

# Anatomical Variation of the Radial Artery Associated With Clinically Significant Ischemia

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**Purpose** The purpose of this retrospective review was to investigate the incidence of radial artery anatomical variations in patients with clinically significant distal upper extremity (UE) ischemia. Available anatomical studies report that high takeoff of the radial artery occurs in up to 15% of the population. We hypothesized that there is a higher incidence of high origin of the radial artery in patients with clinically significant ischemia compared with the reported frequency in the general population.

**Methods** We performed a retrospective review of all patients who underwent UE angiography for clinically significant hand and digital ischemia in our institution from 2012 to 2016. Data collected included patient age, sex, comorbidities, and modality of treatment.

**Results** Twenty-six angiograms were performed for UE ischemia meeting inclusion criteria. Eight patients had Raynaud disease or scleroderma. Ten patients (38%) had high radial artery takeoff with radial artery origin proximal to the antecubital fossa. The need for surgical intervention was similar in patients with normal anatomy and those with high takeoff of the radial artery.

**Conclusions** Incidence of high radial artery takeoff was found more frequently in patients with distal UE ischemia requiring angiogram than in reported population data. (*J Hand Surg Am.* 2018; ■(■):1.e1-e5. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

**Type of study/level of evidence** Diagnostic IV.

**Key words** Radial artery, upper extremity ischemia.



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**C**RITICAL ISCHEMIA IN THE UPPER extremity (UE) is significantly less common than ischemia in the lower extremity.<sup>1</sup> The hand is generally resistant to end-stage ischemia given the anastomotic network between the radial, ulnar, and interosseous arteries. Vascular thrombosis, injury, and even sacrifice of either the radial or the ulnar artery may be well tolerated in the general population because of this rich network of vascular anatomy, as evidenced by the common use of the radial artery for coronary artery bypass graft and as the vascular pedicle for free flap reconstruction cases. The radial artery originates

from the brachial artery at the level of the cubital fossa, but variations in the path or source of the radial artery are seen in up to 30% of individuals.<sup>2</sup> The most common of these variants is the proximal origin of the radial artery, from either the brachial or the axillary artery in up to 14% of upper extremities.<sup>2-7</sup> Other variations are much less commonly reported. The radial artery and ulnar artery may be transposed (radial artery from the medial and ulnar artery from the lateral side of the brachial artery) or the radial artery may be duplicated or completely absent.<sup>3,6,8</sup> Although high takeoff is a well-known anatomical variation, the clinical implications of this variation have been infrequently reported in the literature. The purpose of this retrospective review was to investigate if there is a higher incidence of abnormal anatomy of the origin of the radial artery in patients with clinically significant UE ischemia.

## MATERIALS AND METHODS

After approval by the institutional review board, we performed a retrospective review of all patients who underwent UE angiography, in the setting of clinically significant hand and digital ischemia, at our institution from January 2012 through January 2016. Exclusion criteria included angiogram for ischemia secondary to known trauma, known proximal embolic disease of the brachium or more proximally, or proximal pathology such as thoracic outlet syndrome. One patient was excluded because there was no visible angiographic runoff distal to the brachial artery and, therefore, determination of the radial artery origin was inconclusive. Data collected from the electronic medical record included presenting symptoms; ischemia-related clinical diagnosis; demographics including age, race, sex, and tobacco use; and medical comorbidities such as diabetes, hypertension, and hyperlipidemia.

Two independent examiners (E.M.P. and J.M.S.) reviewed the angiogram images in the digital radiology imaging system. If there was discordance between the examiners, the senior author (J.P.H.) provided the final determination regarding anatomical variance. The angiograms were reviewed for the presence or absence of proximal radial artery origin as well as the specific location of the radial artery origin (axillary or brachial).

Patient demographics were summarized using descriptive statistics. Group data from our patients with proximal radial artery origin and those with normal origin location are presented; however, the sample size is too small to allow for any statistical analyses.



**FIGURE 1:** Angiogram demonstrates the normal anatomy of the radial artery.

## RESULTS

There were 26 angiograms for UE ischemia performed in patients who met the inclusion criteria during the study period. Of those, 12 patients were male and 14 patients were female. Angiograms were performed on 16 right UEs and 10 left UEs. The mean patient age was 52 years (SD, 17 years). Of the 26 patients, 13 patients (50%) were documented smokers, 6 (23%) denied smoking, and 7 patients (27%) had no smoking history documented in the chart. Of the 26 patients, 8 (31%) carried a documented diagnosis of Raynaud disease or scleroderma.

Of the 26 angiograms from patients in our cohort meeting the inclusion criteria, 10 (38%) demonstrated a high takeoff of the radial artery and 16 had normal anatomy (Fig. 1). There were no notable differences in demographics or need for surgery between those with a high takeoff and those without (Table 1). Three radial arteries originated from the axillary artery (Fig. 2), and 7 radial arteries originated from the brachial artery (Fig. 3). Of the 7 brachial artery takeoffs, 2 originated from the proximal brachial artery and 5 originated at the mid brachium.

Five patients of 10 with a high takeoff ultimately underwent surgical intervention for ischemia. Seven of the 16 patients without high takeoff of the radial artery underwent surgical intervention. Of those 7, 4 were known smokers, 2 had scleroderma, and 1 had the diagnosis of Raynaud disease.

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