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Expanding limits and decreasing calibers. Revisiting the adoption of the distal radial artery access in the anatomical snuffbox

Expandindo limites e diminuindo calibres. Revisitando a adoção do acesso vascular através da artéria radial em seu segmento distal na região da tabaqueira anatômica

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ABSTRACT – The use of the radial artery as a vascular access route for performing percutaneous coronary procedures has been reinforced based on consistent data attesting to its efficacy, greater safety and comfort for patients, when compared to femoral or brachial approaches. However, decreasing the rate of acute or chronic occlusion of the radial artery after the use thereof remains a challenge. The most recently adopted strategy to minimize the risk of arterial occlusion consists of puncturing the radial artery in its distal segment, in the topography of the anatomical "snuffbox". In this review article, we describe historical, technical and potential benefits of this new vascular access technique in the upper limb.

Keywords: Vascular access devices; Radial artery; Percutaneous coronary intervention

RESUMO – O uso da artéria radial como via de acesso vascular para a realização de procedimentos coronários percutâneos consolidou-se a partir de dados consistentes atestando sua eficácia, maior segurança e conforto para os pacientes, quando comparado aos acessos femoral ou braquial. Persiste, porém, o desafio da diminuição da taxa de oclusão aguda ou crônica da artéria radial após sua utilização. A estratégia mais recentemente adotada, com o objetivo de minimizar o risco de oclusão arterial, consiste na punção da artéria radial em sua porção distal, na topografia da "tabaqueira" anatômica. Descrevemos, neste artigo de revisão, aspectos históricos, técnicos e potenciais benefícios advindos dessa nova técnica para obtenção do acesso vascular pelo membro superior.

Descritores: Dispositivos de acesso vascular; Artéria radial; Intervenção coronária percutânea

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CONTEXTUALIZING THE TOPIC

The use of the radial artery as a vascular access route to perform percutaneous coronary procedures, originally described by Lucien Campeau, in 1989,[1] has become promising, after the publication of the ACCESS study, in 1997, by Kiemeneij et al.,[2] who compared it with the traditional, brachial and femoral access routes, demonstrating its potential observed in the safety outcomes and comfort for patients after performing the procedures.

The radial route and the arm blood flow pose some challenges, which resulted in an underestimation of the radial access adoption for a long time. These challenges included, for example, the absence of radial artery-specific devices, as the radial artery generally has a smaller caliber and is more "reactive" and predisposed to vasospasm phenomena, if excessively and inappropriately manipulated. Another particularity is a more frequently observed vascular tortuosity with its broader adoption from the wrist to the root of the aorta, which will make the learning curve longer. Due to these

setbacks, the radial access was initially used only when an alternative vascular access was needed to perform the procedures, and it was preferentially adopted only by some professionals, in a few centers.

With the miniaturization of materials and the overcoming of the learning curve, the radial approach lacked the scientific support of randomized studies comparing the clinical outcomes of patients who had their interventions performed through this route with those using the femoral approach. Several studies have endorsed the benefit of the radial approach when compared to the femoral approach. In 2008, Chase et al. published the M.O.R.T.A.L study, which was an all comers registry of more than 30 thousand patients, showing that patients who had their interventions performed radially had lower rates of hemorrhagic complications and mortality.[3]

In 2011, Jolly et al. published the RIVAL study,[4] and, in 2012, Romagnoli et al. published the RIFLE STEACS study,[5] both dedicated to the radial approach in patients with acute coronary syndrome, which also demonstrated lower incidence of vascular and hemorrhagic complications and lower mortality in this clinical setting. The results of these and several other studies resulted in the modification of the recommendation of the European guidelines for the management of acute coronary syndromes, which started recommending percutaneous diagnostic and therapeutic procedures in these patients should be performed preferably by the radial approach (Class IA), in centers with great experience with this vascular access.[6]

THE CHALLENGE IN REDUCING RADIAL ARTERY OCCLUSION RATES

Despite the data previously exposed, reducing the rate of acute or chronic occlusion of the radial artery after the use thereof still remains a challenge. Several studies have shown rates ranging from 0.8% to up to 30% of patients.[7]

The main strategies to reduce this complication were related to ultra-miniaturized materials (slender techniques); undersized materials, *i.e.*, with smaller crossover profiles and sheathless systems; optimized heparinization; spasmolytic agents; and adequate control of hemostasis using the patent hemostasis technique after the procedure.[8] The most recently adopted strategy to minimize the risk of arterial occlusion was accessing the radial artery in its distal portion, in the topography of the anatomical "snuffbox".

