NARRATIVE REVIEW

Prevalence of agenesis of palmaris longus in male and female genders on clinical examination — a review

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Abstract

Palmaris longus is a muscle that is located in the anterior compartment of the forearm. Among the muscles belonging to the flexor compartment of forearm, palmaris longus is located at the most superficial position and that is why it is easy to access. It exhibits high variability and its prevalence ranges between 1.5% and 63.9%. The knowledge of prevalence of agenesis of palmaris longus is essential both in terms of updating anatomical information and also for physicians, radiologists, physiotherapists and surgeons. The surgeons must know about the variability as it may be beneficial while they plan surgeries involving the palmaris muscle as a graft. The current narrative review was planned to highlight the variability pattern of palmaris longus muscle in terms of prevalence, gender and laterality. Palmaris longus agenesis is more common in females and on the left side. Besides, unilateral agenesis is more common compared to bilateral agenesis.

Keywords: Palmaris longus, Agenesis, Prevalence, Gender, Clinical examination.

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Introduction

Palmaris longus (PL) is a muscle that is located in the anterior compartment of the forearm.[1,2] Among the muscles belonging to the flexor compartment of the forearm, PL is located at the most superficial position.[3] The muscle is proximally attached to the median epicondyle, while distally its attachment is on the palmar aponeurosis.[2,4] PL acts as a weak flexor of the forearm[1] along with tensing the palmar aponeurosis.[5] In case the muscle is absent, other muscles in the forearm take over its actions.[6] PL is considered to be among the muscles which show high anatomical variability.[7-9] The variability differences are attributed to the phylogenetic regression.[10]

The tendon of PL being superficially located can be identified clinically. There is a total of 11 tests that can be used for that purpose. As PL is a muscle that has the highest variability, its prevalence ranges between 1.5% and 63.9%.[11] A research conducted in eastern Nigeria documented the agenesis to be 3.7%.[4] A research conducted on cadavers in Iran documented the prevalence to be 36.3%.[12] Similar prevalence was mentioned in a cadaveric study done in Poland.[8] An interesting study conducted in a village in Ukraine revealed that the individuals born before 1945 presented with agenesis prevalence of 70% while the agenesis prevalence decreased by 23% in those who were born after 1945.[13]

The agenesis of PL muscle differs in terms of laterality, too. A study was conducted on aborted foetuses in the gestation age range of 18 to 38 weeks. The unilateral absence of the PL muscle was 22.5% while bilaterally it was observed in 26.25%.[8] A study conducted in Anambra State University reported only unilateral agenesis and no case of bilateral agenesis.[4] There are ethnic differences in the prevalence of agenesis as well. A research based on multiethnic population revealed different prevalence values for individuals belonging to different ethnic origins. The agenesis was maximum in the natives of Malaysia (10.3%), followed by the Indians (9%), while the lowest values (7.2%) were mentioned for the Chinese.[14] A study conducted on foetuses documented that the absence of PL was the commonest among the Japanese, followed by the Europeans, while it was the lowest for the Turks.[15] It was observed in many studies that PL muscle agenesis was more notable in females compared to the males.[4] A study on the intrauterine foetuses documented that there were no differences in terms of PL agenesis between the genders.[7]

The agenesis of the PL muscle does not result in disability as its absence does not affect the daily chores. Across the world, when it comes to reconstructive surgeries, the tendon is a preferred choice for grafting surgeries.[8,16] The tendon of PL is considered a good choice in reconstructive surgeries because the muscle tendon can be accessed easily as it lies in close proximity to the hand.[15] Okafor et al. documented that the tendon of PL is frequently used as graft for hand and reconstructive plastic surgeries.[4] The use of PL tendon has also been stated in the ligaments and tendon surgeries[17] along with chin and lip restoration procedures.[5] The insight about PL muscle is of vital importance for physicians, radiologists, physiotherapists and surgeons. The surgeons must know about the variability as it may be beneficial while they plan surgeries

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involving the PL muscle as a graft. The current narrative review was planned to highlight the variability pattern of PL muscle in terms of prevalence, gender and laterality.

