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Original Contribution

RELIABILITY OF THE TESTS USED FOR PREDICTING THE PRESENCE OF PALMARIS LONGUS MUSCLE

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ABSTRACT

Purpose: This study aimed to determine the intra-observer and inter-observer reliability of nine tests used for predicting the presence of palmaris longus muscle.

Methods: Three observers tested the presence of palmaris longus muscle three different times on each of the 52 subjects' right and left wrists. The interobserver agreement was evaluated using Cohen's Kappa statistics. And the intraobserver agreement was evaluated using the Intraclass Correlation Coefficient.

Results: Inter-observer agreements, defined by kappa, varied from 0.293 (slight) to 0.687 (substantial) ($p<0.001$ for all), while intra-observer agreements varied from 0.691(substantial) to 0.885 (almost perfect) ($p<0.001$ for all).

Conclusions: Many of the current tests used for determining the presence of palmaris longus tendon have substantial interobserver reliability. As the testing experience of the observers improves, the agreement rates increase too.

Key words: kappa statistics, palmaris longus, intraobserver, interobserver, reliability

INTRODUCTION

The palmaris longus is one of the most variable muscles in terms of its presence, attachments, and morphology (1-11). It is considered to belong to a class of retrogressive muscles (7). With palmar aponeurosis, the muscle represents the most superficial part of the primitive common flexor muscle of the fingers (1, 6, 7).

The palmaris longus tendon assumes great clinical importance in tendon transfer or transplant. It has been used in surgery of the hand, leg, head, neck, and face (7, 12). This wide variety of surgical applications combined with its ease of harvest makes it a tendon of great importance. Besides, the palmaris longus is an anatomical landmark for operations in the forearm and wrist area (2, 3, 6, 12).

Ethnic variations in the prevalence of absence of the palmaris longus are well known. Prevalence of the agenesis of palmaris longus has been variously reported in different percentages in the literature ranging between 0,6-64% among different races (3). The textbooks also differ in the reported prevalence of palmaris longus. These studies affirm that palmaris longus agenesis is race dependent. Hence it is not possible to assert a general statement for all populations about the prevalence of palmaris longus agenesis (1-3, 13-15). Various techniques are reported to demonstrate the palmaris longus tendon on clinical examination, most claimed to have an advantage over other techniques. However, most of these reports were based on personal clinical observations not on statistical analysis (8, 11, 16-21).

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What is the most reliable technique for determining the presence of the palmaris longus tendon? To address this concern, we examined the inter-observer and intra-observer reliability of nine tests to determine the presence of the palmaris longus tendon. At three different times, three examiners have evaluated the presence of palmaris longus by using nine different techniques. This study aims to assess the interobserver and intraobserver reliability of nine methods of examination of the presence of palmaris longus tendon.

MATERIAL AND METHODS

Fifty-two young adult subjects (29 females and 23 males) aged between 18 and 21 years (mean age: 18,9 years) were selected and assessed with nine different types of tests used for predicting the presence of palmaris longus muscle. At three different times, three observers tested the presence of palmaris longus muscle on each of the 52 white Caucasian subjects' right and left wrists.

Subjects with obvious hand and wrist deformities, previous hand and wrist injuries, and previous surgery to the hand and/or wrist were excluded.

Three anatomists (CB, SC, and AY) from the same department were recruited as observers for this study. The observers did not see each other's assessments. All observers had more than 10 years of experience in anatomy. All tests are performed 3 times on each subject's each wrist.

Each observer examined the 52 volunteers on one occasion and with nine tests for palmaris longus. The results were recorded by the observer as palmaris longus present or absent in volunteers. After the first observer finished his/her examination, the volunteer went to the other observer in another room to have the tests done. This test cycle was repeated on three different days by the same observers. Thus, nine examination results per observer were collected from each volunteer. The nine tests administered by the observers are shown in **Figure 1**.

The nine tests were;

Four finger sign: is a combination of forced anteduction and pronation of the thumb at the first metacarpophalangeal joint with full extension of the second to fifth digits **(Figure 1a).**

The Lotus sign: is done by bringing the fingers and thumb together to form a cone **(Figure 1b).**

Mishra's test I: The metacarpophalangeal joints of all fingers are passively hyperextended by the examiner and the subject is asked to actively flex the wrist **(Figure 1c).**

Mishra's test II: The subject is asked to abduct the thumb against resistance with the wrist in slight palmar flexion **(Figure 1d).**

The open hand sign (Fingers fan out sign): the subject is asked to fan out all the fingers and slightly flex the wrist **(Figure 1e).**

