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Distal transradial versus conventional transradial access in acute coronary syndrome

Akut koroner sendromda distal transradial erişim ile konvansiyonel transradial erişimin karşılaştırması

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ABSTRACT

Objective: Distal transradial access (TRA) has been recently introduced as an alternative access site for coronary angiography (CAG). Both procedures can be performed in cardiology clinics by interventional cardiologists. Although distal TRA is considered to be more difficult as it requires artery puncture and experienced cardiologists, it seems to be more advantageous because of the limited risk of arterial occlusion. In this study, we share our experiences with distal TRA and conventional TRA.

Methods: Seventy patients undergoing CAG via distal TRA and 63 patients via conventional TRA were included in this study. The patients' data were reviewed retrospectively and compared in terms of procedural characteristics and complications.

Results: There was no significant difference between the distal TRA group (94.2%) and the conventional TRA group (98.4%) in terms of success rate (p=0.217). In the distal TRA group, the total sheath emplacement time was longer (p<0.001), and hemostasis time was shorter (p<0.001) compared with conventional TRA. Total procedural time and hospitalization period were not statistically different between the groups (p>0.05). Radial spasm and radial occlusion were more common in the conventional TRA group than in the distal TRA group (7.9% vs 1.4% and 3.1% vs 1.4%, respectively), and hematomas were not statistically different between the groups.

Conclusion: Although distal TRA seems more advantageous in terms of less hemostasis time and less vascular complications, it takes a longer time for sheath insertion and may cause more pain, which may diminish its efficiency. Large-scale studies are needed to address this issue.

ÖZET

Amaç: Distal transradial erişim (TRE), son zamanlarda koroner anjiyografi (KAG) için alternatif bir erişim bölgesi olarak tanıtılmıştır. Distal TRE ve geleneksel TRE işlemlerinin her ikisi de girişimsel kardiyologlar tarafından uygulanabilmektedir. Distal TRE arter ponksiyonu ve giriş kısmen daha zordur ve ayrıca ek deneyim ve tecrübe istemekle birlikte radial arter oklüzyonunun daha az olması açısından avantajlı gibi görünmektedir. Bu çalışmanın amacı, distal TRE ve geleneksel TRE ile ilgili deneyimlerimizi paylaşmaktır.

Yöntemler: Distal TRE yöntemi ile yapılan ardışık 70 KAG hastası ile geleneksel TRE yöntemi ile yapılan 63 hasta retrospektif olarak incelendi ve işlemsel özellikler ve komplikasyonlar açısından karşılaştırıldı.

Bulgular: Başarı oranı açısından distal TRE grubu ile (94.2%), geleneksel TRE grubu (98.4%) arasında istatistiksel olarak anlamlı bir fark yoktu (p=0.217). Toplam sheath yerleştirme süresi distal TRE grubunda daha uzun (p<0.001), hemostaz zamanı daha kısa (p<0.001) tespit edildi. Toplam işlem süresi ve hastanede yatış süresinde iki grup arasında fark yoktu (p>0.05). Distal TRE grubunda 3 hastada (4.2%) minör kanama olurken, geleneksel TRE grubunda kanama komplikasyonu olmadı. Radial spasm ve radial oklüzyon geleneksel TRE grubunda distal TRE grubuna göre daha fazla (7.9% ve 1.4%; 3.1% ve 1.4%, sırasıyla), hematom ise gruplar arasında istatistiksel olarak farklı değildi.

Sonuç: Distal TRE daha az hemostaz zamanı ve daha az vasküler komplikasyonlar konusunda daha fazla avantajlı gibi görünürken, sheath yerleştirme zamanı daha uzun ve daha ağrılı bir işlemdir. Bu durum klinik etkinliğini azaltabilir. Bu durumu netleştirecek daha kapsamlı çalışmalara ihtiyaç vardır.

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Coronary angiography (CAG) and percutaneous coronary intervention (PCI) play an important role in the diagnosis and treatment of coronary artery disease (CAD). Technological advances and a better conception of the vascular system anatomy have led to the emergence of new ideas and techniques in CAG.[1] Numerous studies have been carried out so far to determine the most appropriate anatomical site for certain patients and in different conditions.

