



RESEARCH ARTICLE

PREVALENCE OF NON-FUNCTIONAL SUPERFICIAL PALMAR ARCH IN SOUTH INDIAN POPULATION

<sup>1</sup>Amal Fathima Sameer, <sup>2</sup>Vidya G., <sup>3,\*</sup>Gladwin V. and <sup>4</sup>Parkash Chand

<sup>1</sup>Department of Anatomy, JIPMER, Puducherry

<sup>2</sup>Senior Resident, Department of Anatomy, JIPMER, Puducherry

<sup>3</sup>Associate Professor, Department of Anatomy, JIPMER, Puducherry

<sup>4</sup>Professor, Department of Anatomy, JIPMER, Puducherry

ARTICLE INFO

Article History:

Received 23<sup>rd</sup> June, 2016  
Received in revised form  
19<sup>th</sup> July, 2016  
Accepted 15<sup>th</sup> August, 2016  
Published online 20<sup>th</sup> September, 2016

Key words:

Allen's Test,  
Anastomoses,  
Collateral Circulation,  
Radial Artery.

ABSTRACT

**Background:** Superficial palmar arch is an anastomosis between the ulnar artery and radial artery in the palmar region of the hand, in which the contribution is predominantly by the ulnar artery. The functionality of superficial palmar arch is highly important in procedures involving radial artery since the advent of reports of pain, ischemia and gangrene following the procedures. There is paucity in the literature regarding the prevalence of a non-functional superficial palmar arch in the South Indian population. Hence, the present study was attempted to determine the prevalence of superficial palmar arch in South Indian population.

**Materials and Methods:** A descriptive cross-sectional study with a sample size of 400 adult subjects was carried out with the approval from Institute committees. Modified Allen's test was done to ascertain the functionality of superficial palmar arch which was performed in subjects after obtaining informed consent.

**Results and Conclusion:** A prevalence of less than 1% was observed in the population which is relatively low compared to previous studies in different population. The possible risk factors for the non-functional superficial palmar arch need to be ascertained by a study with a larger sample size for possible subgroup analysis. Though Modified Allen's test was used to screen the patients, a confirmatory test is mandatory for patients before undergoing radial artery procedures.

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Citation: Amal Fathima Sameer, Vidya G., Gladwin V. and Parkash Chand. 2016. "Prevalence of non-functional superficial palmar arch in south indian population" *International Journal of Current Research*, 8, (09), 38172-38174.

INTRODUCTION

Superficial palmar arch is an anastomosis between the ulnar artery and radial artery in the palmar region of the hand, in which the contribution is predominantly by the ulnar artery (Susan Standring, 2015). Functional superficial palmar arch, in which there is a good and adequate collateral circulation through ulnar artery and branches of radial artery, is of prime clinical importance in patients who undergo procedures like radial artery grafting in coronary artery bypass surgery, arterio-venous fistula for hemodialysis, catheterization through radial artery approach and radial artery cannulation for blood gas analysis (Habib et al., 2012). There are various reports of hand ischemia, pain and gangrene of digits following these procedures.

\*Corresponding author: Gladwin V.

Associate Professor, Department of Anatomy, JIPMER, Puducherry.

One of the reasons for the complications related to these procedures being a non-functional superficial palmar arch (Tağil et al., 2007). Further, the above mentioned procedures are contraindicated in persons with an established non-functional superficial palmar arch. The non-functionality of superficial palmar arch can be due to either an anatomical variation or consequent to any underlying pathology of ulnar artery like thrombosis etc., leading to poor and inadequate collateral circulation (Ottone et al., 2010). In order to ascertain the functionality of superficial palmar arch, there are various methodologies adapted namely Doppler ultrasound, pulse oximetry, digital pressure monitoring, Allen test and Modified Allen test etc., Among the various methods employed, screening for a large population, modified Allen test is a simple and reliable clinical examination to assess the unction of the superficial palmar arch (Ronald, 2005). Many studies have been attempted to document the variations of superficial palmar arch and its branches.

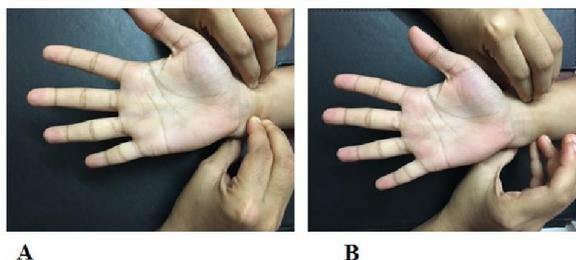
Most of these studies were carried out in cadavers in whom the functionality of the superficial palmar arch could not be determined (Anitha *et al.*, 2011). The ulnar contribution is fairly constant while anatomical variations lie in the part of radial artery. The radial artery may give contribution to the superficial palmar arch or may not contribute at all (Verma, 2004). In case of latter, radial artery should not be punctured for any procedure compromising its supply. Uncompromised blood circulation through the ulnar artery is mandatory for an adequate blood supply for the distal part of the hand and the digits. This is mostly related to the patency of the ulnar artery and the contribution of the radial artery to the superficial palmar arch.