Pushpakumar's "two-finger sign" test: The subject is asked to fully extend the index and middle finger, the wrist and other fingers are flexed and finally the thumb is fully opposed and flexed **(Figure 1f).**

Schaeffer's test (Traditional method): The subject is asked to oppose the thumb to the little finger and then flex the wrist **(Figure 1g).**

Thompson's test: The subject is asked to make a fist, then flex the wrist and finally the thumb is opposed and flexed over the fingers **(Figure 1h).**

Wrist flexion to resistance: the wrist was flexed against resistance **(Figure 1i).**

Statistical Analysis

The interobserver agreement of the observers was evaluated using Cohen's Kappa statistics. And, the intraobserver agreement of the observers was evaluated using the Intraclass Correlation Coefficient. Weighted Kappa statistics were defined as follows: Kappa < 0.40 was considered to indicate "no agreement"; Kappa = 0.41 to 0.60 as "moderate agreement"; Kappa = 0.61 to 0.80 as "substantial agreement"; Kappa = 0.81 to 1.00 as "almost perfect agreement".

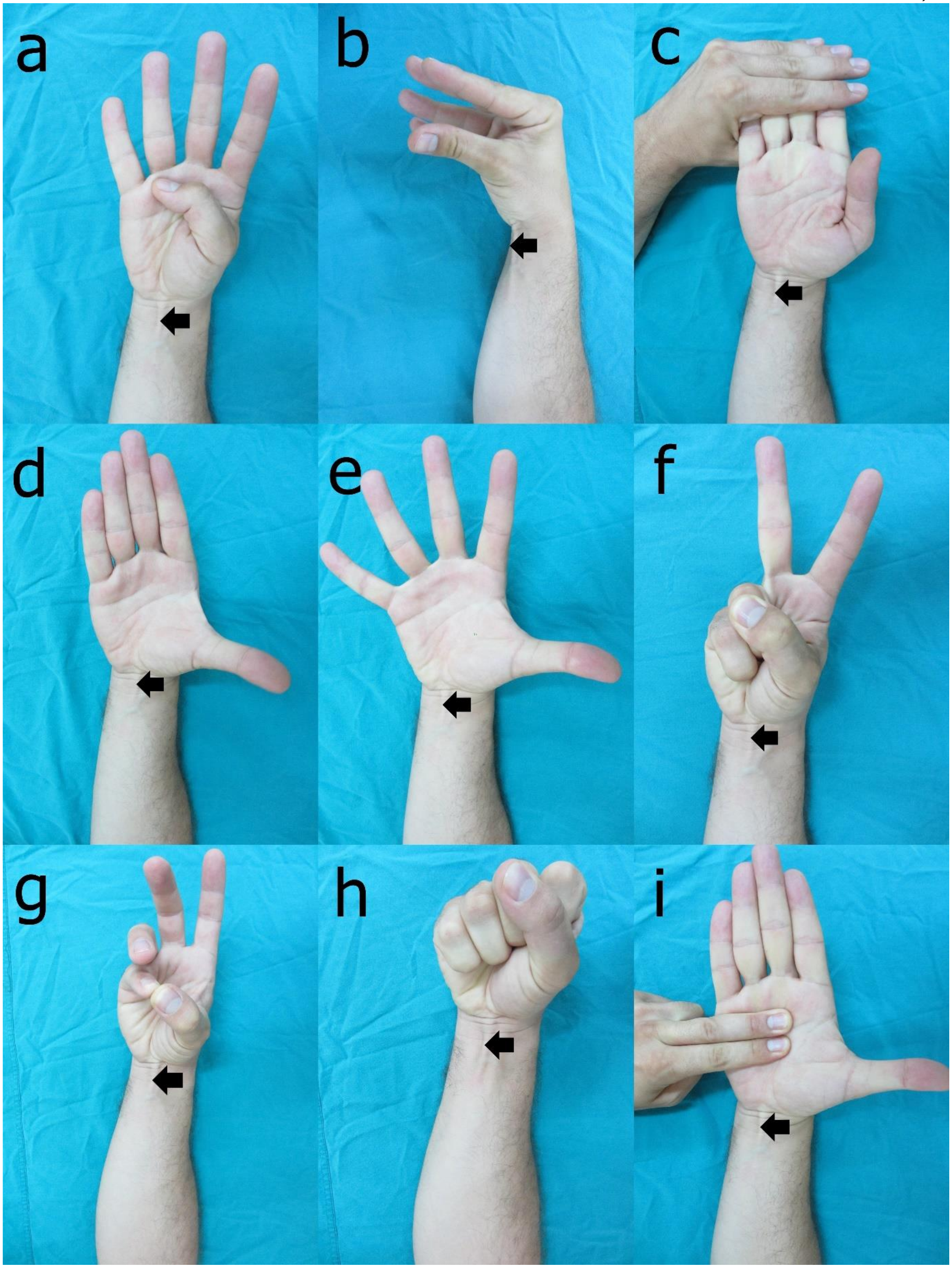

Figure 1. The nine tests used for predicting the presence of palmaris longus muscle. The black arrows indicate the palmaris longus tendon. **a.** Four-finger sign, **b.** The Lotus sign, **c.** Mishra's test I, **d.** Mishra's test II, **e.** The open hand sign (Fingers fan out sign), **f.** Pushpakumar's "two-finger sign" test, **g.** Schaeffer's test (Traditional method), **h.** Thompson's test, **i.** Wrist flexion to resistance.

RESULTS

All volunteers participated in all examinations. As a result of the examinations, a total of 468 results were obtained from 52 volunteers.

Intra-observer agreement

The kappa values with their strength of agreement and percentage for all intra-observer observations along with probability values are shown in **Figure 2**. Intra-observer agreement ranged from 0.691 (substantial) to 0.885 (almost perfect).