The first published experiences with the distal radial artery access date back to the 1970's, as an alternative arterial route for invasive blood pressure monitoring in pediatric cardiology and anesthesiology.[9,10] In 2011, Babunashvili et al. published their initial experience with the distal radial artery access in a retrograde manner, in the recanalization of a subacute occlusion of the radial artery after a conventional access in the wrist, which he had used days before to perform a cardiac catheterization.[11] Kaledin et al. published their experience in a series of 2,884 patients who underwent endovascular interventions, using the distal radial route in 96% of them, with a 97% success rate, and a 2% occlusion rate of the distal portion of the radial artery. It is important to highlight that the occlusion rate observed by the same authors, when using a conventional wrist access was 4.2%.[12] In another small series, with 235 patients, on the use of the distal radial route published by Roghani-Dehkordi et al., a success rate of 94% and an occlusion rate of approximately 1% were observed.[13]

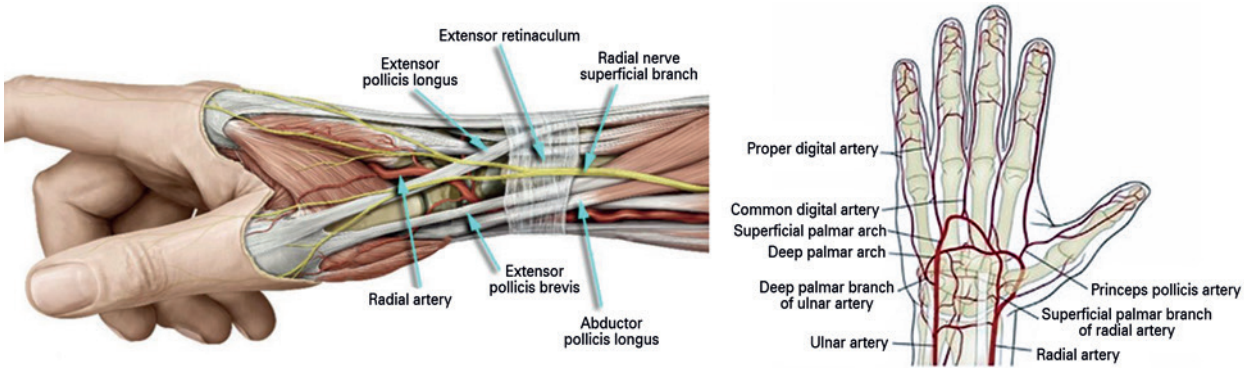
REDISCOVERY OF THE DISTAL RADIAL PUNCTURE TECHNIQUE

The right radial artery is preferentially used due to ergonomic issues related to the operation of the cath lab equipment. The use of the left radial artery may be uncomfortable both for the operator (especially those with short stature or lumbar spine-related orthopedic problems), and also for the patient, especially those who are obese, and have short wingspan or some limitation of supination or pronation of the forearm. In 2017, Kiemeneij published his initial experience with this left upper limb access in 118 patients, reinforcing the additional comfort gain for both operator and patient, with the procedures performed using the left distal approach, in addition to a significant reduction in the rate of arterial occlusion (0%).[14] Since this publication, the medical community has taken great interest in the "new" technique.

