Palmaris Longus Agenesis among Banjarese People in South Kalimantan Indonesia

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Abstract. Palmaris Longus Muscle (PLM) agenesis is an anatomical variation characterized by the absence of the PLM tendon, typically identified using the Schaeffer test and supporting examinations. This study aims to determine the prevalence of PLM agenesis among the Banjarese population in South Kalimantan. A descriptive observational design with a survey approach was employed, involving 160 respondents selected through purposive and cluster sampling across 10 villages in Banjarmasin. The results show that 11.25% of respondents exhibited PLM agenesis, while 88.75% had normal presence. Agenesis was more common in females (16.25%) than males (6.25%), and more frequent in individuals under 41 years (12.38%) compared to those over 40 (8.5%). It was also more prevalent among right-hand dominant individuals (83.33%) than left-handed individuals (16.67%).

Keywords: musculus palmaris longus, variation, agenesis, banjarese tribe

1 Introduction

Agenesis of the palmaris longus muscle (PLM) was an anatomical variation of the palmaris longus muscle. Agenesis of PLM was characterized by the absence of the tendon of the muscle on the volar side of the anatomical antebrachial region [1]. This muscle has been extensively studied in both living and cadaveric individuals, showing results of varying prevalence around the world.[2][3]

The PLM is a muscle in the antebrachium region of the anterior compartment (flexors), located in the outer layer (superficial), from the radius to the ulna bone. This area consists of the pronator teres, flexor carpi radialis, palmaris longus, and flexor carpi ulnaris muscles. Apart from the pronator teres, all of these muscles are corrosive in the epicondyle medial humeri, which together function as flexors of the elbow and wrist joints. Especially for PLM, it functions as a wrist flexor but is quite weak and serves also for thumb abduction[4][5]. This muscle is innervated by branches of the median nerve [6].

PLM was one of the muscles that have various and most variations [7]. The most common variation was agenesis, either unilateral or bilateral. Some other variations were tendon ends which can be 2 or 3 separate tendons, muscle venter position, in the form of muscle fibers or just strands,

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the bifid of muscle venter or its tendon, and deviation from its insertion to the pisiform or to the musculus *abductor pollicis brevis*.

The palmaris longus muscles are known to have degenerated phylogenetically and vestigial that can be seen from the short and small of its venter while the tendons extend to the insertion in the palmar aponeurosis. Generally the PLM function is not significant and can be negated[4]. This is why the PLM tendon is the surgeon's choice for tendon grafts in orthopedics, hand surgery, reconstructive surgery, and plastic surgery. PLM has clinical importance as a location marker for the median nerve.

Several studies have shown agenesis was more common in women on the left hand, showing significant differences based on gender [8]. Also in subjects with left-handed dominance, agenesis was found 3.7 times in their left hand as well, although many other studies indicated that PLM agenesis was present has nothing to do with the side of the dominant hand.

Even though many studies on PLM agenesis had been reported, however, there is no specific research target on the population of the Banjarese tribe in South Kalimantan Indonesia. Hence, we conducted a study to determine the prevalence of PLM agenesis in the Banjar tribe in South Kalimantan based on its variation, sex, age range, and dominant hand. It is hoped that it can provide an overview of the prevalence of PLM in the Banjar tribe population in South Kalimantan, increase knowledge of anatomy, become a basic reference for further research on the inheritance pattern of PLM agenesis, and in practice, it can be used as a reference for medical personnel and surgeons to conduct procedures or actions related to MPL

2 Methods

This study is a descriptive observational research design with a survey study. The research target population was the Banjarese tribe in South Kalimantan while the population was the Banjar tribe in the city of Banjarmasin. The sample was taken using the purposive sampling method and cluster sampling of 160 people, from 10 villages that had been randomized in Banjarmasin City, 16 respondents were taken from each village. The inclusion criteria were the Banjar tribe with at least one parent as well as the Banjar tribe and the exclusion criteria were not willing to be research subjects, paralysis/paresis of the forearm area, have a history of trauma or surgery on the forearm, have congenital abnormalities, and do not have an arm. To establish the diagnosis of PLM agenesis in this study, we used several methods, including the Schaeffer test, Mishra test I and II, Gangata test, Lotus test, Bhattacharya test, Thompson test, Pushpakumar two fingers sign, Four fingers sign, Hiz-Ediz test. The main test was the Schaeffer Test. If the results are negative then it is confirmed again by the Mishra Test I and II, Gangata Test, Lotus Test, Bhattachary Test, Thompson Test, Pushpakumar's two fingers sign, Four fingers sign, Hiz-Ediz Test. If all these confirmatory tests did not reveal the PLM tendon, then the subject was defined as having PLM agenesis.

