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ANATOMICAL STUDY OF THE RELATIONSHIP BETWEEN THE MEDIAN NERVE AND LINES DRAWN ON THE PALM OF THE HAND

ESTUDO ANATÔMICO DA RELAÇÃO DO NERVO MEDIANO COM LINHAS TRAÇADAS NA PALMA DA MÃO

ESTUDIO ANATÓMICO DE LA RELACIÓN DEL NERVIO MEDIANO CON LAS LÍNEAS TRAZADAS EN LA PALMA DE LA MANO

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ABSTRACT

On the palmar surface of the hand, there are reference lines that help locate deep structures and prevent injuries during surgeries. The main one, the Kaplan's Cardinal Line (KCL), described in 1953 and redefined in 1968, extends from the crease between the thumb and index finger toward the ulnar border of the hand. It is used together with the A1 line to guide incisions and identify structures such as the median nerve, ulnar nerve, superficial palmar arch, and transverse carpal ligament. The present study aims to describe and correlate, through dissections, the anatomy and variations of the median nerve in relation to these palmar lines, comparing the findings with the medical literature in order to assist surgeons in their clinical practice. Our results showed positional variations of the motor branch relative to the A1 and KCL lines. When compared with studies found in the literature, our findings are consistent regarding the KCL line but differ concerning the positioning of the nerve in relation to the A1 line.

Keywords: Kaplan's Cardinal Line. A1 Line. Motor Branch of the Median Nerve. Anatomical Variations.

RESUMO

Na superfície palmar da mão existem linhas de referência que auxiliam na localização de estruturas profundas e na prevenção de lesões durante cirurgias. A principal delas, a Linha Cardinal de Kaplan (LCK), descrita em 1953 e redefinida em 1968, parte da prega entre o

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polegar e o indicador em direção à borda ulnar da mão, sendo usada junto à linha A1 para orientar incisões e identificar estruturas como o nervo mediano, nervo ulnar, arco palmar superficial e o ligamento transverso do carpo. O presente estudo busca descrever e correlacionar, por meio de dissecações, a anatomia e variações do nervo mediano com essas linhas palmares, comparando os achados com a literatura médica, a fim de auxiliar cirurgiões durante a sua prática médica. Os nossos resultados apresentaram variações de posição do ramo motor com as linhas A1 e LCK. Comparando com estudos presentes na literatura, nossos achados concordam com os resultados com relação à linha LCK, entretanto divergem sobre o posicionamento do nervo referente à linha A1.

Palavras-chave: Linha Cardinal de Kaplan. Linha A1. Ramo Motor do Nervo Mediano. Variações Anatômicas.

RESUMEN

En la superficie palmar de la mano existen líneas de referencia que ayudan a localizar estructuras profundas y a prevenir lesiones durante las cirugías. La principal de ellas, la Línea Cardinal de Kaplan (LCK), descrita en 1953 y redefinida en 1968, parte del pliegue entre el pulgar y el índice hacia el borde cubital de la mano. Se utiliza junto con la línea A1 para orientar incisiones e identificar estructuras como el nervio mediano, el nervio cubital, el arco palmar superficial y el ligamento transverso del carpo. El presente estudio busca describir y correlacionar, mediante disecciones, la anatomía y las variaciones del nervio mediano con estas líneas palmares, comparando los hallazgos con la literatura médica, con el fin de ayudar a los cirujanos en su práctica médica. Nuestros resultados mostraron variaciones en la posición de la rama motora con respecto a las líneas A1 y LCK. Al comparar con estudios presentes en la literatura, nuestros hallazgos coinciden en cuanto a la línea LCK, pero difieren en relación con la posición del nervio respecto a la línea A1.

Palabras clave: Línea Cardinal de Kaplan. Línea A1. Rama Motora del Nervio Mediano. Variaciones Anatómicas.

1 INTRODUCTION

On the palmar surface of the hand, there are reference lines, which are used to assist in locating deep structures. The branch of the median nerve to the muscles of the thenar region of the hand, responsible for the opposable movement of the thumb, which is the most important function of the hand, can be damaged when performing surgical procedures in the region.

In 1953, Kaplan1 described a line "starting at the apex of the interdigital fold between the thumb and index finger towards the ulnar side of the hand, parallel to the middle palmar fold, and called it the cardinal line, which allows the establishment of the relationship with deep structures such as vessels and nerves of the hand. In 1968, Kaplan himself began to consider the cardinal line as being drawn from the junction of the line, which begins at the apex of the interdigital fold between the thumb and index finger, and proceeds towards the ulnar border of the hand, to a point 2 cm distal to the pisiform bone2 (Fig.1). The Cardinal Kaplan Line (KL) and the A1 reference line, which follows the radial border of the middle finger, have been frequently used as a reference for surgical incisions and to identify deep structures, guide surgical incisions, and prevent damage to structures located deep in the palm2,3,4,5. The intersection of the KLA with an A1 reference line that follows the radial border of the middle finger has been used to locate branches of the median nerve1,3,4,5. This point of intersection has been described as the location of the origin of the median nerve branch to the muscles of the thenar region,3,4,5,6 or the place where the nerve enters the thenar muscle mass1. In addition, the KLA path has been used to identify the deep ramus of the ulnar nerve 1, the superficial palmar arch,1,3,5 and the distal margin of the transverse carpal ligament 4. Other authors have used these lines to describe the location of surgical incisions for procedures such as open carpal tunnel release4,5,7, endoscopic carpal tunnel release7, and Dupuytren's fasciectomy8. The interstyleid line (between the styloid processes of the radius and ulna in the wrist), which corresponds to the palmar crease of the wrist.

