

## Tortuosity of forearm arteries in adult Indian cadavers

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### Abstract

Radial arteries are increasingly being used now a days for percutaneous coronary intervention, however this procedure encounters a high failure rate due to radial artery variations especially its tortuosity. Although clinical cases of syndromes like Guyon's canal syndrome and arm vibration syndrome have been ascribed to the tortuosity of ulnar artery but a systematic study on ulnar artery tortuosity is wanting.

The present study was conducted in Sixty one embalmed upper limbs, to report the tortuous character in different segments of forearm arteries.

The radial artery was found to be tortuous in about 12 per cent of the limbs. This tortuous character was more pronounced on the bony bed of the radial artery near the wrist joint. The ulnar artery was found to be tortuous in about 23% of the limbs, proximal and distal to the Guyon's canal and in 16% limbs within and adjoining the canal.

In the present study it was observed that the superficial segment, the segments which are subject to traction and terminal parts of the arteries are more tortuous. This may be a response to- a) regulate the pressure and b) a result of reduced elastic tissue in the vessel wall.

### Introduction

The radial and the ulnar arteries are principal arteries of forearm. The radial artery in recent times is increasingly being used for percutaneous coronary intervention as this is associated with enhance patient comfort and significant lower complication rates and better immediate and long term outcomes<sup>[1,2]</sup>. However the main failure cause of transradial coronary intervention is smaller size and more variations in radial artery approach Li et al.<sup>[2]</sup> have reported about 12% cases of arterial tortuosities in patients undergoing transradial coronary intervention which according to them is the main cause of failure of this procedure.

There are few published clinical cases of a tortuous ulnar artery being a cause of 'Guyon's canal syndrome'<sup>[3]</sup> or an effect of repetitive movements and trauma causing 'Hand arm vibration syndrome' and 'Hypothenar hammer syndrome'<sup>[4]</sup>. The present study focussed on studying the tortuous character of forearm arteries in adult cadavers.

### Material and Methods

Sixty one embalmed upper limbs (30 right and 31 left) from the collection of limbs available in the department of Anatomy were utilized for the present study. The limbs were dissected and the radial and ulnar arteries were dissected from commencement to

termination. The tortuous character of these arteries was studied in different segments of arteries as follows:

#### 1. Ulnar artery:

- From commencement upto Guyon's canal
- In the Guyon's canal
- From canal upto termination of ulnar artery
- From commencement of superficial branch upto the commencement of superficial palmar arch

#### 2. Radial artery:

- Part of radial artery on the muscular bed
- Part of radial artery on bony bed
- Superficial branch of radial artery

- Superficial palmar arch:** The character of the arteries was defined as wavy (if less tortuous) or tortuous. However this characterisation was done only on simple observation in the absence of any valid criteria for quantifying tortuosity in published literature.

### Observations

Table 1 shows the tortuous character of the forearm arteries. The ulnar artery was found to be either wavy or tortuous in about twenty per cent of the limbs. In segment A of the artery mostly the terminal part near the wrist joint was tortuous. Fig. 1 shows a tortuous ulnar artery near the wrist joint.

**Table 1: Showing wavy/ tortuous character of ulnar, radial arteries and superficial palmar arch**

	Segments of artery	Right		Left		Total- No. of cases	Total %
		Wavy	Tortuous	Wavy	Tortuous		
Ulnar artery	A	-	6	6	2	14/60	23.3
	B	1	5	3	1	10/60	16.6
	C	1	5	4	1	11/60	18.3
	D	1	5	5	4	15/60	25
Radial artery	E	2	1	1	1	5/61	8.3
	F	1	1	3	1	8/61	13.3
	G		3		1	4/61	6.6
Superficial palmar arch	H	-	6	-	6	12/61	20



**Fig. 1**

In one limb an oblique band of fibres extended between pisiform and the flexor retinaculum covering the ulnar artery superficially within the Guyon’s canal. After cutting the ligamentous band some transversally disposed muscle fibres were observed. These anomalous muscle fibres occupied the Guyon’s canal and covered ulnar nerve and artery superficially. The fibres seem to originate from flexor retinaculum laterally and after crossing neurovascular bundle converged on to the flexor retinaculum medially near the origin of hypothenar muscles (Fig. 2).



**Fig. 2**

The radial artery was found to be tortuous in about 12 per cent of the limbs. This tortuous character was more pronounced on the bony bed of the radial artery near the wrist joint (Fig. 3).



**Fig. 3**

**Discussion**

Tortuosity of arteries is not a new phenomenon, still the cause and effect of such tortuosity is an intriguing topic for research. While describing the tortuosity of coronary arteries in the article “Coronary tortuosity: a long and winding road” the authors have put forward a hypothesis that tortuosity of the artery leads to energy dissipation and ischemia of the tissue supplied by it<sup>[5]</sup>.

Traction of the vessel and luminal pressure are the two factors that are believed to be responsible for the tortuosity<sup>[5]</sup>.

The artery maintains a stable length till the elastic tissue in the vessel wall resists the pressure. With advancing age and in some diseases degeneration of the elastic tissue in the vessel wall may lead to tortuosity<sup>[6]</sup>.

The ulnar artery was found to be tortuous in about 23% of the limbs in segments A and D i.e. proximal and distal to the Guyon’s canal and in 16% limbs within and adjoining the canal. A tortuous artery within the canal may be a cause of compression of ulnar nerve resulting in a clinical condition described as Guyon’s canal syndrome<sup>[7]</sup>.

A tortuous ulnar artery resulting from use of vibrating tools (Hand arm vibration syndrome) or repetitive trauma (Hypothenar hammer syndrome) may result in arterial spasm, thrombosis and embolism. This may ultimately lead to digital ischemia<sup>[4]</sup>. Although clinical cases of ulnar artery tortuosity have been described in literature, no anatomic study is available for comparison.

The radial artery was found to be tortuous in 13% of the limbs on the bony bed. Li et al.<sup>[2]</sup> has reported radial artery tortuosity in 3.6% patients undergoing percutaneous coronary intervention via radial artery approach. They attribute radial artery tortuosity as a significant cause of failure of transradial coronary procedure. Since the radial artery approach is gaining popularity over the femoral approach in recent times, the findings of the present study are noteworthy for interventional cardiologists.

The present study highlights some facts which need to be further scrutinized for understanding the cause and effect of tortuosity of arteries:

- a. The superficial segments of the arteries are more tortuous.
- b. Segments of the artery which are subjected to traction as a result of movement are more tortuous. It is noteworthy however that in the proximity of a joint an artery is subjected to traction in extension of the joint rather than flexion.
- c. Terminal parts of the arteries are more tortuous. This may be a response to- a) regulate the pressure and b) a result of reduced elastic tissue in the vessel wall.

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