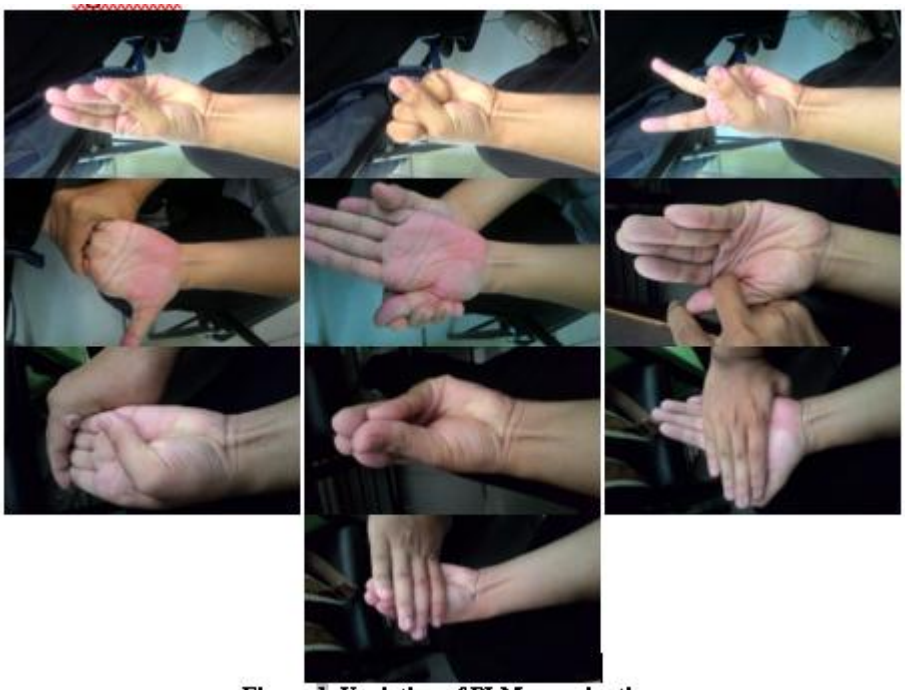

Figure 1. Variation of PLM examination

The observational data, both genesis data, unilateral agenesis, and bilateral agenesis, will be calculated and tabulated. Then from the sample obtained by agenesis, the proportions were then searched based on gender, age, and side of the dominant hand. The data will be processed using the Microsoft Office Excel 2007 and SPSS 25 software. This study is a descriptive observational research design with a survey study. The research target population was the Banjarese tribe in South Kalimantan while the population was the Banjar tribe in the city of Banjarmasin. The sample was taken using the purposive sampling method and cluster sampling of 160 people, from 10 villages that had been randomized in Banjarmasin City, 16 respondents were taken from each village. The inclusion criteria were the Banjar tribe with at least one parent as well as the Banjar tribe and the exclusion criteria were not willing to be research subjects, paralysis/paresis of the forearm area, have a history of trauma or surgery on the forearm, have congenital abnormalities, and do not have an arm. To establish the diagnosis of PLM agenesis in this study, we used several methods, including the Schaeffer test, Mishra test I and II, Gangata test, Lotus test, Bhattacharya test, Thompson test, Pushpakumar two fingers sign, Four fingers sign, Hiz-Ediz test. The main test was the Schaeffer Test. If the results are negative then it is confirmed again by the Mishra Test I and II, Gangata Test, Lotus Test, Bhattachary Test, Thompson Test, Pushpakumar's two fingers sign, Four fingers sign, Hiz-Ediz Test. If all these confirmatory tests did not reveal the PLM tendon, then the subject was defined as having PLM agenesis..