Materials and Methods

The narrative review comprised literature search on Google, Google Scholar and PubMed databases of relevant publications from 2015 to 2020. The search of articles was done by using the key words; palmaris longus, agenesis, absence, prevalence, gender, clinical examination. Articles included were in the English language reporting clinical examination of the agenesis of plamaris longus, and those that mentioned PL prevalence along with details related to right-sided, left-sided and bilateral agenesis in frequencies and percentages in male and female subjects. Articles in any language other than English, with incoherent tables and those that did not mention the results in terms of frequencies and percentages were excluded.

Results and Discussion

Of the 29 articles found, 11(38%) did not meet the inclusion criteria, and the remaining 18(62%) were analysed in detail (Table).

Overall prevalence of agenesis: The prevalence of agenesis of PL is variable and differs from region to region. A study conducted in Egypt found the agenesis in two age groups; 9 and 19. It was 4.75% and 4.5% among the two groups, respectively.[18] An Indian research mentioned the value to be 11.3%[19] while its prevalence was 11.7%, 15.8% and 23.9% in Putrajaya, Malaya and Sabah, respectively.[20,3,21] The prevalence was 17.05% in the Philippines.[22] A recent research documented the prevalence to be 33.9% while a study in Egypt reported 33.9% in the gymnasts group compared to 37% in the students group.[23] Another study in Egypt revealed a prevalence of 34.3%.[24] In Pakistan, a study in Multan documented the overall agenesis to be 12.87%[25] while in Faisalabad, it was reported to be 23.6%.[26] Studies conducted in Turkey mentioned prevalence of agenesis to 21.8% and 31.05% in Konya and Istanbul, respectively.[27,28] in Nepal, studies reported 11.8% and 14.8% in Biratnagar and Bhairahawa, respectively[29,30] while in Kathmandu, it was 27.65%.[31] In Iran, studies have documented the values to be 26.6% and 33.7%.[32,33] A research in Serbia documented the prevalence to be 52.3%.[34]

Clinical examination

Tests used: Various studies incorporated different tests to record the agenesis of PL muscle. Clinical examination can be done by incorporating the most simple and the most reliable method, called the Schaeffer's test. The studies confirmed the agenesis by using one to seven tests, with only a few studies using a single test.[3,22] Only one research was based on two tests.[32] Majority of the researchers used the Schaeffer's test. In case Schaeffer's test was not able to visualise the tendon of PL, other tests were also used to ensure the absence or presence of the muscle tendon. Some studies were based on three tests,[24,29] while majority of the studies used four tests.[18,19,25,27,28,30,31,33] Four studies were based on five tests,[20,21,26,34] while one study employed the use of seven tests.[23]

Association of laterality among the participants in terms of PL agenesis: Studies in Nepal documented more unilateral agenesis compared to bilateral agenesis. Jha et al. reported 8.2% unilateral agenesis and 3.5% bilateral agenesis, Sharma et al. reported unilateral agenesis 11.1% against bilateral agenesis 3.7% while Misha et al. documented unilateral absence in 77.16% cases against 22.84% on both sides.[29-31] An Egyptian study also reported unilateral agenesis 14.5% and 12.5% against bilateral values 4.75% and 4.5% in subjects aged 9 and 19 years, respectively.[18] Another Egyptian study also reported more unilateral agenesis 19.1% against bilateral absence 15.2%.[24] Kular et al., Yong et al., Lamichanne et al., Rehman et al., and Abdolreza et al., also documented parallel results with more unilateral agenesis of 6%, 7.90%, 14.51% 15%, 17.3% against bilateral agenesis 2%, 3.7%, 2.98%, 7.9%, 16.3%, respectively.[19,20,22,26,33] Contrary to these results, Anjum et al., Kasim et al., Irmak et al., Eric et al., and Erdagi et al. documented more bilateral agenesis (7.23%, 9%, 9%, 15.4%, 18.8%, 19.47%) compared to unilateral agenesis (5.56%, 6.8%, 5%, 6.37%, 14.11%, 11.5%), respectively.[25,3,27,23,28] Another study also mentioned more bilateral absence (29.3%) than unilateral (23%).[34]