## MATERIALS AND METHODS

The patients and the relatives of the patients who had attended the out patients department services of Medicine and Surgery were the participants of the present study. The study was initiated after obtaining approval from the Research Monitoring Committee and the Institute Ethics Committee of the Institute. The present study was a descriptive cross sectional type. Four hundred adult subjects of both genders, above the age group of eighteen, irrespective of nature of occupation, illness were recruited for the present study. Children, adult persons with; oedema, ulceration, inflammatory lesion, hyperkeratosis of hand, those with severe pallor, previous hand trauma or surgery and non-cooperative patients were excluded from the study. The participants were then informed and explained about the clinical examination procedure of Modified Allen test as mentioned in the WHO guidelines ("Modified Allen test," 2010). The participants were informed about the study and the test through the information sheet.

Consent was obtained from the participants of the study. After recording the demographic data, the Modified Allen test (Figure 1) to determine the patency of ulnar artery collateral circulation was done as follows.

### Positive – Modified Allen's Test



**Figure 1.** Picture A shows blanching of palm after occlusion of both ulnar and radial arteries. Picture B shows flushing once occlusion of ulnar artery is released – positive modified Allen's test

- The participants was asked to clench his or her fist
- The pulsations of radial and ulnar arteries were felt and occlusive pressure was applied with fingers to blanch palm region of the hand.
- Then the pressure on the ulnar artery was released to determine whether the test is positive or negative ("Modified Allen test," 2010).

The above mentioned clinical examination procedure was done in both the hands. The test was considered POSITIVE if the hand flushed within 5-15 seconds after the pressure on the ulnar artery was released meaning that the collateral blood flow through the ulnar artery was good. The modified Allen test was considered NEGATIVE if the hand did not flush within 5-15 seconds which indicated the ulnar circulation was inadequate or non-existent. The modified Allen test was performed in the both the hands of all individuals and the results were recorded.

## RESULTS

Out of the 400 participants, 176(44%) were male and 224(56%) were female with a mean age of  $45.16 \pm 14.01$  and  $38.54 \pm 11.69$  respectively. 286 participants were from rural background while 114 from urban population with a percentage of 71.5% and 28.5% respectively (Table 1). The modified Allen test was negative in four individuals among whom it was negative bilaterally in one and the other three it was unilateral. Among the four with the negative Allen test, three were male and one was female. The prevalence of negative modified Allen's test in the population was less than 1%. History from those patients revealed two were agricultural workers and one had a history of smoking, hypertension and diabetes mellitus.

**Table 1. Categorical variables- Descriptive statistics**

Variables	Percentage (n=400)
Male	176(44%)
Female	224(56%)
Rural	286(71.5%)
Urban	114(28.5%)
Skilled worker	98(24.5%)
Unskilled worker	302(75.5%)
Smoker	56(14%)
Non-Smoker	344(86%)
H/o Diabetes	71(18%)
H/o Hypertension	78(20%)

## DISCUSSION

The prevalence of non-functional superficial palmar arch in the studied population was less than 1%. Invariably, all three men with non-functional superficial palmar arch were smokers. In an epidemiological study done among the French population by Patrick H *et al*, in a sample of 2000 individuals from the general population across four different locations of France and a subsample of 1033 persons with symptoms of Raynaud's phenomenon, a non-functional superficial palmar arch, mainly contributed by the ulnar artery occlusion was found to be 9.6% in men and 1.0% in women. The study was carried out in two phases. Participants reporting of Raynaud's phenomenon and random negative participants were selected for phase 2. Modified Allen test was performed to screen for a non-functional superficial palmar arch especially due to occlusion or inadequate blood flow through the ulnar artery (Carpentier *et al.*, 2009). As compared to the previous study done in French population, the prevalence of non-functional superficial palmar arch is relatively low in the South Indian population. The possible factors of higher prevalence in the previous studymight be due to estimation in subsamples of general

population who were interviewed for symptoms of Raynaud's phenomenon and in those modified Allen test was done. Hence the prevalence there may not be the general population per se rather a subsample of the general population. The inadequate collateral circulation might be due to occlusion of ulnar artery due to thrombus formation. Furtherin our study, the risk factors for this non-functional superficial palmar arch could not be ascertained due to inadequate numbers for subgroup analysis. Based on the previous study and the current one, it was the prevalence of a non-functional superficial palmar arch is more in men. The reason might be attributed to smoking status and also possibly due to occupational hazards, like hard manual laborer, nature of work with vibrating tools etc. Further evaluation of these patients is mandatory to differentiate from a pathological cause to a possible normal anatomical variation.

### Conclusion

For any procedure involving radial artery, functionality of superficial palmar arch is highly significant. Though Modified Allen test is a reliable screening test, confirmatory tests like Doppler ultrasound or digital pulse oximetry / pressure monitoring are mandatory before commencing any procedures involving the radial artery to prevent post procedural complications.

### Acknowledgement

The authors acknowledge the STS program – ICMR for providing a platform to conduct this study.

### Conflict of Interest

The authors declare that there is no conflict of interest.

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