Despite the ease of femoral artery access for CAG, vascular complications apart from the risks of increased bleeding, morbidity, mortality, and length of hospital stay, particularly in patients taking anticoagulation and antiplatelet therapies, have prompted researchers to seek alternative approaches.[2] Transradial access (TRA) was introduced as a result of such a need, with the first angiography performed by Radner[3] using a cut-down technique in 1947. Percutaneous TRA for CAG was first performed by Campeau[4] from the Montreal Heart Institute in 1986, and the first 100 cases were published in 1989. The first radial transluminal coronary angioplasty with a Palmaz-Schatz stent implantation was performed by Kiemeneij in 1992 and was a milestone in invasive cardiology.[5-7] When compared with the transfemoral approach (TFA), the most important advantages offered by TRA include fewer bleeding complications, improved safety and patient comfort, and early mobilization of the patient following the procedure.[8] TRA in coronary interventions has been adopted worldwide as a result of these advantages.[8,9] Therefore, TRA has been recognized as a default method for vascular access in most coronary interventions and has witnessed an increased use in peripheral endovascular and interventional radiological procedures as well.[10]

Although TRA has become the golden approach in routine coronary procedures, there exists some disadvantages such as radial artery occlusion which is seen in approximately 4% of the patients as a silent complication despite appropriate anticoagulation.[11] Furthermore, repeated transradial procedures may increase the probability of arterial occlusion. This, in particular, may limit the use of transradial interventions for repeated procedures in emergency cases. Furthermore, transradial interventions may also cause radial injuries without occlusion, leading to arterial stenosis because of intimal hyperplasia and endothelial damage. Recently, distal TRA has been proposed as a new approach that cancels out these disadvantages of TRA.[12-16]

There are some studies reporting that this new approach is more advantageous than the classical radial approach owing to limited occlusion, compression syndrome, limited risk of bleeding, and increased patient and operator comfort.[15]

Abbreviations:

ASA	*Acetylsalicylic acid*
BMI	*Body mass index*
CABG	*Coronary artery bypass graft*
CAD	*Coronary artery disease*
CAG	*Coronary angiography*
ECG	*Electrocardiography*
NSTEMI	*Non-ST-segment elevation myocardial infarction*
PCI	*Percutaneous coronary intervention*
STEMI	*ST-segment elevation myocardial infarction*
TFA	*Transfemoral approach*
TIMI	*Thrombolysis in myocardial infarction*
TRA	*Transradial access*
VAS	*Visual Analogue Scale*

In this study, our aim was a retrospective evaluation of the procedures performed on patients admitted to our clinics and to compare our experiences with those in the relevant literature comparing distal transradial and conventional transradial techniques.

METHODS

In this retrospective study, 70 patients underwent distal TRA and 63 patients underwent conventional TRA. Procedural characteristics such as sheath insertion time, hemostasis time, total fluoroscopy time, complications, coronary interventions, previous comorbidities, and medications were recorded. The Ethics Committee of Selçuk University School of Medicine approved this study (Approval Date: May 22, 2019; Approval Number: 2019/136).

ST-segment elevation myocardial infarction (STEMI) was defined as new ST elevation at the J point in two contiguous leads of >0.1 mV, new or presumed new left bundle branch block, or isolated posterior MI. Non-ST-segment elevation myocardial infarction (NSTEMI) was defined by the rise and fall of cardiac biomarkers accompanied by at least one of the following: symptoms of ischemia, new ST-segment/T-wave changes, or development of pathologic Q waves on the electrocardiography (ECG). Unstable angina was defined by the presence of clinical symptoms of new-onset anginal chest pain, change in typical anginal pattern, development of angina at rest, or change in typical anginal equivalent without

myocardial necrosis as evidenced by normal cardiac biomarkers regardless of ST-segment depression or T-wave inversions on ECG.[17]

All the procedures were performed by a single operator. The consecutive patients admitted to the emergency room were first assigned to the conventional TRA group and then to the distal TRA group. The pulsation of the distal radial artery was confirmed manually via palpation. The right distal radial artery in the anatomical snuffbox was used as the primary access site when performing distal TRA (Figure 1), and skin preparation was performed for the left distal radial artery, which was set as the secondary access site. The right hand was placed in the semi-prone position with the forearm supported with pads. Lidocaine 2% was infiltrated subcutaneously for local anesthesia. Terumo Radifocus Introducer II Transradial Kit Introducer 6F Sheath (Terumo Medical, Tokyo, Japan) was used in both the groups. A 6F Sheath was used in both groups. A small skin incision was made in the distal transradial intervention. A radial spasmolytic cocktail containing verapamil 2.5 mg, nitroglycerine 100 mcg, and 3000 IU unfractionated heparin was administered. Catheters 5F right and left (Boston Scientific) were used for diagnostics with 6F right or left guiding catheters (Boston Scientific) being used for interventional procedures.