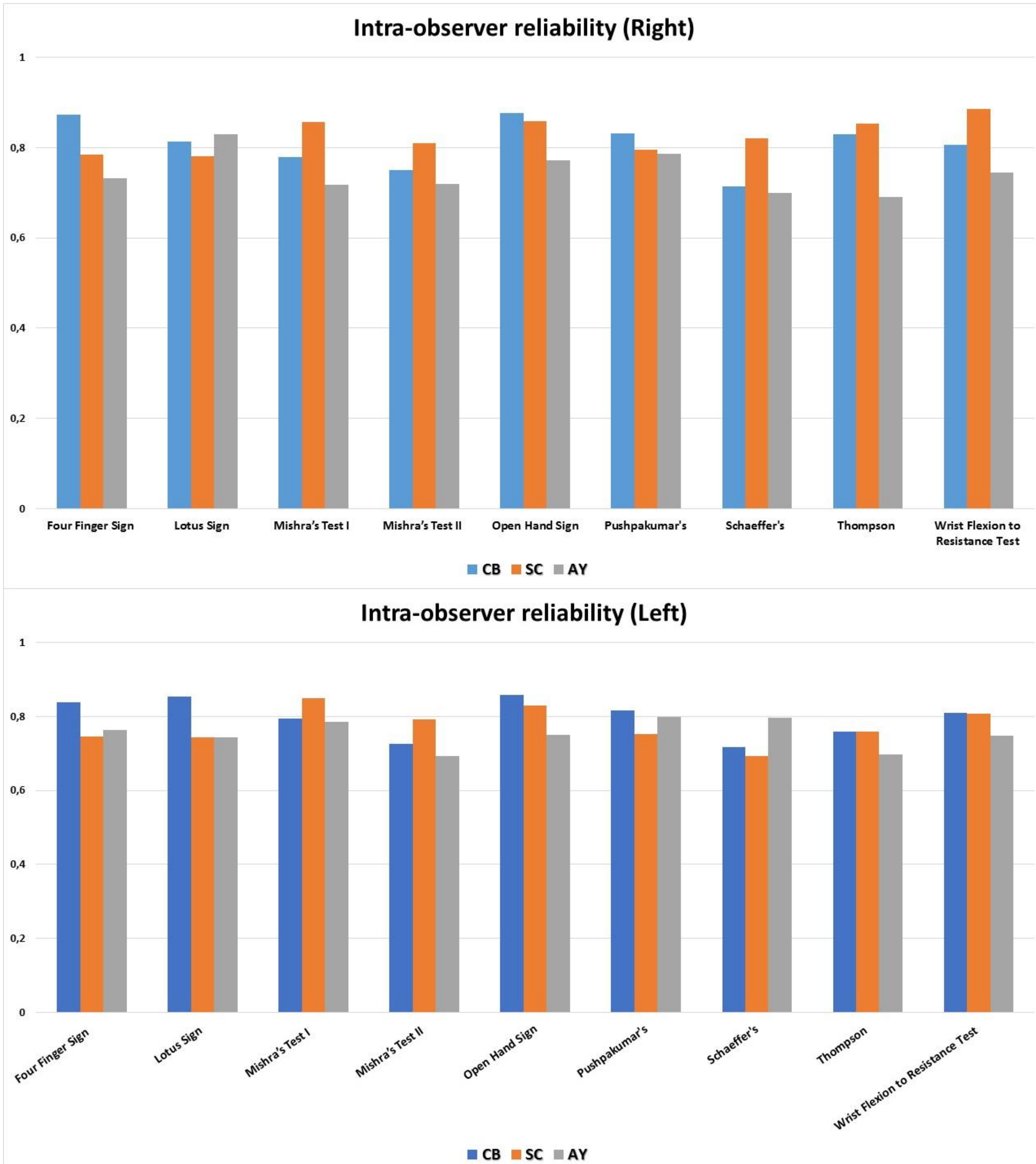

Figure 2. Intraclass Correlation Coefficients of each observer that show intra-observer reliability for the right and left sides. * $P < 0.001$ for all Intraclass Correlation Coefficient

Inter-observer agreement

Inter-observer variability was assessed between the three observers for all nine tests. The kappa values, its strengths