INTRODUCTION

The Palmaris longus (PL) tendon is reminiscent of evolution where it used to enhance grip in primeval apes. It is known as musculus palmaris longus in Latin. It is frequently reported to be absent in Man despite dexterous hand function and elaborate hand muscle usage of humans. Although in the primate hand it is known to enhance palmer function and grip strength; its absence or malformation in humans does not seem to cause any maneuvering disability. The slender PL tendon lies superficial to the flexor retinaculum, is nourished by the ulnar artery and...
innervated by the median nerve as it weakly flexes
the wrist. It originates in the medial epicondyle of
humerus (at the common flexor tendon) and inserts
in the palmar aponeurosis of hand. The PL tendon
occupies a narrow space between the flexor carpi
radialis and flexor carpi ulnaris muscles, although
it may not always be present.
Many methods are described for clinically
determining the presence of PL, including Mishra,
Pushpakumar, Schaffer and Thompson tests.\(^1\)
Being a superficial muscle, its absence can be easily
demonstrated through these tests. Of late, PL has
received a growing interest in plastic surgery for
tendon transfers and free-tendon grafts. It has
also been used for a wide variety of reconstructive
procedures including restoration of lip and chin
defects, ptosis correction, glans penis coronaplasty,
eyelid defects and restorative management of facial
paralysis.\(^2\)
Studies on PL agenesis indicate a wide variation
across racial and demographic boundaries; the
range of absence varying from 6 to 25%.\(^3\) Owing to
significant racial disparities in its occurrence and
agenesis patterns, there is a need to investigate
the native Saudi population for PL absence, since
most available reports represent Caucasians and
Blacks and published literature regarding Arabs is
inadequate. Our study probes into the incidence
of PL absence and its agenesis patterns in the
relatively less explored Saudi population of Jazan.
Jazan province comprises an area of 40,000
sq km in the southwestern part of Saudi Arabia
along the Red sea coast, with a population of
approximately 1.2 million, including some 5,000
villages and cities. Its major city, Giza is Saudi
Arabia’s third most important port. To the best
of author’s knowledge, no previous reports on
PL trends among Saudi’s are available in medical
literature and representative information offered
by our study will promote a better understanding
of morphological features and reconstructive
procedures in the Saudi population.

**METHODOLOGY**

This simple random sampling based cross
sectional study used Thompson’s, Schaeffer’s and
Pushpakumar’s two-finger sign tests\(^1\) for clinically
determining the absence of PL among 400 young
adult volunteers from the university community of
Jazan. (200 Male and 200 Female students; age range
21-25 yrs; College of Medicine / Applied Health
Sciences / Pharmacy and Dentistry Faculty of Jazan
University, Saudi Arabia). We chose these tests
because they were easy to maneuver and applicable
in a large number of subjects with considerable
degree of accuracy. Also, subjects belonging to this
age group were physically and mentally competent
of following out instructions in an efficient manner.
Schaeffer’s test was performed on both hands of
the subjects in standing position. If PL tendon was
either ‘visible’ or ‘palpable’; the muscle was noted
as present. In case of absence, Pushpakumar’s and
Thomson’s tests were applied to re-confirm the
muscle’s non-existence. Cases with history of injury
and surgery in the forearm/hands or paralysis of
upper limbs were not included. Those unwilling,
with joint stiffness, recent rheumatologic afflictions
of wrist and trauma to hand were also excluded.
The observation data was collected by one author
(TH) and results were tabulated by another (FNH).
Basic descriptive statistics using SPSS version 14
was used to analyze data with a confidence interval
of 95% and a p value of less than 0.05 to indicate
significance.

Ethical approval of the institutional review board
was taken prior to conducting the study and volun-
tary informed consent of participants was obtained.

**RESULTS**

The overall incidence of PL tendon agenesis
was noted as 24.6%. Unilateral absence was a
predominant occurrence as compared to bilateral
absence (16.7% cases presented with unilateral
absence and 7.75% had bilateral absence; p>0.05-

<table>
<thead>
<tr>
<th>PL tendon</th>
<th>Females n (%)</th>
<th>Males n (%)</th>
<th>Total n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>145(72.5%)</td>
<td>157(78.5%)</td>
<td>312(78%)</td>
</tr>
<tr>
<td>Absent</td>
<td>55(27.5%)</td>
<td>43(21.5%)</td>
<td>98(24.5%)</td>
</tr>
<tr>
<td>Unilateral absence</td>
<td>39(19.5%)</td>
<td>28(14%)</td>
<td>67(16.7%)</td>
</tr>
<tr>
<td>Right side absence</td>
<td>12(6%)</td>
<td>19(9.5%)</td>
<td>31(7.75%)</td>
</tr>
<tr>
<td>Left side absence</td>
<td>27(13.5%)</td>
<td>9(4.5%)</td>
<td>36(9%)</td>
</tr>
<tr>
<td>Bilateral absence</td>
<td>16(8%)</td>
<td>15(7.5%)</td>
<td>31(7.75%)</td>
</tr>
</tbody>
</table>
not significant). Sexual dimorphism was noted in agenesis trends; although the difference across genders was non-significant (p>0.05). Right sided absence was more common in males while left sided absence was more common in females. The overall ‘right’ versus ‘left’ sided absence showed statistically non-significant difference in the population; p>0.05. The detailed results are presented in Table-I.