Thus, the present study intends to describe the anatomy of the structures of the hand, from the dissection of the upper limbs of cadavers, and relate them to the anatomical variations of the median nerve, also correlating with the lines drawn on the palm of the hand and promoting their illustration through the morphology of the dissections. In the end, our findings will be compared with information from the medical literature.

2 METHODOLOGY

14 hands of healthy male cadavers were obtained from the anatomy laboratory of the Faculty of Medical Sciences of Sorocaba (PUC-SP). Hands with traumatic or surgical injuries, deformities, or scars were not included in this study. The dissection technique followed the following order: it started with an incision proximal to the wrist crease, in the interval between the flexor carpi radialis and palmaris longus muscles, extending distally into the palm of the hand. The palmar skin, subcutaneous tissue, and palmar fascia were removed. The median nerve was identified close to the transverse carpal ligament, the ligament was longitudinally sectioned on its ulnar side, and its branches were dissected from proximal to distal. The reference line A1 was drawn from the second interdigital commissure, in a proximal direction, following the axis of the hand. The reference lines A1 and the Kaplan line intersect at a certain point. The distance between the motor branch of the median nerve to the muscles of the thenar region was measured with the KLC, reference line A1 and interstyloid line (between the styloid processes of the radius and ulna in the wrist, which corresponds to the palmar fold of the wrist). The identified specimens were photographed and will be exhibited in the final report of our study.

For the dissections, basic materials were used, such as non-sterile latex gloves, scalpel, anatomical forceps, rat tooth forceps, Kelly forceps, Iris scissors, Mayo scissors, needle holders, cotton threads and magnification lenses.

3 OBJECTIVES

The purpose of this study is to evaluate the anatomical relationships between the motor branch of the median nerve and the lines of the palm of the hand, and to compare the findings with those obtained in current medical literature, in order to help surgeons avoid damage to this structure, which is so important for the functionality of the hand. during surgical procedures.

4 RESULTS

We identified that the origin of the motor branch of the median nerve to the muscles of the thenar region was proximal LCK with a distance ranging from 0.3 to 2.5 cm, a mean of 1.4 cm. In 2 limbs, the branch was positioned exactly on the A1 reference line, and in 11 limbs, the RMT was positioned on the ulnar side in relation to the A1 line, with a distance ranging from 0.2 to 0.6 cm, with a mean of 0.4 cm. In one limb, it was positioned 0.3 cm on

the radial side in relation to line A1. In all limbs, the NMRM detached from the anteroradial aspect of the median nerve. The mean distance in relation to the bi-styloid line ranged from 33.8 to 40.2 with a mean of 36.5 cm.

5 DISCUSSION

Analyzing the literature, we observed that there is no consensus regarding the definition of KCL, four different descriptions were found [1,2,9,10,11,12,13]. Vella et al 9 reported that their research showed that most of the surgeons who participated in their research used the KLA as a reference in the surgical procedure. In this study, we consider the KLL to be the one described by this author in 1968, as being traced from the junction of the line that begins at the apex of the interdigital fold between the thumb and index finger, proceeding towards the ulnar border of the hand, until a point 2 cm distal to the pisiform bone2.

Kaplan's cardinal line has been used as a surface marker in various clinical and anatomical studies. In the present study, we identified that the origin of the TMR was proximal LCK with a distance ranging from 0.3 to 2.5 cm, with a mean of 1.4 cm. In 2 limbs, line A1 passed exactly over the RMT, in 11 it was positioned on the ulnar side in relation to line A1 with a distance ranging from 0.2 to 0.6 cm, mean of 0.4 cm, and in another limb it was positioned 0.3 cm on the radial side in relation to line A1 (Fig 1). In all limbs, the RTNM detached from the anteroradial aspect of the median nerve.