of agreement, percentage, and probability values of inter-observer observations are shown in **Figure 3**. Interobserver agreements, defined by kappa, varied from 0.293 (slight) to 0.687 (substantial).

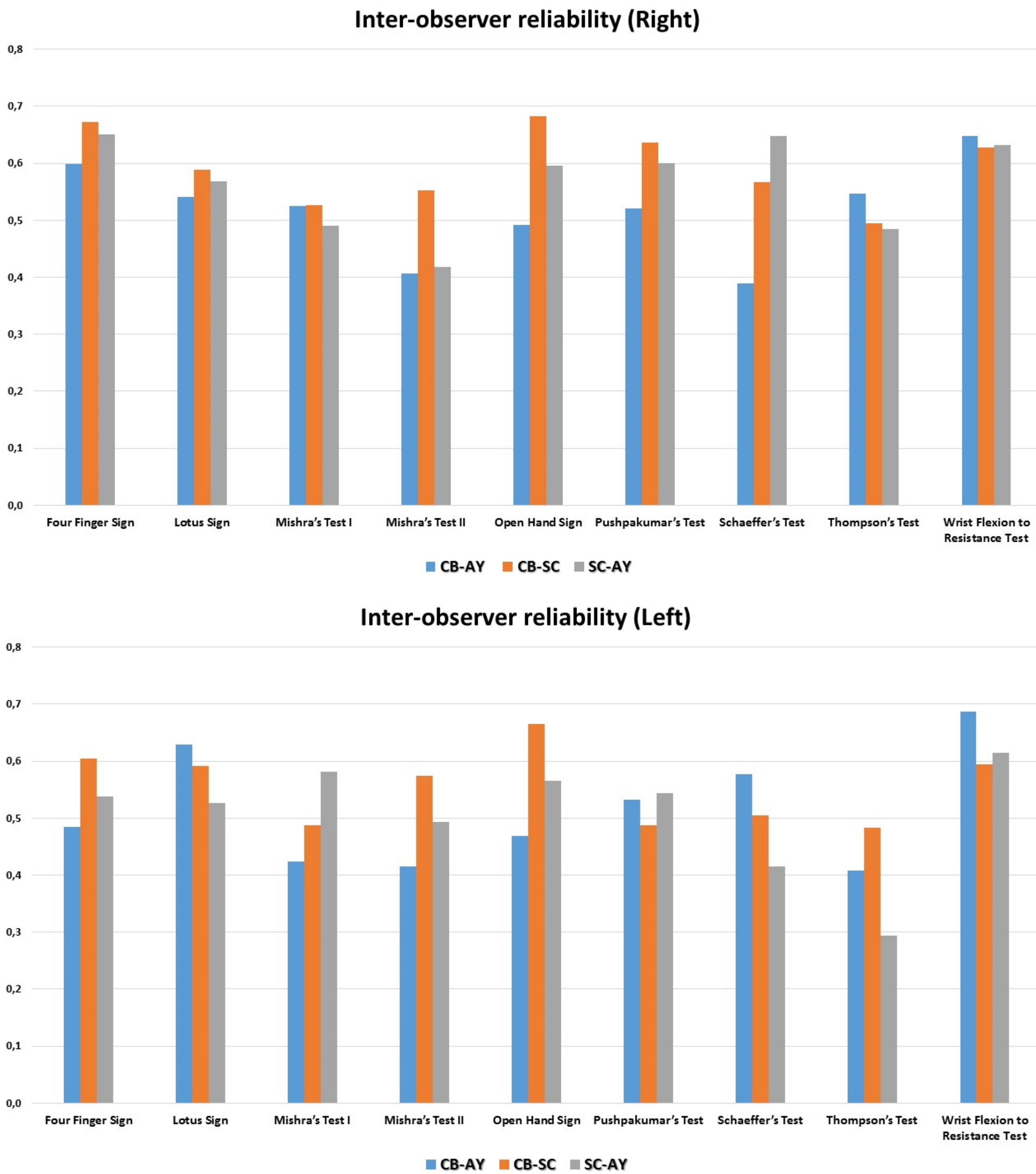

Figure 3. Inter-observer agreement rates for the right and left sides. The statistical significance level is set to be P < 0.001.