**DISCUSSION**

Till date, many studies have been conducted in numerous parts of the world to elucidate the absence of PL muscle. It is a dispensable muscle with no ‘active’ function in hand movements which would otherwise lead to any form of functional deficiency if the muscle were absent. Despite its functionally passive role, PL is a popular agent for tendon transfers, free tendon grafts and in reconstructive procedures. On the routine operation table, it serves as a landmark to identify or lead to the palmer fascia or median nerve. It has been noted as a stabilizer of superficial structures in the palm in preparation to thumbs abduction.4

This study explored PL absence in native Jazani population of Saudi Arabia. All the participants of this study belonged to indigenous Arab populace and no foreigners were included to eliminate confounding bias (here, it is imperative to mention that Saudi Arabia comprises a third of its population from amongst foreigners and expatriate workers). Our observations of 24.5% absence were considerably higher than values reported in Pakistani (12%) and Indian (17%) populations (comparable Asian populations).2 Our cluster exhibited an agenesis incidence lying on the upper limit of the commonly reported range (5 to 25%) in various races.3 Sexual dimorphism was observed in our study, a phenomenon that has been reported previously by Troha5 and Ceyhan.6 The difference between unilateral and bilateral absence was not marked, findings which contradicted the reports of Mokaba GO et al.3 The lower incidence observed bilaterally is consistent with previous accounts of Thompson on Caucasians7 and Sebastain on Chinese8 but differed with Ceyhan’s6 records on Turkish population. Unilateral absence was observed to be higher in females (19.5%) than males (14%) of our study group; which correlated with findings of Troha5; Ceyhan6 except for the report on Ugandans by Igbigbi and Ssekitoleko.8

A study on 300 Caucasian subjects by Thompson et al found that PL was absent unilaterally in 16%, bilaterally in 9% of the study sample for an overall 24% prevalence of absence.7 The incidence of unilateral as well as bilateral absence was more common in males, which contrasted with our results where females exhibited a higher preponderance of unilateral and bilateral absence. In a study conducted by Elizabeth O’Sullivan and Barry S Mitchell on Chinese race, 22 out of 25 hands with anomalous superficial palmer arches presented with no PL tendon.9 This is a significant finding and indicates noteworthy association between these two anatomical features. Some researches point to a concomitant absence of Plantaris tendon in 50% of cases where PL tendon was found missing, which is another interesting morphological correlation.10

Karatay found the agenesis frequency to be 20.5% in Turks.11 Ceyhan and co-researchers stated that “Agenesis is more frequent in Whites than in Yellow and Blacks”.6 They also suggested that PL occurrence is a dominant character in humans. According to Tahir et al, PL absence was recorded as 2.2% in Chinese, 13.2% in Indians, 3.4% in Japanese, 4.8% in American Blacks, 12.7 in Russians, 14.1% in American whites, 15.3% in European whites, 8.6% in Polish, 19.5% in Jewish and 25.4% in French.7 The overall incidence for African blacks as reported by Igbigbi PS is relatively on the lower side (1.02%)8 except for recent reports by Enye L indicating a higher rate of prevalence(12.6%).12 In a study on 500