Procedural success was defined as the successful insertion of the sheath and the completion of the CAG or PCI without any need to switch to another artery for vascular access. Access time was defined as the time from the subcutaneous administration of the local anesthetic to the administration of the standard spasmolytic cocktail by the nurse.

After the procedure, the radial artery compression device TR Band (Terumo Medical, Tokyo, Japan) was employed in all cases undergoing conventional TRA. When removing the sheath, the first hemostasis was achieved with 15 mL of air. The TR band was slowly deflated until pulse and blood flow were seen. Then, 2 mL air was given again to achieve hemostasis. The same device was also used for all cases in patients with distal TRA. As in conventional TRA, it was placed on the radial artery. Because of anatomical differences of the patients' snuffboxes, manual pressure on distal radial artery was performed with a sterile sponge for 5 minutes after sheath removal and before application of TR Band. The first hemostasis

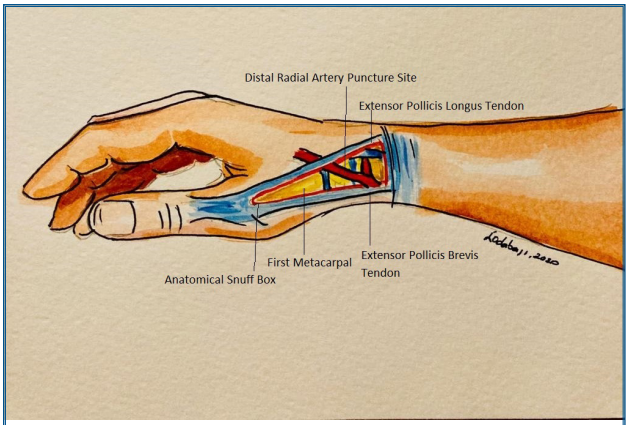

Figure 1. The anatomical relationship of the distal radial artery in the anatomical snuffbox and surrounding tendons.

with TR Band was achieved with 15 mL air when removing the sheath. The TR band was slowly deflated until pulse and blood flow were seen. Air 2 mL was given again to achieve hemostasis. After the procedure, hemogram measurements were made at the 12th hour in all the patients, and if necessary, at the 6th and the 24th hours again. To differentiate major and minor bleedings, the thrombolysis in myocardial infarction (TIMI) major bleeding was defined as a decrease of >5g/dL in hemoglobin, together with clinically significant hemorrhage or intracranial hemorrhage, and TIMI minor bleeding was defined as 3 g/dL but a ≤5 g/dL decrease in hemoglobin, together with significant bleeding.[18] The wrist diameter was measured 2 cm above the styloid process. Risk factors and medications were recorded during face-to-face interviews with the patients, and past diseases and medications used by the patients were retrieved from the social security system network (Medula). Similarly, the Visual Analogue Scale (VAS) pain score was recorded during the face-to-face interviews. The radial artery was evaluated by the investigator with a superficial Doppler ultrasound in all the patients. Patients without radial blood flow, decreased flow, or complaints were re-evaluated by the radiologist. The study was conducted with an effect size of 0.3 and a value of α=0.05 with 80% power.

Statistical analysis

Continuous variables were expressed as mean±standard deviation and were compared using the Student's t-test. Categorical variables were expressed as number and percentage and were analyzed using the Fisher's exact and chi-squared tests. Pearson's

correlation coefficient was used to evaluate the relationship between numerical variables. The data was evaluated using the SPSS version 21.0 for Windows (IBM Corp.; Armonk, NY, USA) software. A p value <0.05 was considered statistically significant.

RESULTS

Seventy patients who underwent distal TRA were compared with 63 patients who underwent conventional TRA. Baseline characteristics of the study population are shown in Table 1. In the distal TRA group, left distal radial artery for TRA was used in five (7.1%) patients because of a past history of coronary artery bypass graft (CABG) surgery. In the remaining 65 (92.9%) patients in the distal TRA group, right distal radial artery for TRA was used. The two groups were comparable in terms of basic characteristics such as age, sex, history of diabetes mellitus, and smoking. Family history of CAD and past history of PCI were higher in the distal TRA group than in the conventional TRA group (34.3% vs 1.6% and 24.3% vs 3.2%, respectively, p<0.001 for both). Regarding medications, only clopidogrel use was significantly more common among the patients who underwent conventional TRA compared to those who underwent distal TRA (87.3% vs 67.1%, p=0.007).