TECHNICAL ASPECTS

The anatomical snuffbox is a triangular shaped area on the dorsal face of the hand. It is bordered medially by the extensor pollicis longus tendon, and laterally by the abductor pollicis longus and extensor pollicis brevis tendons. Its floor is formed by the trapezium and scaphoid bones (Figure 1). In the proximal portion of the "snuffbox", the distal radial artery originates a branch which, in conjunction with a superficial branch that originates in the homologous ulnar artery, forms the superficial palmar arch. In the distal portion of the snuffbox, the radial artery continues as a deep palmar branch which, together with the distal portion of the ulnar artery, forms the deep palmar arch. A vast network of collateral circulation is interconnected between these two palmar arches, which is very important, because even in the case of occlusion of the distal radial artery, the anterograde flow is maintained through the superficial palmar arch and its extensive network of collaterals with the deep palmar arch.[15]

The distal radial artery puncture technique we adopted is similar to that described by the pioneer authors.[11,13,14]



Source: adapted from Kaledin AL, Kochanov IN, Podmetin PS, Seletsky SS, Ardeev VN. Distal radial artery in endovascular interventions, 2017. https://doi.org/10.13140/RG.2.2.13406.33600. Figuras 1 e 2. Figura 1, Blood vessels of distal forearm and hand; p. 4. Figure 2, Catheterization site of radial artery at forearm and at hand (marked with black arrows, left to the right: radial artery of the dorsum of the hand - RADH; radial artery within the anatomical snuffbox - RAAS; forearm radial artery - FRA); p. 4.
Figure 1. Anatomical snuffbox structures.

Both arteries (right and left) can be punctured with the operator at the patient's right side, or the side chosen for the procedure.

For left radial artery access from the patient's left side, in the same way normally used in the conventional right radial technique, after positioning the chosen upper limb beside the body with discrete abduction (45°), with the arm in neutral position, exposing the snuffbox region (instead of the palmar aspect of the wrist used in the conventional technique), the patient is asked to hold a roll of gauze with the hand in ulnar deviation, to facilitate individualization and identification of the most favorable puncture point (Figure 2).[16] Next, local anesthesia is performed, with subcutaneous injection of 3 to 5mL of xylocaine, and the artery is punctured with a 21G gauge metallic needle, at a 30° to 45° angle, lateral to medial. After obtaining an adequate flow, a 0.018" metal guide wire with a J-tip is gently inserted, with great attention to the presence of resistance, which is frequent, due to the initial arterial sinuosity, as well as the possibility of the guide wire entering a sub-branch or even the palmar arch.

For left radial artery access from the patient's right side, the patient is lying on the table in the usual manner. After ensuring comfortable support, with the aid of pillows and/or surgical drapes at the height of the left shoulder/arm, the arm is positioned towards the right groin with the forearm duly flexed, under the surgical drapes positioned in the abdominal region. In the same way as described for the right access, after adequate exposure of the snuffbox region, with slight extension of the wrist and flexion of the thumb, the distal radial artery is individualized and palpated. After antisepsis and anesthesia of the snuffbox region, the puncture is performed, as already described.

In our experience, performing the left puncture from the left side has some advantages. When puncturing the left radial artery from the patient's right side, small changes in the position of the hand may render the palpation and identification of the distal radial pulse difficult, making the puncture sometimes more difficult. Positioning the left hand on the abdomen towards the right iliac fossa may be more difficult in patients with a shorter wingspan and centripetal obesity. Another additional detail is that, in this position, the navigation of the guidewire/catheter

Source: adapted from Davies et al.[16]
Figure 2. Preparation and positioning of the patient's hand for puncture.

in the left elbow region may be more challenging, due to the tortuosity generated by the flexion of the forearm, which is easily resolved with the extension of the forearm. Our routine is to perform the left puncture from the left side and, after positioning the guidewire in the brachial artery, we adopt the final positioning of the left upper limb on the abdomen, towards the right iliac fossa, in the most comfortable position for both the patient and the operator.

PRACTICAL GUIDELINES FOR THE PUNCTURE

In this region, the skin is thicker, the needle must pass a greater amount of tissue to reach the artery, and the artery has greater sinuosity in the distal segment than in the forearm. Thus, to avoid damaging the tip of the sheath/introducer and facilitate its positioning, without risk of injury to the artery, we make a small incision at the puncture point, with the aid of a scalpel blade, and predilate this path, first only with the dilator of the introducer set, before the introduction of the complete sheath.