3 Results and Discussion

The number of respondents in the study was obtained as many as 160 respondents (80 male and 80 female) according to the inclusion criteria that had been selected by purposive sampling technique and cluster sampling from 10 randomized villages, namely South Basirih and Mantuil Villages (South Banjarmasin District), South Belitung Sub District and North Belitung Sub District (West Banjarmasin), Great Antasan Sub-District and Sea Pekapuran (Middle Banjarmasin District), Karang Mekar Sub-District and Sungai Lulut Sub-District (East Banjarmasin), and North Kuin Sub-District and Andai River Sub-District (North Banjarmasin District). Primary data were obtained after examining the PLM tendon, on both arms of the respondent with a total of 320 arms. Respondents in this study had a mean age of 29.83, from the lowest age of 2 years to the oldest aged 74 years.

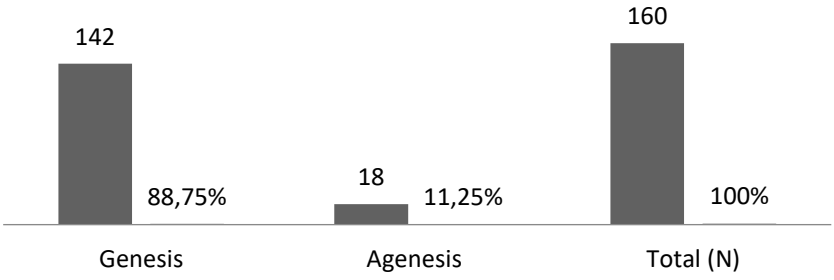

Fig. 1. PLM Distribution in Banjar tribe

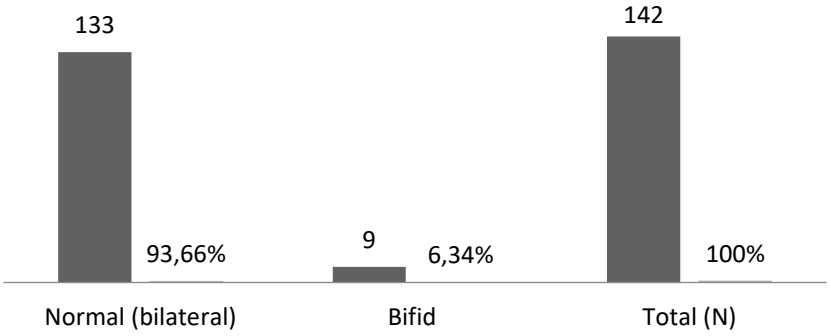

Fig. 2. Type of PLM Agenesis

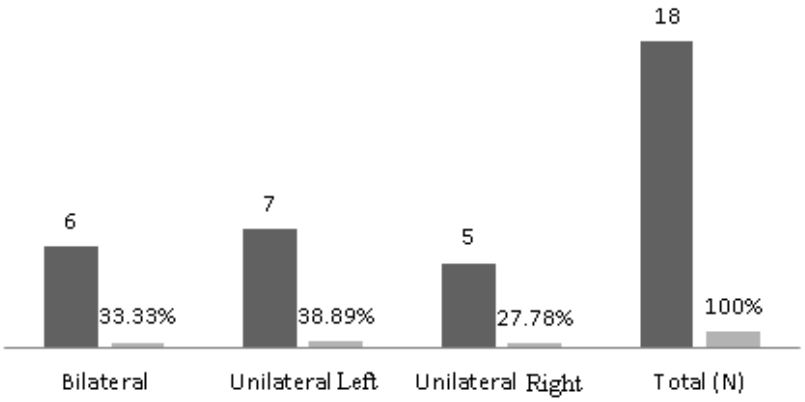

Fig. 3. Lateralism of Agenesis PLM

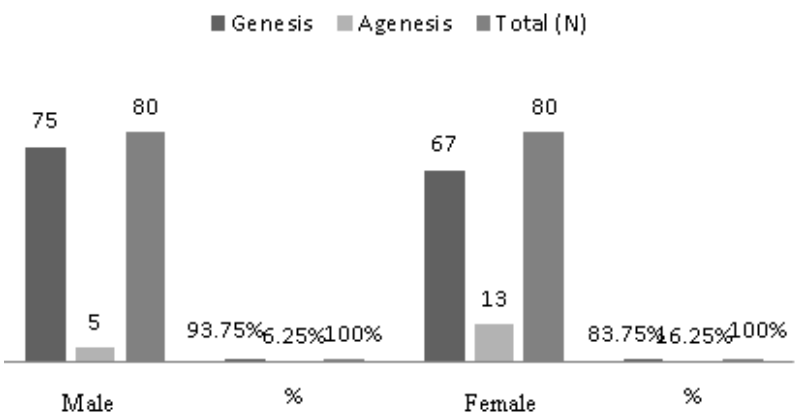

Fig. 4. Sex of PLM

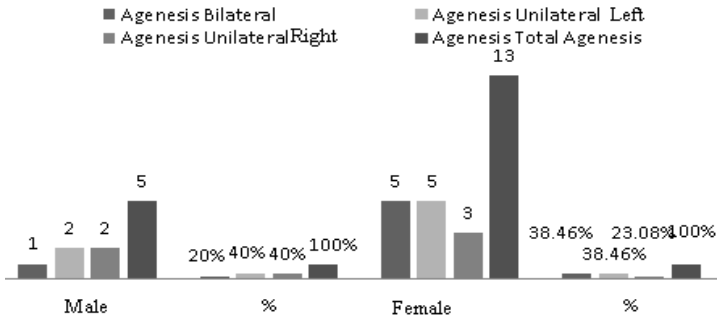

Fig. 5. Distribusi Agenesis PLM Berdasarkan Jenis Kelamin pada Suku Banjar di Kalimantan Selatan

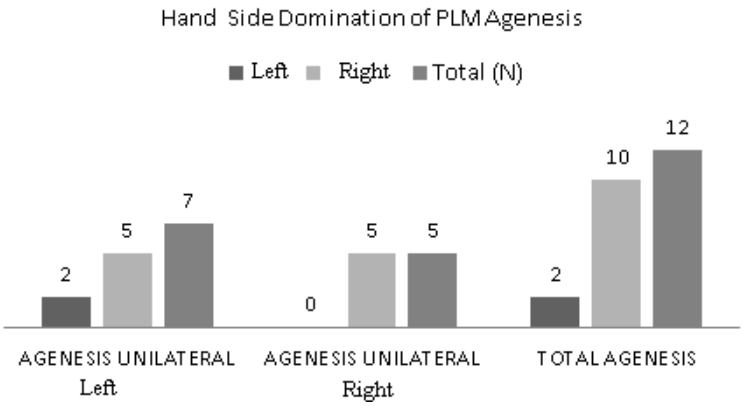

Fig. 6. Hand domination in PLM Agenesis

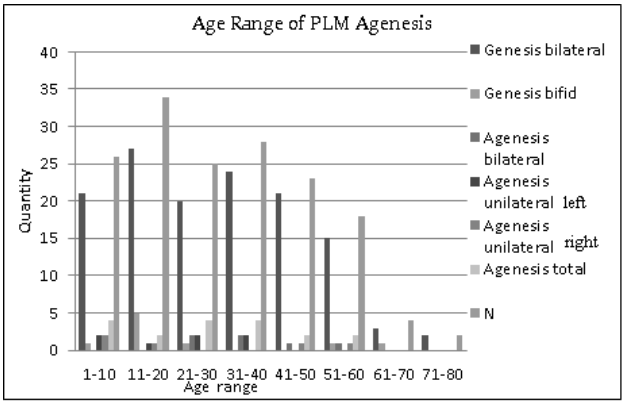

Fig. 7. Age range of PLM agenesis on Banjar tribe

In this study, the results showed that 12 respondents had agenesis (11.25%) and the rest had genesis (Table 1). Among all respondents who had genesis, 9 people had a bifid tendon form (6.34%). Based on the type of variation, agenesis can be divided into bilateral, left unilateral, and right unilateral. 6 people (33.33%), 7 people (38.89%), and 5 people (27.78%) were found, respectively. It shows that unilateral agenesis is more common than bilateral agenesis (Table 2). Based on gender, it was found that agenesis was more common in women (16.25%) than men (6.25%) (table 3 and 4). In table 5, the data used for the distribution of PLM agenesis based on the dominant hand side only used 12 respondents who had unilateral agenesis. Only 2 respondents with the left dominant hand were found and all of them did not find right unilateral agenesis. Meanwhile, respondents with the right dominant hand have the same number of left unilateral agenesis as right unilateral agenesis. Agenesis is more common in respondents who have a dominant right hand, which is 83.33% compared to respondents who have a dominant left hand which is only 16.67%. The findings of agenesis were mostly found in respondents who were less than 41 years old, as many

as 14 people with a percentage of 12.38%, while those who were more than 40 years old were 4 people with a percentage of 8.5% (Table 6).