**Table-II: Prevalence of congenital absence of Palmaris Longus tendon in various populations.**

<table>
<thead>
<tr>
<th>Population</th>
<th>Authors</th>
<th>Absence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Americans</td>
<td>Troha [5]</td>
<td>24%</td>
</tr>
<tr>
<td>Pennsylvania. USA</td>
<td>Wehbe [14]</td>
<td>23%</td>
</tr>
<tr>
<td>Seattle, USA</td>
<td>Vanderhoof [10]</td>
<td>12%</td>
</tr>
<tr>
<td>Germans</td>
<td>Gruber [15]</td>
<td>20.4%</td>
</tr>
<tr>
<td>European</td>
<td>George [16]</td>
<td>15.2%</td>
</tr>
<tr>
<td>Turkish</td>
<td>Ceyhan [6]</td>
<td>25%</td>
</tr>
<tr>
<td>Japanese</td>
<td>Adachi [17]</td>
<td>3.4%</td>
</tr>
<tr>
<td>Chinese</td>
<td>Sebastian [1]</td>
<td>4.6%</td>
</tr>
<tr>
<td>Ugandans(Africa)</td>
<td>Igbigbi [8]</td>
<td>1.02%</td>
</tr>
<tr>
<td>Yourbas, Nigeria</td>
<td>Mokba [3]</td>
<td>6.7%</td>
</tr>
<tr>
<td>Pakistani</td>
<td>Hussain FN [2,22]</td>
<td>12.95%</td>
</tr>
<tr>
<td>Indians</td>
<td>Kapoor [13]</td>
<td>17.2%</td>
</tr>
<tr>
<td>Malays</td>
<td>SA Roohi [18]</td>
<td>11.3%</td>
</tr>
<tr>
<td>Amazonians</td>
<td>Machado [19]</td>
<td>3.7%</td>
</tr>
<tr>
<td>Arabian Gulf region</td>
<td>Sater [20]</td>
<td>36.8%</td>
</tr>
<tr>
<td>Present study</td>
<td>Hussain FN</td>
<td>24.5%</td>
</tr>
</tbody>
</table>
Indian subjects during 2008, Kapoor et al concluded the prevalence of PL agenesis to be 17.2% (8% bilateral and 9.2% unilateral). The prevalence of unilateral agenesis was more common in female subjects (findings similar to our study where 19.5% Saudi females presented with unilateral absence as compared to 14% males); who were still more likely to have bilateral agenesis (results that contrasted with our findings of a preponderance of left sided agenesis in females). Numerous studies in the past have indicated that PL absence is more common in women and on the left side, although the observed differences were usually not significant. Our study exhibited similar findings and again, the differences were non-significant.

Thus, a wide variation of PL absence patterns exists among numerous ethnic and racial sub-groups as documented in available literature. A race specific cumulative and comparative representation of congenital absence of PL muscle has been depicted in Table-II. However, due to lack of complete access to all these studies and fundamental differences in study designs and involved variables, a conclusive inference cannot be rendered until all these studies are meta-analyzed scientifically.

Our report of an incidence of 24.5% absence among native Jizani Arabs is higher than the agenesis frequency documented in most standard anatomy text books (McMinn:15%). Interestingly, it is more akin to Caucasian rates, while it exceeds the values generally observed among Asians: Pakistani’s, Indians, Chinese, Japanese, Malays, therefore denying the popular assumption that “Caucasians have a considerably higher prevalence of agenesis than Asians”. Also, it matches the findings of Sater et al in 2010 on 1043 Bahraini subjects, (Arabian Gulf region) who reported similar high rates of PL absence (36.8%) in their population. This brings forth the possibility that the customary prevalence of PL absence in Asian populations may not be applied to Arab populations.

Ceyhan et al argue that the PL muscle appears to be ‘increasing’ in their native Gazientep population, while it is generally seen as a diminishing muscle among Turks. This elucidates an interesting possibility of PL absence frequency being a dynamic equation in races and contingent upon changing variables with time. This prospect further underlines the relevance of updated demographic records on PL incidence in different populations.

Despite being reasonably objective, our study had certain drawbacks as well; its sample size was moderate and the study area confined to a single demographic region in the western province of Saudi Arabia. A large scale multi-centric study based on cluster sampling of native Arab population might elucidate a more realistic picture regarding this phenomenon. Also, further researches focusing on possible existence of ‘PL disparities’ among different tribal/ethnic subgroups of the region would be a worthwhile direction to explore.

**CONCLUSIONS**

The prevalence of PL absence among Arabs resembles the demographic trends observed in other races, although lying on the upper limit of the reported range and being more analogous to Caucasian values rather than Asians. This contradiction is interesting, but seems logical because PL incidence exhibits a well documented racial dependence. Comparable with certain earlier studies, unilateral absence is a more common occurrence than bilateral absence and sexual dimorphism with a female preponderance is noted among Saudi’s. The knowledge of population specific incidence of PL absence, its prevalent gender trends and current morphologic status is important for tendon grafts and reconstructive surgery as well as for anatomists, orthopedicians and biological anthropologists.

**ACKNOWLEDGEMENTS**

K Abdelaziz and Moaz Mohamed who helped in data collection for the study.

**List of abbreviations:**

- PL: Palmaris Longus
- M: Male
- F: Female

**Competing interests:** ‘The authors declare that they have no competing interests’.

**REFERENCES**


Author’s contributions:

FNH was involved in conceiving the study, tabulating the data, drafting the manuscript and gave final approval of the version to be published. TH was involved in collecting the data, revising the manuscript and gave final approval of the version to be published.