Routine angiography and fluoroscopy are not necessary, although they are essential if there is any resistance to the progression of the 0.018" guidewire. In these cases, a 0.014" coronary guidewire is very useful, as it is more flexible and steerable than the guidewires included in commercially available radial introducer kits, since these were originally designed for the vascular anatomy of the radial access in the forearm.

A transfixion puncture using a Jelco/Abocath-type needle/cannula is not recommended, since the needle may touch the periostium of the scaphoid or trapezium bones, which, in addition to being painful, may have some late clinical impact.

When thin-walled introducers (Slender®, Terumo Inc. – Japão) are used, kinking may occur after the dilator is removed, sometimes requiring the aid of the catheter to advance the guidewire in its interior.

HEMOSTASIS

The principles of hemostasis should be the same as those used for a radial artery access in the wrist, adopting patent hemostasis. It is rarely necessary to inflate the cuff with more than 10mL of air for adequate hemostatic control.

Among the devices commercially available in Brazil, the most comfortable is SafeGuard® (Merit Medical N.T. falta informação do país) however its contact surface area with the puncture site is quite small, requiring precision in its positioning (Figure 3).

For the use of cuff type hemostasis devices similar to TR Band™ (Terumo Inc., Japão), the rigid acrylic support has to be removed, making it more flexible and allowing adequate adaptation to the hand and snuffbox anatomy (Figure 4).

Figure 3. SafeGuard® hemostatic device.

Figure 4. Adapted TR Band™ hemostatic device.

ADVANTAGES OF THE DISTAL RADIAL ACCESS

The use of the radial artery in the distal segment in the anatomical snuffbox may have some potential benefits when compared with the radial access in the forearm. For example, its hemostatic control requires less pressure on cuff-type hemostatic devices, rendering this process generally less painful, easier, faster and with probably less vascular and hemorrhagic complications, which can facilitate hospital discharge.[17]

In this segment, during the hemostasis process, the risk of simultaneous compression of the ulnar artery is minimized. If there is arterial occlusion in this segment, the use of the radial artery at its conventional site, in the wrist, still remains possible.

The distal radial access allows flexion movement of the wrist immediately after the procedure, with earlier functional recovery of the wrist/hand (Figure 5).

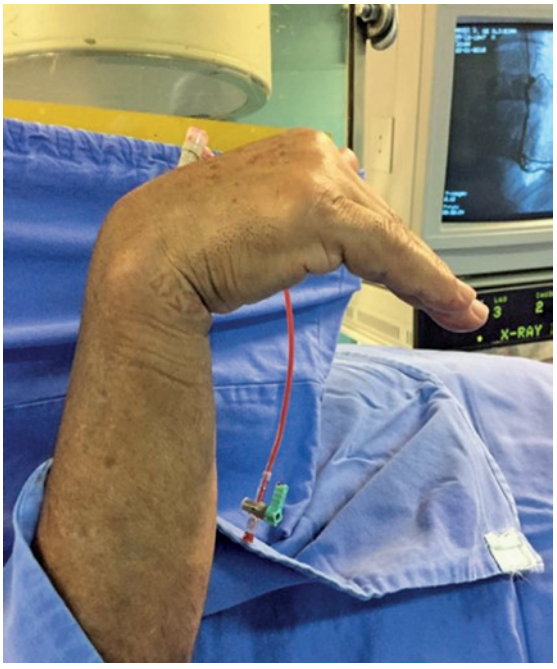


Figure 5. Wrist mobility, despite the presence of the arterial introducer.

It allows the preservation of the radial artery in the forearm for future use, if there is a need for an arteriovenous fistula in dialysis patients, or its use as an arterial graft, in myocardial revascularization surgery.

The snuffbox access has an arterial occlusion rate after the use thereof lower than the rates historically described with the traditional access in the forearm, according to a meta-analysis published by Hamandi et al.[18]

ANATOMICAL SNUFFBOX ACCESS IN THE LEFT UPPER MEMBER

The use of this access in the left upper limb has some additional benefits.

In general, this access has less arterial tortuosity, when compared to this approach in the right upper limb.