Fig. 8. Genesis PLM

Fig. 9. PLM with Tendon Bifida Type

Fig. 10. PLM Agenesis

One of the most varied muscles in the human body is the palmaris longus musculus (PLM), its vestigial function is known and are classified as retrogressive muscles. Its anatomical variations had more significant importance than other muscles of the superior extremity. Matteo Realdo Colombo of Italy has first reported it in 1559 about the possible absence of PLM in his De Re Anatomica Libri XV and has been recognized for its validity. Since then PLM has been widely studied in various parts of the world with different methods and interests.

There are several clinical tests used to determine the presence or absence of MPL. The Schaeffer test is a standard test performed by placing the thumb with the little finger and then the wrist is flexed.19,37 Another test can be done when the Schaeffer test is found to be negative. These tests are the Thompson test (clenching the fist by flexing the wrist), Pushpakumar two fingers sign (extension of the index and middle fingers together with full flexion of the ring and little fingers and opposition of the thumb), the Mishra I test (passive hyperextension). metacarpophalangeal joints II-V and slightly flexing the wrist) and Mishra II test (thumb abduction and wrist flexion against resistance), Gangata test (holding passive abduction of the thumb and passive flexion of the wrist), four fingers sign (combination Flexion and opposition of the thumb and passive hyperextension of the II-V fingers), Lotus sign (joining all the fingers to form a bud and flexing the wrist), the Bhattacharya test (flexion of the wrist against resistance), and the Hiz-Ediz test (the hand forming a bud then flexion of the wrist against resistance). Here we divide these clinical tests into 2 types, the first type is clinical tests with active movements such as tests Schaeffer, Thompson test, Pushpakumar two fingers sign, and Lotus sign. The second type is a clinical test with passive movement, this test requires assistance from the examiner to move the subject's hand. These second tests are the Mishra I and II test, Gangata test, four fingers sign, Bhattacharyan test, and Hiz-Ediz test. In this study, it appears that the second type of clinical test is more sensitive to the PLM tendon so that in the next study it is necessary to compare the two types of examinations.

Various kinds of PLM have been reported by various researchers in the world, both morphologically and based on prevalence. The variations include, unilateral and bilateral agenesis, bifida or bitendon, distal insertions that deviate from normal, tendons are proximal and in distal, or it can also have tendons in both and the venter is in the middle, in the form of a whole venter without any tendons, or the whole is only a tendon. When the muscle venter is distal while the tendon is proximal then called inversus long palmaris (reverse palmaris longus). The reverse palmaris longus is known to cause compression of the median nerve and ulnar nerve.These variations are of clinical importance because they may cause or increase the risk of forearm and wrist compartment syndrome hand that can lead to Volkmann's ischemic contracture, carpal tunnel syndrome, Guyon syndrome, and Dupuytren's contracture.

The most common variation is the MPL agenesis. Many surgeons use the tendon as a landmark when performing procedures on the volar forearm and use it in a wide variety of reconstructive surgical procedures, the presence or absence of PLM is very important. to know before performing these surgical procedures. Variation is also known to have a positive association with Dupuytren's disease in Caucasians.

Among vertebrates, palmar longus is limited to mammals only and is well-formed in species that move and swing in trees, especially in lower primates such as orangutans but its presence varies in upper primates such as chimpanzees, gorillas and gabon.

The prevalence of PLM agenesis in humans varies widely, it is known that the prevalence of PLM agenesis around the world is from the lowest in the Korean population of 0.6% to the highest

in the Turkish population of 63.9%. Body size, sex, ethnicity, and population may influence differences in the prevalence of MPL agenesis. Research by Pekala et al. In a meta-analysis study, it was stated that the geographic distribution of agenesis on cadavers was found that agenesis was higher in Europe 24.7% and North America 15.5% than in Asia, namely 6.8%, whereas when using clinical examination the prevalence of PLM agenesis was highest in Europe. 21.7%, then Asia 16.2%, Africa 12.1%, and finally North America 11.0%. A significant difference between the cadaveric study and clinical examination in Asia is thought to be due to the very small number of cadaveric studies in Asia at only 3.8%, which may cause bias.

