J Am Coll Cardiol (2004);44:349-56
Radial versus femoral approach for percutaneous coronary diagnostic and interventional procedures; Systematic overview and meta-analysis of randomized trials
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OBJECTIVES: We sought to compare, through a meta-analytic process, the transradial and transfemoral approaches for coronary procedures in terms of clinical and procedural outcomes. BACKGROUND: The radial approach has been increasingly used as an alternative to femoral access. Several trials have compared these two approaches, with inconclusive results. METHODS: The MEDLINE, CENTRAL, and conference proceedings from major cardiologic associations were searched. Random-effect odds ratios (ORs) for failure of the procedure (crossover to different entry site or impossibility to perform the planned procedure), entry site complications (major hematoma, vascular surgery, or arteriovenous fistula), and major adverse cardiovascular events (MACE), defined as death, myocardial infarction, emergency revascularization, or stroke, were computed. RESULTS: Twelve randomized trials (n = 3,224) were included in the analysis. The risk of MACE was similar for the radial versus femoral approach (OR 0.92, 95% confidence interval [CI] 0.57 to 1.48; p = 0.7). Instead, radial access was associated with a significantly lower rate of entry site complications (OR 0.20, 95% CI 0.09 to 0.42; p < 0.0001), even if at the price of a higher rate of procedural failure (OR 3.30, 95% CI 1.63 to 6.71; p < 0.001). CONCLUSIONS: The radial approach for coronary procedures appears as a safe alternative to femoral access. Moreover, radial access virtually eliminates local vascular complications, thanks to a time-sparing hemostasis technique. However, gaining radial access requires higher technical skills, thus yielding an overall lower success rate. Nonetheless, a clear ongoing trend toward equalization of the two procedures, in terms of procedural success, is evident through the years, probably due to technologic progress of materials and increased operator experience.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15261930

Catheter Cardiovasc Interv (2004);63:215-9
Direct coronary stenting by transradial approach: rationale and technical issues
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Direct stent implantation using radial approach represents to date the less invasive, less traumatic strategy to perform a percutaneous coronary intervention, rendering its adoption an attraction for many interventional cardiologists. A growing series of reports suggests the feasibility of transradial direct stenting in a variety of clinical situations. Here we discuss the main advantages of the adoption of this technique. Moreover, a detailed analysis of the technical issues specifically related with each phase of transradial direct stenting procedures is reported.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15390247

Catheter Cardiovasc Interv (2004);61:74-8

Management of iatrogenic radial artery perforation
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The aim of this study was to evaluate a new protocol allowing coronary angiography to be performed transradially in spite of the occurrence of iatrogenic radial artery perforation during catheterization. Nine patients with iatrogenic radial artery perforation were managed conservatively by inserting a long arterial sheath in the damaged radial artery up to the brachial artery, after which the diagnostic and/or interventional procedures that had motivated transradial catheterization were completed via the protected radial artery. Radial angiography performed immediately thereafter showed no extravasation, and no major vascular complications developed during follow-up. The day after the procedure, two patients had asymptomatic radial occlusion, but the other seven patients had normal radial pulses and reversed Allen test responses showing normal perfusion. A conservative management technique, installation of a long arterial sheath not only promotes resolution of iatrogenic radial artery perforation but also allows the procedures motivating catheterization to be completed transradially.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=14696163

Circulation (2004);110:II23-6
Five-year angiographic patency of radial artery bypass grafts
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BACKGROUND: Little information exists regarding mid-term and long-term patency of radial artery grafts. METHODS AND RESULTS: We performed restudy coronary angiography at 5.2+/-0.4 years after surgery on 50 asymptomatic patients who had undergone coronary artery bypass graft surgery, using at least 1 radial artery graft, to determine both graft patency and presence of narrowing. We examined preoperative clinical or angiographic variables that might predict graft occlusion. Radial artery graft patency was 89%, with 91% of grafts free of narrowing. Preoperative New York Heart Association anginal class < or =2, target vessel proximal stenosis < or =70%, and small target vessel supply territory were predictive of graft occlusion. CONCLUSIONS: At 5 years after surgery, radial artery grafts have disease-free patency rates that are similar to other graft types.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15364833