The use of the left arm is also more convenient and comfortable, both for the operator and the patient, as it does not require active maintenance of supination of the wrist during the procedure, and, due to the higher prevalence of right functional dominance in the population, it provides more comfort for the patient and earlier functional restoration after the procedure.

It also allows for greater technical ease in performing selective catheterization of left internal mammary artery grafts, as well as venous grafts for the right coronary artery in patients who previously underwent surgical myocardial revascularization with these grafts.

FINAL CONSIDERATIONS

The technical principles for the use of this segment of the radial artery do not differ from those of the conventional radial technique, however some issues related to the use of this route still need further investigation and require time to understand its true potential, such as:

- Since it is more distal, for anatomical reasons, its use does not seem to be as reproducible as the radial route at the wrist level (not all patients have adequate caliber and superficiality). The use of ultrasound-guided puncture can play a role in selecting the best patients, as well as overcoming these anatomical barriers (Figure 6).[16]
- Although there are reports of experiences with distal radial access in unstable clinical settings,[19] since this puncture site requires greater technical refinement, especially when using ultrasound, this may translate into time wasting and, in this scenario, mitigate its possible advantages.
- Due to the proximity of bone structures (scaphoid and trapezium), the puncture requires greater precision. The ideal is performing a puncture using a metallic needle (21G) avoiding transfixion, because, if there is no adequate control and transfixion occur, patients may experience significant pain when the periosteum is touched.

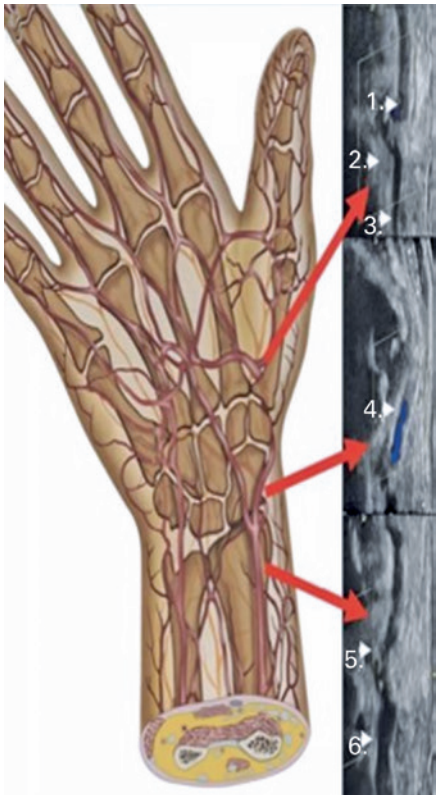


Figure 6. Ultrasonographic evaluation of the puncture point of the distal radial artery.

- Due to its initial sinuosity, the 0.018" guidewire included in commercially available introducer sets generally has insufficient flexibility to navigate in the initial portion. Therefore, it is important to always have a 0.014" coronary guidewire available, while being very attentive, because it may often "navigate" towards the palmar arch or a sub-branch. For this reason, in the presence of any resistance, it is prudent to monitor by fluoroscopy the proper positioning of the guidewire before the definitive introduction of the introducer set (Figure 7).
- The available cuff-type hemostatic devices were not specifically developed for this region and, especially in male patients, the available devices may not have a diameter that allows their proper use, sometimes requiring bandages to properly anchor them (Figure 8).
- What is the most suitable protocol and hemostasis device for this portion of the radial artery? There is a cuff-type hemostatic device dedicated to the snuffbox anatomy, called Prelude Sync Distal™ (Figure 9), but it is not yet commercially available in Brazil.
- In patients with larger stature and very elongated and tortuous subclavian artery and aorta, the use of longer catheters (125cm) is more frequent than traditional ones (100cm).