From the results of this study, it was found that the PLM agenesis was 11.25% in the Banjar tribe while the genesis was 88.75%. Given that the Banjar tribe is closely related to the Malay and Dayak tribes[10]. It is stated that two hypotheses underlie the formation of the Banjar tribe, namely the localgenius hypothesis, namely that the Banjar tribe originated from the Dayak Bukit people who descended to the lowlands and formed a community, while the pot melting hypothesis is that the Malays who crossed with the Dayak tribe later became the Banjar tribe [11], [12][13]. So it can be seen in the research that raised the Malays as respondents, namely research in Malaysia, it was found that the prevalence of PLM agenesis was 11.3% 14 and 11.7% 26 which showed almost the same results as the Banjar tribe[14][15]

Although the pattern of genetic inheritance is not certain, PLM is thought to have genetic inheritance based on the Mendelian principle, its agenesis is autosomal dominant while its genesis is autosomal recessive, genetically this inheritance is formed and regulated by the HOX gene. As is well known by recent studies, the skeletal muscles originate from the mesoderm lining of certain myotome somites. The myoblasts from the hypaxial region are joined to each other and are the origin of the myotube, which migrates to the periphery, forming the skeletal striated muscles and differentiating as the muscles of the extremity area. from the dorsolateral somite cells that migrate to the extremity stalk at week 7 of embryonic development. Then it is divided into two layers, namely the superficial layer and the deep layer, in the clumps of the flexor region originating from the mesenchymal cells[16][17]

For the distribution of PLM agenesis based on sex, the results of this study indicate that agenesis was found in women more than men, namely 16.25% in women and 6.25% in men. Research conducted by Pekala et al. also obtained more agenesis results in women, namely 17.6%, and in men, namely 15.1%.[18] Although many studies state that the ratio of agenesis in men and women is not so significant, several other studies state that agenesis is more common in women.

In this study, the results of data comparing between 2 age groups, namely those under 41 years of age and over 41 years, found that the findings of agenesis were mostly found in respondents who were less than 41 years old, namely 14 people with a percentage of 12.38%, while those who were 4 people over 40 years old with a percentage of 8.5%. Although not significant, there is a study from Ouies SM that compared 2 age groups, namely the 19-year group with the 9-year group with the prevalence of agenesis, respectively, 18% and 19%, 29 which could be used as a basis for suspicion that there is a possibility that it will increase agenesis found in many generations - the next generation.

In this study, we discovered that agenesis was found more in respondents who had a right-hand dominant which was 83.33% compared to respondents who had a dominant left hand which was only 16.67%. Research on agenesis and its relationship with the dominant hand side is quite limited in the literature. Several studies have stated that there is no relationship between PLM agenesis and

the dominant side of the hand. However, when viewed from the type of agenesis, the unilateral type is more common than the bilateral type.

4 Conclusion

This study concludes that PLM agenesis in the Banjar tribe (11.25%) in this study is not much different from the research on ethnic Malays in Malaysia (11.3% and 11.7%) and relatively not much different from other ethnic in Indonesia (10.4%).

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References

[1] Q. Javaid, "Prevalence of agenesis of palmaris longus in male and female genders on clinical examination - a review.," *J. Pak. Med. Assoc.*, vol. 72, no. 4, pp. 733–737, Apr. 2022, doi: 10.47391/JPMA.4514.

[2] C. Pham, P. Vien, and A. Hielscher, "A Cadaveric Case of Palmaris Longus Agenesis and Reversal.," *Cureus*, vol. 15, no. 10. United States, p. e47664, Oct. 2023. doi: 10.7759/cureus.47664.

[3] G. Longhurst, D. Stone, and N. Mahony, "Bilateral reversed palmaris longus muscle: a case report and systematic literature review.," *Surg. Radiol. Anat.*, vol. 42, no. 3, pp. 289–295, Mar. 2020, doi: 10.1007/s00276-019-02363-z.

[4] S. J. Sebastin, A. Y. T. Lim, W. H. Bee, T. C. M. Wong, and B. V Methil, "Does the absence of the palmaris longus affect grip and pinch strength?," *J. Hand Surg. Br.*, vol. 30, no. 4, pp. 406–408, Aug. 2005, doi: 10.1016/j.jhsb.2005.03.011.