Association of gender in terms of overall PL agenesis: Studies reported more agenesis in females (9.8%, 12.72%, 14.2%, 14.5%,15.2%, 22.3%, 25.5%, 35.3%) compared to the males (5.8%, 4.77%, 9.1%, 7.8%, 14.4%, 21.3%, 20%, 31.6,) in Iran, the Philippines, Putrajaya in Malaysia, Biratnagar and Bhairahawa in Nepal, Turkey, Sabah in Malaysia and Egypt, respectively[33,22,20,29,30,27,21,24] while studies in Bathinda in India, Kathmandu in Nepal, Faisalabad in Pakistan and Turkey reported more values in the males (17.3%, 28.42%, 29.5%, 31.25%) compared to those (9.3%, 26.67%, 17.3%, 30.9%) in the females, respectively.[19,31,26,28] A study in Multan documented more agenesis with significant results in males (15.67%) compared to the females (10/.87%).[25] Vucinic et al. documented parallel results with more agenesis in the males.[34]

Association of gender in terms of unilateral and bilateral PL agenesis: Studies conducted in the Philippines and Malaysia documented more unilateral agenesis both in the males and the females compared to bilateral ones.[20-22] A Nepalese study reported that in both males and females there was more unilateral absence

Table: The agenesis of palmaris longus muscle among males and females belonging to different regions of the world.

Author	Year	Place	Sample size	Tests used	Right agenesis - M	Right agenesis - F	Left agenesis - M	Left agenesis - F	Bilateral agenesis - M	Bilateral agenesis - F
Jha[29]	2015	Nepal	400	Schaeffer's Mishra's I Thompson's	2.40%	2.20%	2.40%	8.60%	3%	3.90%
Mehta[31]	2015	Nepal	1020	Schaeffer's Mishra's I Thompson's Pushpakumara's	44.80%	46.91%	55.20%	53.09%	22.84%	32.50%
Ouies[18]	2015	Egypt	800	Schaeffer's Mishra's II Thompson's Pushpakumara's	Groups Age 9 -6.50% Age 19 -5%	Groups Age 9 -9.5 Age 19 -9%	Groups Age 9 -5.50% Age 19 -4%	Groups Age 9 -7.50% Age 19 -7%	Groups Age 9 -0.04% Age 19 -5%	Groups Age 9 -5.50% Age 19 -4%
Abdolreza[33]	2015	Iran	900	Schaeffer's Mishra's Thompson's Pushpakumara's	5.80%	9.80%	10.20%	8.90%	17.10%	15.60%
Anjum[25]	2016	Multan	567	Schaeffer's Mishra's I Thompson's Pushpakumara's	4.60%	3.62%	4.60%	2.11%	6.35%	5.13%
Vucinic[34]	2016	Serbia	300	Schaeffer's Mishra's I Mishra's II Thompson's Pushpakumara's	10.70%	10.70%	15.30%	9.30%	35.30%	33.30%
Lamichanne[22]	2017	Philippine	503	Thompson's	1.39%	4.57%	2.98%	5.57%	0.40%	2.58%
Yong[20]	2017	Malaysia	1239	Schaeffer's Mishra's I Mishra's II Thompson's Pushpakumara's	4.20%	3.90%	3.80%	4.90%	3%	4.40%
Irmak[27]	2017	Turkey	533	Schaeffer's Mishra's Thompson's Pushpakumara's	2.90%	5.40%	2.90%	1.50%	15.40%	15.40%
Safari[32]	2017	Iran	480	Schaeffer's Thompson's	11.60%	12.90%	16.90%	5.80%	23%	34.16%
Qaoud[24]	2019	Egypt	700	Schaeffer's Modified Schaeffer's Mishra's II	8.90%	10.80%	7.90%	9.20%	14.80%	15.20%
Sharma[30]	2019	Nepal	270	Schaeffer's Mishra's Mishra's Thompson's Pushpakumara's	4%	4.80%	7.20%	6.20%	3.20%	4.10%
Kular[19]	2019	India	600	Schaeffer's Mishra's I Mishra's II Pushpakumara's	2%	1.30%	4%	6.60%	3.30%	5.30%
Eric[23]	2019	Croatia, Serbia, Bulgaria, Slovenia,	370	Schaeffer's Mishra's I	Gymnasts -7%	Gymnasts -3.60%	Gymnasts -7.80%	Gymnasts -9.10%	Gymnasts -19.10%	Gymnasts -18.20%