Features of procedural and post-procedural complications are shown in Table 2. Although the success rate was numerically lower in the distal TRA group than in the conventional TRA group, there was statistically no significant difference between them (94.2% vs 98.4%, p=0.217). Sheath insertion time was higher in distal TRA group when compared with that in the conventional TRA group (3.20±1.85 vs 1.53±0.63 min, p<0.001). However, there was also no significant difference regarding the total procedural time between the groups (Table 2).

Regarding radiation exposure, total fluoroscopy times, total air kerma, and total dose area product level were not different between the groups. Hemostasis time was significantly shorter in the distal TRA group than in the conventional TRA group (33.35±6.64 vs 43.98±5.20, p<0.001, respectively). Length of hospital stay and contrast medium exposure were also similar between the groups (Table 2).

Minor bleeding occurred in three (4.2%) patients in the distal TRA group, whereas no bleeding occurred in the conventional TRA group. Radial spasm and radial occlusion were more common in the conventional TRA group than in the distal TRA group (7.9% vs 1.4% and 3.1% vs 1.4%, respectively, p=0.101 and p=0.603). Hematomas were more common in the distal TRA group than in the conventional TRA group (7.1% vs 3.1%, p=0.445), although the difference between the groups was not statistically significant. Four patients in the distal TRA group suffered post procedural hand edema after 10-14 days, which is an unusual complication. The arterial Doppler study of these four patients was normal, and only tissue edema was detected. All of these patients were

Table 1. Baseline demographic and clinical characteristics of the study population

	Distal TRA (n=70)	Conventional TRA (n =63)	*p*
Age, years	67.5±12.8	65.6±12.1	0.393
Male (%)	44 (62.9%)	44 (69.8%)	0.253
Height, cm	167.2±28.9	172.4±6.1	0.172
BMI, kg/m^2	24.8±2.3	25.6±2.7	0.690
Wrist diameter, cm	18.0±0.7	17.9±0.5	0.523
Hypertension, (%)	62 (88.6%)	54 (85.7%)	0.407
Diabetes mellitus (%)	22 (31.4%)	22 (34.9%)	0.404
Hyperlipidemia (%)	63 (90.0%)	58 (92.1%)	0.458
Smoking (%)	36 (51.4%)	35 (55.6%)	0.634
Chronic AF (%)	7 (10.0%)	6 (9.5%)	0.580
Family history of CAD (%)	24 (34.3%)	1 (1.6%)	<0.001
Past PCI (%)	17 (24.3%)	2 (3.2%)	<0.001
Past CABG (%)	5 (7.1%)	2 (3.2%)	0.266
CHF (%)	11 (15.7%)	5 (7.9%)	0.133
ACE/ARB (%)	41 (58.6%)	44 (69.8%)	0.121
Beta blocker (%)	50 (71.4%)	51 (81.0%)	0.140
Statins (%)	61 (87.1%)	60 (95.2%)	0.090
ASA (%)	65 (92.9%)	61 (96.8%)	0.135
Clopidogrel (%)	47 (67.1%)	55 (87.3%)	0.007
Ticagrelor (%)	2 (2.9%)	3 (4.8%)	0.450
Prasugrel (%)	1 (1.4%)	0	0.526
GP IIb/IIIa inhibitors (%)	1 (1.4%)	0	0.526

ACE/ARB: angiotensin-converting enzyme/angiotensin receptor blockers; AF: atrial fibrillation; ASA: acetylsalicylic acid; cm: centimeter; BMI: body mass index; CABG: coronary artery bypass grafting; CAD: coronary artery disease; CHF: congestive heart failure; GP IIb/IIIa inhibitors: glycoprotein IIb/IIIa inhibitors; kg: kilogram; PCI: percutaneous coronary intervention; TRA: transradial access.