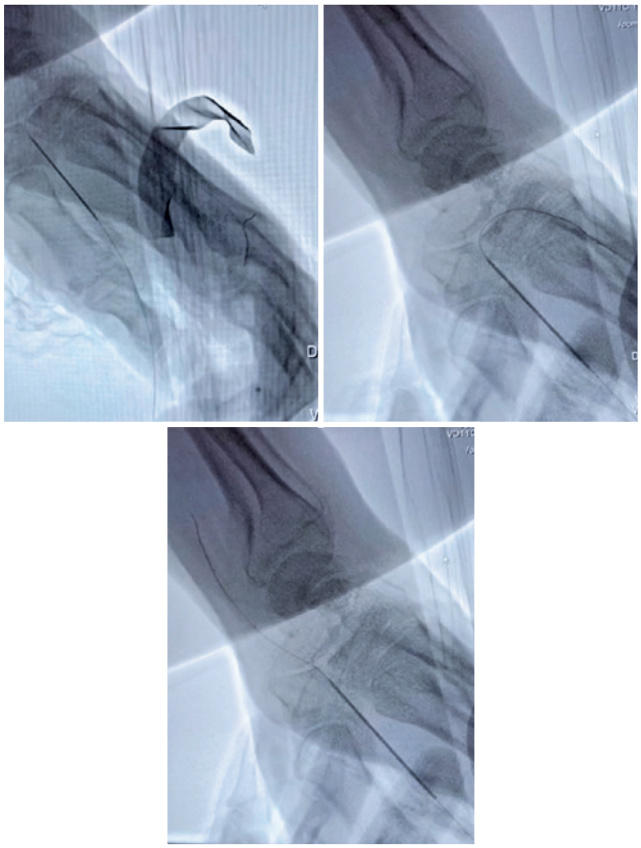
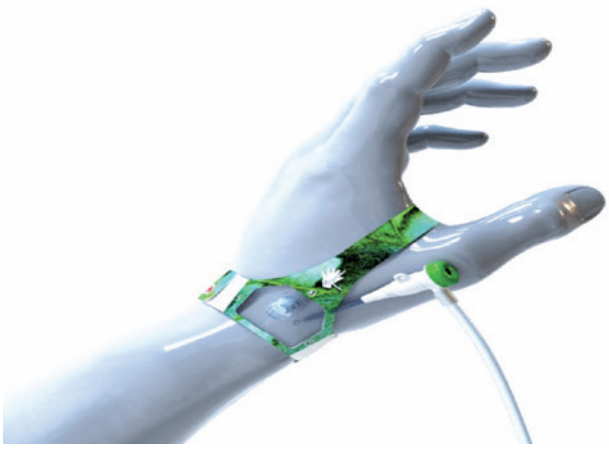


Figure 7. Repositioning of a 0.014" coronary guidewire from the palmar arch, with the aid of fluoroscopy.

- The scaphoid bone is notorious for the scarcity of its irrigation, and the branch that supplies it, in general, originates in that portion of the radial artery. It is not yet established whether there may be any immediate or long-term clinical implications if occlusion occurs.
- Finally, there are no randomized studies comparing its use with the conventional radial artery access in the wrist, as well as definitive studies evaluating safety outcomes related to the motor function and sensitivity of the structures of this anatomical region.

Figure 8. Bandage interposition for adequate anchoring of the hemostatic device.



Source: Merit Medical®. PreludeSYNC DISTAL™ [Internet]. [cited Jul 14, 2020]. Available from: https://www.merit.com/search/?x=3&y=9&st=Prelude+SYNC+Distal

Figure 9. Dedicated PreludeSYNC DISTAL™ hemostatic device.

CONCLUSION

The distal radial technique seems promising, since it provides more comfort to the operator and patient, presents a perspective of lower incidence of arterial occlusion, easier control of hemostasis and hemorrhagic complications after procedures. Ultimately, it adds two more alternatives of vascular access to avoid the femoral approach, which has greater potential for vascular and hemorrhagic complications, as already established in the literature. However, it will take time to definitively understand its full potential, as it happened with the conventional radial route in the wrist, which was first published in the late 1980's and gradually gained acceptance throughout the 1990's, and had its due recognition by the interventionist community only 15 years after its introduction.

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CONFLICTS OF INTEREST

The authors declare there are no conflicts of interest.

CONTRIBUTION OF AUTHORS

Conception and design of the study: DMZ; text writing: DMZ; approval of the final version to be published: DMZ.

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