusion. In our previous study, a comparison of long-term outcomes of stenting and semi-closed loop endarterectomy for complex SFA occlusions was conducted. The 4-year primary patency of the operated segment was statistically significantly higher after semi-closed loop endarterectomy (46 % vs. 28 %; $p = 0.04$). Preservation of pulse wave conduction along the arterial wall after its endarterectomy played a significant role in this [25].

Considering the obtained data, it is necessary to continue developing devices with biomechanical properties similar to native arteries, which may ultimately improve the long-term treatment outcomes for patients with stenotic-occlusive lesions of the lower limb arteries.

Study Limitations

This study is a pilot study with a small sample of healthy volunteers and patients. Despite the small sample size, statistically significant results were obtained and explained by us. Participant recruitment for the study is ongoing.

Conclusion

The radial strain of the superficial femoral artery wall under physiological conditions is non-uniform. The greatest stiffness and lowest strain are observed in the region of Hunter's (adductor) canal of the thigh, which is associated with anatomical features and mechanical impact from surrounding tissues. Semi-closed loop endarterectomy allows preservation of the artery with acceptable biomechanical properties, demonstrating even greater radial strain in the region of the adductor canal compared to the native artery, and can be recommended in the absence of suitable autogenous venous material. Stenting (with both laser-cut and braided nitinol stents) leads to a significant increase in stiffness and a sharp decrease in the radial strain of the vascular wall in the stented segment, which may be one of the reasons for unsatisfactory long-term outcomes of stenting. It is necessary to continue the development of devices with biomechanical properties similar to native arteries.

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