Table 2. Procedural characteristics of the study population

	Distal TRA (n=70)	Conventional TRA (n=63)	*p*
Success rate (%)	66 (94.2)	62 (98.4)	0.217
Total fluoroscopy time, min	6.8±1.7	6.7±2.8	0.627
Total air kerma, mGy	530.0±160.7	585.0±243.1	0.130
Total dose area product, mGy/m^2	37837.1±14327.5	52867.0±10917.9	0.149
Sheath insertion time, min	3.2±1.8	1.5±0.6	<0.001
Total procedural time, min	41.2±12.9	39.5±14.8	0.567
Hemostasis time, min	33.3±6.6	43.9±5.2	<0.001
Length of hospital stay, hour	45.4±14.1	46.2±12.1	0.786
Total amount of contrast agent, mL	113.4±40.6	116.5±36.3	0.154
UFH, iu	6263.9±1299.7	6400.0±1375.7	0.124
VAS pain score	3.48±0.76	2.98±0.60	0.034
Bleeding complications, overall	3	0	0.141
TIMI minor bleeding (%)	3 (4.2)	0	0.141
TIMI major bleeding (%)	0	0	-
Bleeding requiring transfusion (%)	0	0	-
Entry site complications, overall (%)	7 (10)	9 (14)	0.380
Surgical intervention to the entrance site (%)	0	0	-
Hematoma (%)	5 (7.1)	2 (3.1)	0.445
Radial spasm (%)	1 (1.4)	5 (7.9)	0.101
Radial occlusion (%)	1 (1.4)	2 (3.1)	0.603
Non-entry site complications, overall (%)	4 (5.7)	0	
Coronary perforation	0	0	-
Coronary dissection	0	0	-
TIA/CVA	0	0	-
Death	0	0	-
Aortic dissection	0	0	-
Hand edema (%)	4 (5.7)	0	
Presentation			0.128
STEMI (%)	2 (2.8)	3 (4.7)	
NSTEMI (%)	53 (75.8)	55 (87.3)	
UAP (%)	15 (21.4)	5 (7.9)	
Procedure			0.084
CAG (%)	25 (35.7)	13 (20.6)	
PCI (%)	45 (64.3)	50 (79.4)	
PCI site			0.170
RCA (%)	13 (18.6)	18 (28.5)	
Cx (%)	14 (20.0)	13 (20.6)	
LAD (%)	15 (21.4)	19 (30.1)	
Cx + LAD (%)	2 (2.8)	0	
Cx + RCA (%)	1 (1.4)	0	

ACE/ARB: angiotensin-converting enzyme/angiotensin receptor blockers; m: meters; mGy: milligray; mL: milliliter; min: minute; AF: atrial fibrillation; ASA: acetylsalicylic acid; cm: centimeter; CABG: coronary artery bypass grafting; CAD: coronary artery disease; CAG: coronary angiography; CHF: congestive heart failure; CVA: cerebrovascular accident; GP IIb/IIIa inhibitors: glycoprotein IIb/IIIa inhibitors; Cx: circumflex artery; kg: kilogram; LAD: left anterior descending artery; m: meters; NSTEMI: non-ST segment elevation myocardial infarction; PCI: percutaneous coronary intervention; RCA: right coronary artery; STEMI: ST segment elevation myocardial infarction; UAP: unstable angina pectoris; UFH: unfractionated heparin; VAS: Visual Analog Scale; TIA: transient ischemic attack; TRA: transradial access.

Table 3. Procedural characteristics of the study population according to diagnostic CAG and PCI

	Distal TRA (n=70)	Conventional TRA (n=63)	*p*
VAS score			
Diagnostic CAG	3.28±0.79	2.75±0.59	0.049
PCI	3.77±0.70	3.24±0.60	0.480
Total Fluoroscopy time (min)			
Diagnostic CAG	4.59±1.41	4.95±1.85	0.509
PCI	6.50±1.60	7.19±2.88	0.157
Total air kerma (mGy)			
Diagnostic CAG	405.0±120.9	413.0±152.5	0.863
PCI	600.9±136.0	628.4±143.5	0.507
Total dose area product (mGy/m^2)			
Diagnostic CAG	28752.0±10652.6	30798.0±11370.9	0.596
PCI	42999.1±13639.5	58384.3±33768.1	0.284
Total procedural time (min)			
Diagnostic CAG	25.6±4.2	24.0±5.7	0.342
PCI	44.3±7.6	43.5±8.9	0.421
Hemostasis time (min)			
Diagnostic CAG	31.5±3.2	41.1±3.4	<0.001
PCI	34.3±5.4	44.7±6.2	<0.001
Length of hospital stay (hour)			
Diagnostic CAG	28.8±8.0	28.6±8.2	0.962
PCI	48.5±7.8	50.8±9.5	0.193
Total amount of contrast agent (mL)			
Diagnostic CAG	71.9±12.9	73.4±20.2	0.211
PCI	125.2±25.2	127.8±28.6	0.224

CAG: coronary angiography; m: meters; mGy: milligray; min: minute; PCI: percutaneous coronary intervention; TRA: transradial artery access; VAS: visual analogue scale.

found to have professions in which they use their hands extensively (construction worker, farmer, tailor, and cook) (Table 2).