Eskandari et al [10], conducted a study on 37 hands of 34 patients who underwent the carpal tunnel release procedure. A radiological marking technique was used to determine the location of the RMT in relation to the KLA and also in relation to the line following the radial margin of the middle finger, which corresponds to line A1 of our study. They concluded that the RMT had a mean ulnar displacement of 12.6 mm (range 4.0 to 19.7 mm) from the radial lateral line of the middle finger and was located 4.4 mm (range 0 to 9.5 mm) proximal to the cardinal line. Our findings are in agreement with those of Escandari et al, in relation to KLA, because in all limbs the RMT was proximal to the KLA. Regarding the radial-ulnar pension, we recorded slightly different results. According to Eskandariel al10, in all cases the RMT was positioned on the ulnar side in relation to the line, following the radial margin of the middle finger. In this study, we identified in 11 limbs, the RMT was positioned on the ulnar side in relation to line A1, in agreement with these authors. in another member it was positioned on the radial side, in two members the A1 line passed exactly over the RMT

Some authors have related KLA to the arterial arches of the palmar surface of the hand. Panchal et al [14] conducted an anatomical study on 30 cadavers, dissecting 60 hands, to describe the relationship between Kaplan's cardinal line and the superficial palmar arterial arch. They opine that from a clinical point of view, Kaplan's cardinal line is the most predictable marking to identify the superficial palmar arch. McLean et al [15] conducted an anatomical study on 48 cadaveric hands in specimens between 50 and 75 years of age, with the purpose of evaluating the distance from the superficial palmar arch and the KL. Similarly, Anand and Trzeciak16 anatomically correlated the relationship of Kaplan's cardinal line with superficial and deep palmar arterial arches. Kwiatkowska et al [17] dissected 20 upper limbs from cadavers. They related the deep structures of the palm to the folds of the palm, but consider that the palmar folds are very variable between people and genetics has a lot of influence on the formation of the folds. They consider the middle palmar fold to be parallel to the KLA. Ruch et al [18] studied 10 hands of recently deceased human cadavers (6 males, 4 females) in the Department of Neurobiology and Anatomy at Wake Forest University School of Medicine. Through a histological study, it was proven that the concentration of nerve fibers in the space between the middle and ring fingers was lower than in the space between the index and middle fingers. They conclude that a longitudinal incision in the palm of the hand in the space between the middle and ring fingers 2 cm proximal to the cardinal line of Kaplan should result in injury to fewer nerve endings, and reduce the incidence of painful neuromas during open carpal tunnel release.

Relatively little information is available regarding the topographic location of the muscular branch in the palmar space. Bonnel et al.[19] reported that the apparent origin of this nerve is located at 2 levels: one greater than 40 to 50 mm and the other less than 20 to 40 mm of the bistyleid line (the line between the radial and ulnar styloid processes). In their studies, Olave et al [20] the mean distance was 34.6 mm in relation to the distal wrist fold, with no significant difference between the right and left hands.

6 CONCLUSION

In all members the RMT was located close to the LCK. The RMT was positioned on the ulnar side in relation to the A1 line in 11 limbs; on one radial side; in two it passed over the RMT. The mean distance in relation to the bi-styloid line ranged from 33.8 to 40.2 with a mean of 36.5cm.

Figure 1

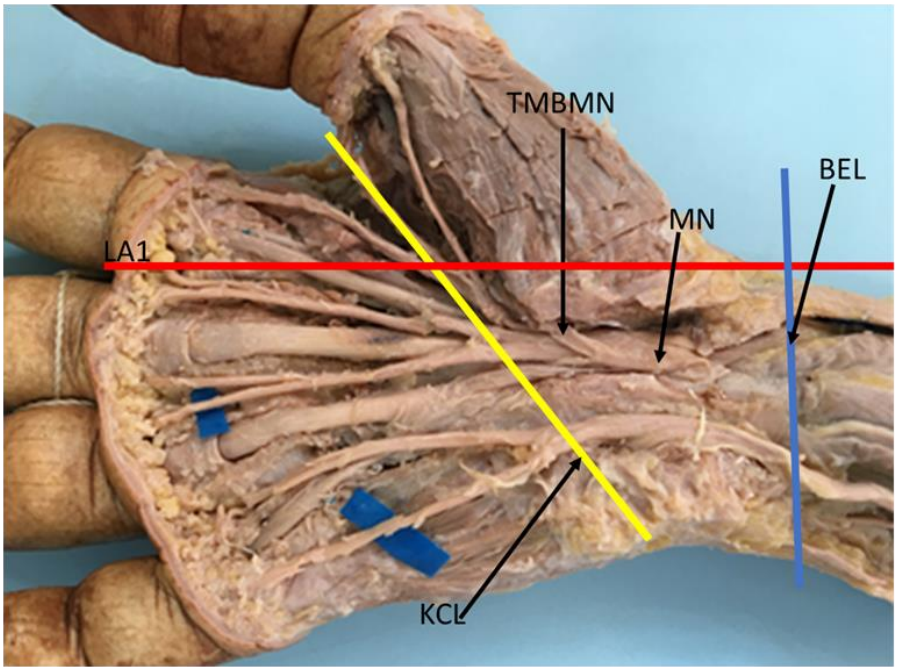
MN- Median Nerve = Nervo Mediano

KCL- Kaplan's Cardinal Line = Linha Cardinal de Kaplan

TMBMN - Thenar Motor Branch of MedianNerve = Motor Branch of Median Nerve

A1- A1 Line = Linha A1

BEL- Bi Styleid Line = Bi Style Line



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