DISCUSSION

Intraobserver agreement rates were substantial to almost perfect and appeared to be significantly higher than interobserver agreement rates. Anatomists seem to have their interpretation of the anatomical definition of palmaris longus tendon.

Many of the current tests used for determining the presence of palmaris longus tendon have substantial interobserver reliability. As the amount of experience in any test increases, the Kappa value tends to increase too. In other words, the amount of experience in any test increases the intraobserver and interobserver reliabilities.

In all nine tests, Kappa ranged from 0.293 (slight) to 0.687 (almost perfect) between the observers CB, SC, and AY. In most tests (Four finger sign, Lotus sign, Mishra's test I, Pushpakumar's test, and Thompson's test) the highest Kappa scores were in the third examinations of the observers. In Mishra's test II, Open Hand Sign, Schaeffer's Test, and Wrist Flexion to Resistance Test the highest Kappa scores were disordered according to the examinations' order.

Wrist flexion to resistance test and Open hand sign had the highest intraclass correlation coefficients concerning the other tests. This finding confirms the comments made by Bhattacharya et al. (16), Sebastin and Lim (21) that the wrist flexion to resistance test as first described by Mishra (18) is the best to demonstrate the palmaris longus tendon. It does not involve any fancy maneuvers and is, thus, the easiest to explain to patients.

Sebastin and Lim (21) reported that Mishra's first test was the easiest to explain to subjects and claimed it was the best way to clinically assess the presence of palmaris longus (18). Mahajan [17] claimed that the Open hand sign (Fingers fan out sign) was the best way to elicit the palmaris longus tendon clearly. Pushpakumar (20) reported that the two finger sign was easier to explain to the patient because of the use of this gesture in everyday life in the United Kingdom and Ireland. Kyung et al. (13) have found that Schaeffer's test (The traditional method) is the most effective in detecting the palmaris longus tendon. Oudit et al, (19) compared the effectiveness and consistency of various tests revealing the palmaris longus in a Korean population. Yet, all these reports were based on personal clinical observations not on statistical analysis.

Ndou et al, (14) assessed the effectiveness of three testing methods according to the pattern of presentation of the palmaris longus tendon. They reported that Mishra's Test II was found to be more reliable for assessing the palmaris longus tendon than Schaeffer's Test. Mishra's Test II involves resisting abduction of the thumb, whereas Schaeffer's Test does not.

In this study, we have sought an answer to the question of which test is the best for determining the presence of palmaris longus instead of assessing the incidence of the absence of palmaris longus muscle. The results of the study confirmed the personal clinical observations reported in the relevant literature. And, the results of this study showed us that as the number of testing experiences increases, more consistent results can be obtained from the tests.

CONCLUSIONS

It is known that the palmaris longus causes thumb abduction, slight pronation, weak flexion of the wrist, and tension on the palmar aponeurosis. It seems that thumb abduction with wrist flexion is the key point for the clinical tests those has higher agreement rates. Mishra's Test II and Open hand sign involve both abductions of the thumb and flexion of the wrist. Moreover, the agreement rates of these tests are substantial and almost perfect, respectively.

Knowledge about the most effective test for detecting its presence may be highly relevant in the preoperative examination, particularly in tendon transfer surgeries of the forearm. This may help clinicians to avoid making a misdiagnosis and assist in reducing complications encountered during surgical interventions of the upper limb.

Limitations

The methods used to determine the presence of the palmaris longus tendon are not entirely reliable. There are several and not rare anatomical variations of the palmaris longus. When these variations exist, such as the reversed palmaris longus (5, 6), bifurcated palmaris longus (9), double/duplicate palmaris longus (6, 10), and multiple tendinous insertions of palmaris longus; (4) these tests may be falsely negative.

Radiological investigations such as ultrasonography or magnetic resonance imaging would be a sure way of detecting the prevalence of palmaris longus agenesis and confirming all variations of palmaris longus precisely. These variations may lead to misinterpretation of an existing muscle as absent. But, performing such an investigation on a large group of subjects would not be feasible in terms of cost and time. Clinical examination remains the only feasible way of predicting the presence of palmaris longus muscle, especially in large groups of patients.

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