The detailed procedural characteristics of the study population according to diagnostic CAG and PCI are displayed in Table 3. The VAS pain score was higher in the distal TRA group than in the conventional TRA group across CAG and PCI subgroups, although P values were borderline. Hemostasis time was statistically significantly shorter in the distal TRA group for patients who underwent diagnostic and PCI procedures.

A correlation analysis of sheath insertion time with age, weight, height, and body mass index (BMI) showed no significant correlation. There was also no significant correlation between hemostasis time and age, weight, height, and BMI, whereas a positive correlation was noted between hemostasis time and length of hospital stay ($p<0.001$, $r=0.44$). Of all patients who developed hematomas, five used acetylsalicylic acid (ASA) and clopidogrel, and one used only ASA.

DISCUSSION

This study found a high success rate among patients undergoing diagnostic procedures and those undergoing PCI, both in the distal TRA (94.2%) and conventional TRA (98.4%) groups. The success rates reported in literature for both the groups range from 88% to 99%, and the results of this study are con-

sistent with those reported in literature.[19-22] None of the applied methods outmatches the other in terms of success rate, although the success rate was numerically higher in the conventional TRA group. Kaledin et al.[20] carried out an ultrasound measurement of the diameter of the radial artery and reported a mean arterial diameter of 2.4 mm in the anatomical snuffbox, which is smaller than the mean diameter of the radial artery, being 2.7 mm in the forearm. Accordingly, puncturing the distal radial artery is more challenging and requires a steeper learning curve.[20] To perform distal TRA, the operator must first gain experience in conventional TRA procedures. All the procedures in our study were performed by a single operator who was experienced in terms of conventional radial interventions, yet was acquiring novel experience in distal radial interventions. Success in the distal TRA group suggests that distal radial interventions by experienced operators will shorten the learning curve and ensure successful implementation processes. However, although the diameter of the distal RA was significantly smaller than the forearm RA, 6-Fr sheaths were successfully introduced in all the patients. Similar to the relevant literature, sheath placement time in the distal TRA group was longer in this study as well.

Edemas in the hand developed in four patients in the distal TRA group. Literature review revealed no reports of hand edemas as a complication of the procedure. The occupations of these four patients were construction worker, farmer, tailor, and cook; and it was a striking finding that all these patients were employed in jobs requiring the active use of their hands and that their right hand, being their dominant hand, was used for the distal TRA. Despite the occurrence of hand edemas, none of these patients developed compartment syndrome. When the distal radial anatomy is examined, trauma in the anatomical region may be a possible cause of edema when puncture or sheath is placed. However, in these patients, no complications or any negative conditions were detected during and after hospital discharge. It is noteworthy that the hand edemas have occurred after the patient had begun working. Distal radial arterial access is beyond the forearm sections, and the risk of compartment syndrome is low owing to its anatomical region.[20] Interventions from the contralateral hand may be considered in patients employed in jobs that require the active use of their dominant hand. Further studies involving a larger series of patients are needed to draw more accurate conclusions in this regard. The right side of the patient is often preferred in conventional radial interventions as interventions via the left radial artery can cause discomfort to short operators with back problems, as well as for the patients with obesity.[23] Distal TRA is more suitable for both the patient and operator on the left side and offers the operator more possibilities in choosing right and left application areas.[21] One of the questions that we sought to answer in this study was whether distal TRA had other advantages besides operator comfort in the left-sided radial approach. Compared with conventional TRA, distal TRA seems to be performed more comfortably for the operator and the patient as it can be performed on the right or left side. Except the comfort it provided, no significant differences between the two processes could be elucidated from this study. Therefore, preference of distal TRA only for this reason should be questioned.

VAS pain score was found to be significantly higher in the distal TRA group. According to the findings of this study, conventional TRA appears to be more advantageous in terms of pain.