[5] H. Gangata, R. Ndou, and G. Louw, "The contribution of the palmaris longus muscle to the strength of thumb abduction.," *Clin. Anat.*, vol. 23, no. 4, pp. 431–436, May 2010, doi: 10.1002/ca.20960.

[6] V. Perdomo-Cárdenas, C. Patiño-Holguín, and J. F. Vélez-García, "Evolutionary and terminological analysis of the flexor digitorum superficialis, interflexorii and palmaris longus muscles in kinkajou (Potos flavus) and crab-eating racoon (Procyon cancrivorus).," *Anat. Histol. Embryol.*, vol. 50, no. 3, pp. 520–533, May 2021, doi: 10.1111/ahe.12656.

[7] A. Kowalczyk and N. Topuzov, "Three in one - unusual palmaris longus muscle anatomical variation.," *Folia Morphol. (Warsz).*, May 2024, doi: 10.5603/fm.98076.

[8] S. J. Sebastin, M. E. Puhaindran, A. Y. T. Lim, I. J. Lim, and W. H. Bee, "The prevalence of absence of the palmaris longus--a study in a Chinese population and a review of the literature.," *J. Hand Surg. Br.*, vol. 30, no. 5, pp. 525–527, Oct. 2005, doi: 10.1016/j.jhsb.2005.05.003.

[9] R. Panghiyangani, "View of Anti-diabetic and Anti-obesity Effects of Citrus amblycarpa Hassk. Peels Extract in High Fat Diet Rats Model."

[10] I. Aflanie, R. Panghiyangan, P. W. Nurikhwan, A. Yudianto, and T. Koesbardiati, "Analysis of Genetic Variations And Specific Locus of Banjar Hulu Tribe Through Short Tandem Repeat (STR) Locus Combine Dna Index System (Codis) in Nuclear DNA," *Indian J. Forensic Med. Toxicol.*, vol.

15, no. 1, pp. 1175–1180, Jan. 2021, doi: 10.37506/IJFMT.V15I1.13577.
[11] D. F. Wardhani, D. Arisanty, A. Nugroho, and U. B. L. Utami, "The Local Wisdom of the Paramasan Dayak Tribe in Environmental Management," *Environ. Ecol. Res.*, vol. 11, no. 5, pp. 859–872, 2023, doi: 10.13189/EER.2023.110514.
[12] S. R. Usop, "Indigenous Indonesian Dayak Traditional Wisdom in Reducing Deforestation", *The Indonesian Journal of Geography,* vol. 53, no. 3, 2021.
[13] E. Y. Nugraheni, M. D. Artaria, Sutinah, and R. Lukens-Bull, "The Social Construction of the Banjar Ethnic Society Toward the Radap Rahayu Dance," *J. Ilm. Peuradeun*, vol. 12, no. 1, pp. 51–70, Jan. 2024, doi: 10.26811/PEURADEUN.V12I1.1029.
[14] D. Radithia *et al.*, "Effectiveness of low-level laser therapy in reducing pain score and healing time of recurrent aphthous stomatitis: a systematic review and meta-analysis", doi: 10.1186/s13643-024-02595-0.
[15] Gunawan, Muhamat, and Maghfiroh, "Ethnobotany and conservation of Kasturi (Mangifera casturi Koesterm.) by Banjar Tribe in South Kalimantan, Indonesia," *Biodiversitas J. Biol. Divers.*, vol. 25, no. 4, pp. 1420–1426, Apr. 2024, doi: 10.13057/BIODIV/D250410.
[16] A. J. Mathew, T. T. Sukumaran, and S. Joseph, "Versatile but Temperamental: A Morphological Study of Palmaris Longus in the Cadaver," *J. Clin. Diagn. Res.*, vol. 9, no. 2, p. AC01, Feb. 2015, doi: 10.7860/JCDR/2015/11212.5542.
[17] E. Adams and A. Rollings, *Fundamentals of Game Design (Game Design and Development)*. 2007.
[18] P. A. Pękala *et al.*, "Congenital absence of the palmaris longus muscle: A meta-analysis comparing cadaveric and functional studies," *J. Plast. Reconstr. Aesthet. Surg.*, vol. 70, no. 12, pp. 1715–1724, Dec. 2017, doi: 10.1016/J.BJPS.2017.08.002.