N Engl J Med (2004);351:2302-9
A randomized comparison of radial-artery and saphenous-vein coronary bypass grafts
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BACKGROUND: In the past decade, the radial artery has frequently been used for coronary bypass surgery despite concern regarding the possibility of graft spasm. Graft patency is a key predictor of long-term survival. We therefore sought to determine the

relative patency rate of radial-artery and saphenous-vein grafts in a randomized trial in which we controlled for bias in the selection of patients and vessels. METHODS: We enrolled 561 patients at 13 centers. The left internal thoracic artery was used to bypass the anterior circulation. The radial-artery graft was randomly assigned to bypass the major vessel in either the inferior (right coronary) territory or the lateral (circumflex) territory, with the saphenous-vein graft used for the opposing territory (control). The primary end point was graft occlusion, determined by angiography 8 to 12 months postoperatively. RESULTS: Angiography was performed at one year in 440 patients: 8.2 percent of radial-artery grafts and 13.6 percent of saphenous-vein grafts were completely occluded (P=0.009). Diffuse narrowing of the graft (the angiographic "string sign") was present in 7.0 percent of radial-artery grafts and only 0.9 percent of saphenous-vein grafts (P=0.001). The absence of severe native-vessel stenosis was associated with an increased risk of occlusion of the radial-artery graft and diffuse narrowing of the graft. Harvesting of the radial artery was well tolerated. CONCLUSIONS: Radial-artery grafts are associated with a lower rate of graft occlusion at one year than are saphenous-vein grafts. Because the patency of radial-artery grafts depends on the severity of native-vessel stenosis, such grafts should preferentially be used for target vessels with high-grade lesions.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15564545

Catheter Cardiovasc Interv (2004);61:60-6
Transradial coronary angiography in patients with contraindications to the femoral approach: an analysis of 500 cases
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The transradial approach to coronary angiography is considered by some to be a route of choice, by others to be a route that should be used only where there are relative contraindications to the femoral approach. We present the largest series to date of patients in whom transradial coronary angiography was undertaken specifically because of contraindications to the femoral approach. Since 1995, patients at this cardiothoracic center have been considered for a transradial approach to coronary angiography if there were relative contraindications to the femoral route. Data from 500 patients was prospectively collected. Patients were aged 66 +/- 9 years; 72% were male. Indications for the radial approach included peripheral vascular disease (305), therapeutic anticoagulation (77), musculoskeletal (59), and morbid obesity (32). Sixty-eight patients (14%) required a radial procedure following a failed femoral approach. Access was right radial 291 (58%), left radial 209 (42%). Eighteen operators were involved, but two

with 5/4 Fr (15%; P < 0.05). Major procedural complications occurred in three cases: brachial artery dissection in one and cardiac arrest in two. Postprocedure major vascular complications numbered three: claudicant pain on handgrip in one, ischemic index finger (with subsequent terminal phalanx amputation due to osteomyelitis) in one, and ischemic hand for 4 hr in one. Patients with contraindications to the femoral approach form a high-risk group. In these patients, transradial cardiac catheterization can be performed successfully and with a low risk of major complications. Minor adverse features remain frequent, occurring in one in five cases, though difficulties are minimized both with increasing operator experience and smaller sheath diameter.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=14696161

Catheter Cardiovasc Interv (2004);61:333-7
Effectiveness of right or left radial approach for coronary angiography
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The transradial approach for catheterization is becoming increasingly more popular. At present, the choice of the right or left radial artery depends on the operator's preference. We examined how the laterality influenced the effectiveness of the approach. Employing Judkins-type catheters, we performed coronary angiography in 232 patients with the left approach and in 205 patients with the right approach. Although access time did not differ between the two groups of patients, the duration of catheter manipulation was shorter in the left- than in the right-approach group (11.7 +/- 5.9 vs. 9.8 +/- 4.4 min; P < 0.001). Because of the shorter duration of catheter manipulation, the total procedural duration was shorter in the left-approach group (13.7 +/- 6.4 vs. 11.4 +/- 4.8 min; P < 0.001). The fluoroscopy time was shorter in the left- than in the right-approach group (3.7 +/- 2.5 vs. 5.0 +/- 3.3 min; P < 0.001). The amount of contrast material did not differ between the groups (79 +/- 27 vs. 83 +/- 25 ml). The rate of guidewire usage to engage the coronary ostium was higher in the right- than in the left-approach group because of the severe tortuosity of the right subclavian artery (20/205 vs. 0/232; P < 0.001). Thus, for operators with significant experience, the left radial approach may provide increased procedural efficacy for coronary angiography compared to the right radial approach.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=14988891