Hemostasis time is approximately 10 minutes shorter in the distal TRA group and statistically significant. However, in the distal TRA group for hemostasis, in addition to the TR tape, additional five minutes of pressure was applied instead of puncture, and thus bleeding in the puncture site could be controlled. We think that the 5-minute compression by hand can be effective in the shorter hemostasis time of the distal TRA group. However, this additional task and follow-up has led to the questioning of this advantage. Whereas in the distal TRA group, TIMI minor bleeding occurred in three (4.2%) patients and hematoma in five (7.1%); in the conventional TRA group, no bleeding complication occurred in any patient, although hematoma was observed in two (3.1%) patients. Although the differences are not statistically significant, they are noteworthy. Difficulty of the procedure and more number of catheters used may be the main reasons for increase in hematoma rate and minor bleeding.

Radial artery occlusions are asymptomatic and do not affect the patient's quality of life; however, they can hinder repeat interventions through the radial artery.[20] The risks associated with occlusions

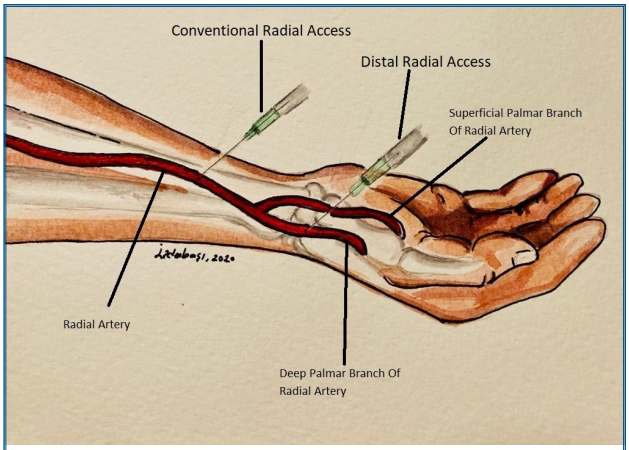

Figure 2. Distal radial artery course through the anatomic snuffbox.

of the distal radial artery are lower than those associated with occlusions of the radial artery in the forearm in that antegrade blood flow is preserved through the superficial palmar arch (Figure 2), even if the distal radial artery in the anatomical snuffbox has been occluded by thrombosis.[20] In a series of 637 patients, Babunashvili and Dundua[19] used distal TRA in 92% of the patients and the dorsal branch of the radial artery in 9% using a 5-F sheath in 91% and a 6-F sheath in 9% of the patients, and performed PCI in 11% of the patients.[9] The overall success rate was 98%, and the rate of radial artery occlusion was 0% in the acute early period and 0.2% in the late period (more than three months). In a series of 2,884 patients who underwent endovascular interventions, Kaledin et al.[20] used distal radial access in 96% and performed PCI in 93.5% of the patients. They used a 6-F sheath in 99% and a 7-F sheath in 1% of the patients. Their success rate was reported to be 97%. The rate of radial artery occlusion was 0.4% in the distal TRA group and 4% in the conventional TRA group. Roghani-Dehkordi et al.[22] performed PCI in 29% of 235 patients and reported a success rate of 94% and an asymptomatic radial artery occlusion rate of 1%. In this study, radial artery occlusion was observed in one (1.4%) patient in the distal TRA group and in two (3.1%) patients in the conventional TRA group. A radial artery spasm occurred in one (1.4%) patient in the distal TRA group and in five (7.9%) patients in the conventional TRA group.

Of the patients undergoing interventions using the distal TRA in this study, 68 (97.2%) were diagnosed with acute coronary syndrome without ST elevation, and 45 (64.3%) underwent PCI. Only two (2.8%) patients opted for elective angiography. All the patients in the conventional TRA group had acute coronary syndrome. We consider that the comparison between distal and conventional TRA among patients with acute coronary syndrome without ST elevation provided in this study may contribute to the literature in terms of the advantages and disadvantages of distal TRA. We also believe that having procedures performed by a single operator is advantageous in that it avoids differences in the skills of the surgeons in the comparison of the two procedures.

Limitations

The study was limited to the available records in the patient charts because to its retrospective study design. Different complications may be identified in a more comprehensive study involving a larger number of patients.

Conclusion

Distal TRA offers a new alternative site for coronary intervention for both patients and operators. According to relevant literature and this study, distal TRA can be safely administered and though artery puncture and access are partially more difficult, it seems to offer an alternative both for the patient and operator. Limited number of arterial occlusions, faster hemostasis, and a shorter hospitalization period, all make distal TRA more preferable. However, being a new technique, only performed in recent times, and a lack of larger patient series in the literature; extensive studies and knowledge sharing are required to ensure distal TRA becomes the golden standard. Nevertheless, experience in conventional TRA is important before being able to perform distal TRA by any operator. According to the findings of this study and relevant literature, distal TRA seems to be a safe method. However, further and larger studies are needed to elaborately address the advantages and disadvantages of distal TRA.