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Author	Year	Place	Sample size	Tests used	Right agenesis - M	Right agenesis - F	Left agenesis - M	Left agenesis - F	Bilateral agenesis - M	Bilateral agenesis - F
		Denmark, France, Romania, South Africa	170 atheletes	Mishra's II Thompson's Pushpakumara's	Students -3%	Students -8%	Students -10%	Students -11%	Students -24%	Students -12%
Kassim[3]	2020	Malaysia	457	Schaeffer's	11	12.7	9.8	14.4	8.1	9.5
Rehman[26]	2020	Pakistan	155	Schaeffer's Mishra's I Mishra's II Thompson's Pushpakumara's	12.20%	5.80%	10.20%	2.90%	7.10%	8.60%
Ravi[21]	2020	Malaysia	134	Schaeffer's Mishra's I Mishra's II Thompson's Pushpakumara's	10%	5.30%	7.50%	12.80%	2.50%	7.40%
Erdagi[28]	2020	Turkey	190	Schaeffer's Mishra's Thompson's Pushpakumara's	6.25%	4.54%	5%	7.27%	20%	19.09%

(4.8% and 10.7%) compared to bilateral agenesis.[29] Other studies have also reported similar picture with more unilateral agenesis in males 6%, 11.2%, 16.8%, 77.16% than in females 8%, 11%, 20.1%, 67.50% respectively.[19,30,24,31] An Iranian study documented more unilateral agenesis in females (18.7%) against bilateral absence, while in males the reverse was true (16%).[33] Eric et al. stated conflicting results with more bilateral agenesis in both the genders.[23] This was endorsed by a study on the Caucasian population.[34] Two Turkish studies revealed more bilateral absence against unilateral absence in both genders.[27,28] A study in Iran documented more bilateral absence in females against unilateral absence (18.7%), while in males the agenesis was more unilateral (28.5%).[32]

Gender-wise comparison of right-sided versus left-sided agenesis: Jha et al. reported that in males there was no difference in agenesis when the right and the left sides were compared, while in females the agenesis was found to be more on the left side.[29] Other studies in Nepal documented that there was more agenesis on the left side compared to the right side in both the genders.[30,31] An Egyptian study reported contrary results, with more agenesis on the right side than the left side.[18] Right-sided agenesis was found to be common in females with significant difference, while the left side in males had more agenesis but the results were not significant.[33] A study in Multan documented equal percentages for agenesis on both the sides in males, while in females the absence was more right-sided.[25] Other studies mentioned more left-sided agenesis in males compared to greater values for right-sided absence in the females.[32,34] Lamichanne et al., Kular et al., Eric et al., and Kassim et al. documented more left-sided absence compared to right-sided agenesis in both the genders.[3,19,22,23] Studies in Egypt and Pakistan stated more right-sided absence in both the genders.[24,26] A research in Malaysia stated equal agenesis in females on both sides, while in the males, the absence was more common on the left side.[20] Studies conducted in Malaysia and Turkey stated more agenesis on the right side in males and more absence on the left side for females.[21,28] Another study mentioned equal agenesis in males on both the sides, while in females the absence was more common on the right side.[27]

Association of ethnicity with PL agenesis: There are ethnic differences in the prevalence of agenesis. A study on Malay population reported the prevalence of PL absence to be 11.7% which was higher than the Chinese population but lower than that of the Indian population.[3] The highest values of bilateral agenesis were noted in the Indian ethnic group than the Malay and the Chinese. Both unilateral as well as bilateral agenesis was lesser in the Chinese participants.[3] The study presented an adaptive evolutionary logic reporting that since the Chinese use chopsticks, the agenesis is the lowest in that community.[3]

Conclusion

PL agenesis is more common in females and is prevalent on the left side, while unilateral agenesis is more common than bilateral agenesis. The knowledge of prevalence of PL agenesis is essential both in terms of updating the anatomical information and also in deciding the

treatment plan according to the gender-wise differences as well as racial backgrounds of the patients.

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