Am J Cardiol (2004);93:1282-5
Comparison of treatment outcomes in patients > or =80 years undergoing transradial versus transfemoral coronary intervention
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differences in patient characteristics, remaining differences in outcomes and postprocedure length of stay were small and not statistically significant at the 95% level, but a decrease in postprocedural length of stay of nearly 1 day was observed and likely was not due to chance. Transradial access in patients > or =80 years old undergoing percutaneous coronary intervention should be preferred due to equivalent success rate and safety and likely reduction in postprocedural hospitalization.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15135705

Catheter Cardiovasc Interv (2004);63:412-6
Balloon crush: treatment of bifurcation lesions using the crush stenting technique as adapted for transradial approach of percutaneous coronary intervention
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The recent advent of drug-eluting stents has allowed the crush stenting technique to be adopted, thus simplifying the treatment of bifurcation coronary artery lesions. However, this can only be achieved in 7 Fr or greater guiding catheters, hence precluding most transradial percutaneous coronary interventions that are usually undertaken using 6 Fr or less guiding catheters. We assessed the feasibility of balloon stent crush as a stepwise procedure in achieving bifurcation crush stenting in 6 Fr transradial percutaneous coronary interventions. Since it is not possible to place two stents through a 6 Fr guiding catheter, we have adapted the crush stenting technique by initially placing a stent in the side branch and a balloon in the main vessel. The side branch stent is then deployed against the main vessel balloon that is later inflated, crushing the side branch stent within the main vessel. The main vessel is then stented and the side branch recrossed for kissing inflations. Seven patients (five males; age range, 47-78 years) with bifurcation lesions were treated using the above-described technique without major complications. Balloon crush of the side branch stent were successfully achieved in all cases without balloon trapping. In six cases where side branch recrossing was attempted, all were successful and kissing balloon inflations were undertaken in five cases. We have demonstrated that the modified crush stenting technique is feasible and can be safely adapted for use in a 6 Fr transradial

patients, sheath insertion time ranged from 2 to 5 min, time from arterial puncture to vessel recanalization ranged from 21 to 36 min. Primary angioplasty was successful in all patients. At 30-day echo color Doppler, all ulnar arteries were patent and with a physiologic pattern of flow. Subcutaneous hemorrhage of the forearm was observed in two patients, whereas hematoma, pseudoaneurysm, thrombus, and arterovenous fistula were not observed. In conclusion, transulnar access may represent an additional option in patients undergoing primary angioplasty when the radial artery access site is not available.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=14696160

Am J Cardiol (2004);94:1177-80
Comparison of transradial and transfemoral approaches for coronary angiography and angioplasty in octogenarians (the OCTOPLUS study)
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This prospective multicenter study was conducted to compare the incidence of significant vascular complications delaying hospital discharge after coronary angiography and percutaneous coronary intervention (PCI) between the radial approach (n = 192) and the femoral approach (n = 185) in octogenarians, a rapidly growing population with numerous risk factors for complications. By intention-to-treat analysis, the incidence of vascular complications was found to be significantly less in the radial group (1.6% vs 6.5%, p = 0.03), without any decrease in the efficacy of PCI and only a slight increase in procedure duration for coronary angiography. All vascular complications, except for 1, occurred in patients treated with the transfemoral approach.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15518616

Catheter Cardiovasc Interv (2004);61:67-73
Comparison of transradial vs. transfemoral approach in the treatment of acute myocardial infarction with primary angioplasty and abciximab
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Compared to the femoral approach, the use of radial arterial access has been demonstrated to reduce the incidence of access site bleeding complications in staged procedures. The purpose of this study was to evaluate clinical outcomes comparing radial and femoral approaches in the treatment of acute myocardial infarction with primary angioplasty and the GP IIb/IIIa inhibitor abciximab. Between 15 September 1999 and 15 September 2002, we prospectively enrolled 119 consecutive patients undergoing primary angioplasty with abciximab 5.9(f)-Poe5.7(he t)-n-6.6( )]T3(itac5.7( )-5t60.1(e)pt)-5.