The visual summary of the article can be seen in the Appendix 1.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Selçuk University School of Medicine (Approval Date: May 22, 2019; Approval Number: 2019/136).

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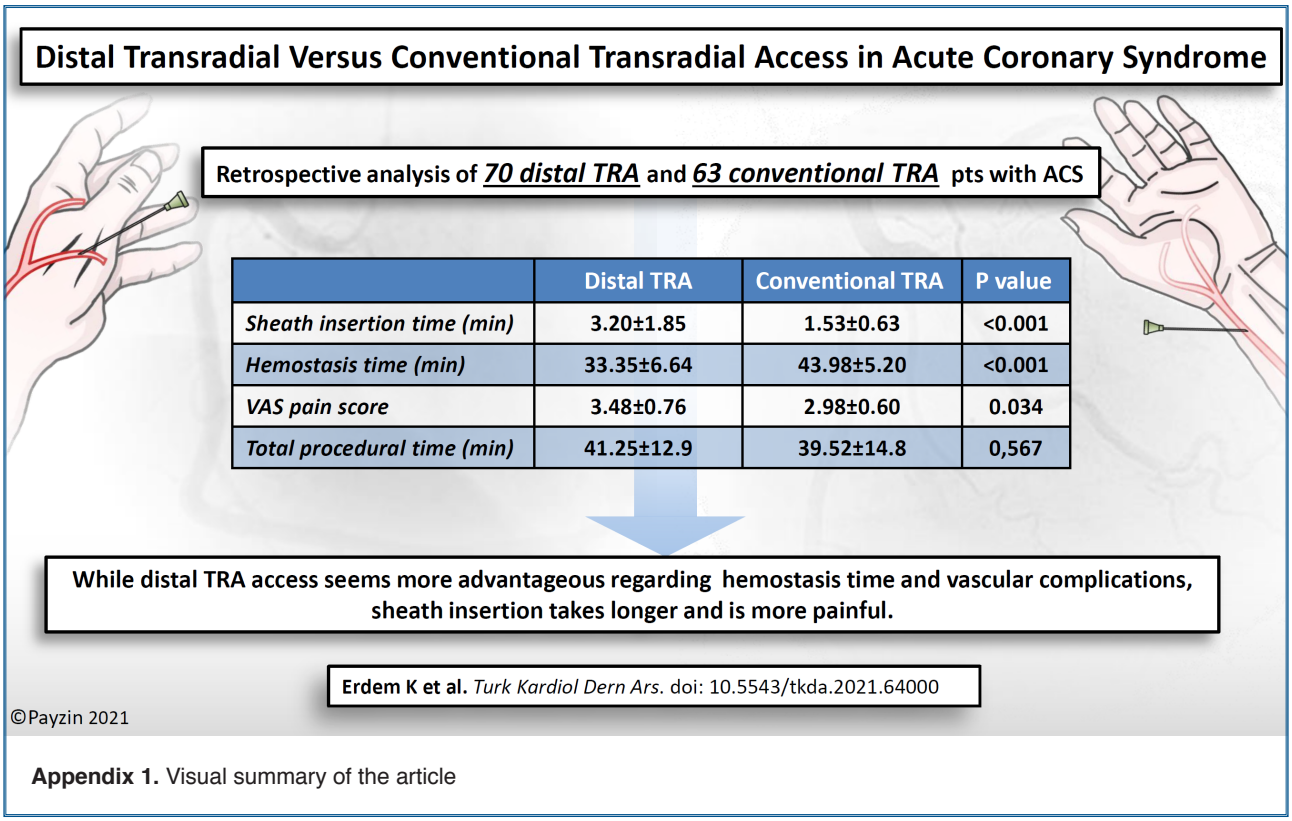
Keywords: Coronary angiography; catheterization; brachial artery; radial artery; ulnar artery

Anahtar Kelimeler: Koroner anjiyografi; kateterizasyon; brakial arter; radial arter; ulnar arter



	Distal TRA	Conventional TRA	P value
Sheath insertion time (min)	3.20±1.85	1.53±0.63	<0.001
Hemostasis time (min)	33.35±6.64	43.98±5.20	<0.001
VAS pain score	3.48±0.76	2.98±0.60	0.034
Total procedural time (min)	41.25±12.9	39.52±14.8	0,567

Appendix 1. Visual summary of the article