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clinical course occurred in 62 (97%) of patients in the radial group and 49 (89%) in the femoral group (P = 0.04). Total hospital length of stay was significantly higher in the femoral group (5.9 +/- 2.1 vs. 4.5 +/- 1.2 days; P = 0.05). Cannulation time (from patient arrival at the catheterization laboratory to the effective placement of arterial sheath) and procedural time were not significantly different in the radial and the femoral group (respectively 8.5 +/- 5.2 vs. 9.0 +/- 5.8 min, P = 0.81, and 42 +/- 28 vs. 44 +/- 27 min, P = 0.74). Nevertheless, time of radiation (23.1 +/- 11 vs. 16.5 +/- 10.9 min; P = 0.01) and dose-area product (28,616 +/- 16,571 vs. 18,819 +/- 10,739 R. cm2; P = 0.01) were significantly higher in the radial group. In patients with acute myocardial infarction treated with primary angioplasty and abciximab, the transradial access is efficacious with fewer major access site complications than transfemoral access. Transradial approach produces a shorter length of stay, as compared to the transfemoral approach, although with longer times of radiation and higher dose-area product.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=14696162

Circulation (2004);110:e40-6
Should radial arteries be used routinely for coronary artery bypass grafting?
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http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15289390

Catheter Cardiovasc Interv (2004);61:503-11
Transradial application of PercuSurge GuardWire device during primary percutaneous intervention of infarct-related artery with high-burden thrombus formation
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A large infarct-related artery (IRA), which mostly contains high-burden thrombus formation (HBTF) and lipid pool-like plaque contents, has been suggested to play a pivotal role in the no-reflow phenomenon during primary percutaneous coronary intervention (p-PCI). To reduce the thrombus burden of the IRA using the PercuSurge GuardWire device before intervention may be of crucial importance to preventing no-reflow. The purposes of this study were to test the transradial application (TRA) of this new mechanical device and to determine its impact on prevention of no-reflow during p-PCI. From May to September 2002, the PercuSurge GuardWire device was utilized in 42 consecutive patients with acute myocardial infarction and large IRA (vessel size >04 Twsysi517 TD-0.00Tc-0.00

< 0.05). In group 1 patients, post-p-PCI myocardial blush (MB) of >or= 2 grades was found to be more than 88.0%. Furthermore, when compared with preintervention, thrombus scores were significantly reduced after aspiration (P = 0.0001), whereas the minimal lumen diameter (P = 0.0001), TIMI flow grade (P = 0.0001), and MB grade (P = 0.0001) had all significantly increased after aspiration using Export Aspiration Catheter. There were no significant differences in corrected TIMI frame count (P = 0.42), TIMI flow grade (P > 0.5), or MB grade (all P values > 0.5) between postaspiration and post-PCI. The TRA of the PercuSurge GuardWire device during primary intervention of large IRA with HBTF was safe and feasible and provided benefits to patients. The initial successful reduction of the thrombus burden with this mechanical device before intervention can be translated into increased final TIMI-3 flow, a combined MB of >or= 2 grades, and fewer final thromboembolic events.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15065147

Circulation (2004);109:1489-96
Improved survival with radial artery versus vein conduits in coronary bypass surgery with left internal thoracic artery to left anterior descending artery grafting
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BACKGROUND: Given its proven survival benefit, left internal thoracic artery to left anterior descending (LITA-LAD) grafting has become a fundamental part of CABG. This grafting also led to increased use of other arterial conduits, of which the radial artery is most popular. Whether radial grafting improves survival beyond that achieved by LITA-LAD alone is not known. METHODS AND RESULTS: We compared 6-year outcomes in propensity-matched CABG-LITA-LAD patients (925 each) divided into those with > or =1 radial grafts and those with vein-only grafting. Matched patients had essentially identical demographics, comorbidities, coronary disease, and operative data. Perioperative outcomes, including death (radial, 11 [1.2%]; vein, 10 [1.1%]), were similar for the 2 groups. Cumulative 0- to 6-year survival was better for radial patients (risk ratio, 0.675), particularly after 3 years (P<0.03). Six-year survival in vein (86.8%) and radial (92.1%) patients indicated 67% greater overall vein mortality. Incidence rates of radial and vein repeated catheterization (190 of 925 [20.5%] versus 199 of 925 [21.5%]) and revascularization (8.8% versus 8.5%) were similar. Angiography data in