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Basic study

The hazards of the neurovascular passage in the wrist

Les aléas du passage neurovasculaire au niveau du poignet

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Abstract

Objective. – Wrist problems are common in grip sports. To better understand the entrapment symptomatology of the different neurovascular passages of the wrist, an anatomical revision seems necessary because confusion and error has increased lately. This study will focus on the ulnar canal. Comparison of the original description of the canal with definitions emanating from scientific papers, anatomical handbooks and Internet websites reveal various differences, which may create clinical confusion.

Design. – With the original paper of Guyon as a reference, comparison was made (i) with 37 cadavers (74 wrists); (ii) with an Internet search and; (iii) with a bibliographic survey. The dissections allowed for the verification of Guyon's description and were used to illustrate the findings.

Results. – Dissection of 74 wrists confirmed Guyon's original description. Out of the 2559 Internet hits, papers in English, French, German and Dutch were considered, only. The Internet websites and the published material presented an erroneous images and/or explanations.

Conclusion. – Dissection and bibliometry suggest that the canal has received multiple denominations including a confusion with the "canalis pisohamatum". This confusion is situated on Internet sites, in scientific/clinical papers and in "classical anatomy literature". A better understanding of this region will undoubtedly enhance our knowledge of entrapment pathologies.

Résumé

Objectif. – Les problèmes de poignet sont très fréquents dans certains sports. Pour mieux comprendre la symptomatologie de compression neurovasculaire observée dans les différents passages carpiens, une révision anatomique semble nécessaire, parce que les descriptions relevées dans la littérature et des sites Internet indique des variations, qui suggère une confusion.

Méthode. – En prenant la publication originale de Guyon comme référence, la comparaison a été faite avec 37 cadavres, une recherche sur Internet et un aperçu bibliographique. Les dissections permettent de vérifier la description originale.

Résultats. – La dissection des 74 poignets, confirme la description de Guyon. Parmi les 2559 résultats d'Internet, seuls les articles écrits en anglais, français, allemand ou néerlandais ont été retenus. Les sites Internet et les articles publiés dans les journaux de référence présentent régulièrement des explications incomplète et fautive.

Conclusion. – La dissection et l'aperçu bibliographique indiquent que le canal de Guyon a reçu plusieurs dénominations, créant une confusion avec le canal pisohamatum. Cette confusion s'est installée dans différentes sources tant cliniques que pédagogiques qu'il s'agisse de sites Internet, d'articles scientifiques et cliniques ou des travaux classiques d'anatomie. Une meilleure connaissance de cette région anatomique améliorera sans doute la prise en charge de ces pathologies.

Keywords: Pisohamatum tunnel; Ulnar tunnel; Guyon; Carpal tunnel; Wrist

Mots clés : Guyon ; Poignet ; Canal pisohamatum ; Canal carpien ; Canal ulnaire

1. Introduction

Wrist problems are not uncommon in grip sports, example tennis, cycling, baseball, golf... and are often associated with

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entrapment syndromes and related phenomena [1]. To understand these syndromes and related phenomena; it is necessary to clarify the existence of three different tunnels at the wrist and to stop the confusion that exists in science a number of years. Guyon's canal or canalis ulnaris, according to the nomina anatomica [2] was first described in 1861 by the French urologist Jean Casimir Felix Guyon and is only occasionally mentioned in basic anatomy atlases. If the canal is mentioned, its information is mostly vague or confusing in spite of the many papers dedicated to this subject under clinical circumstances. Seldom, one observes so many contradictory descriptions of a small and simple anatomical region. Most of the anatomical books and ad hoc Internet sites, describe extensively and precisely the carpal tunnel but if a second passage is described it will be "a version" of the canalis ulnaris. Never a clear description of the carpus with its three different tunnels is found. One thing is clear, Guyon's canal is considered to be the major cause of ulnar tunnel syndrome [3–9]. But the third tunnel never is questioned in a similar clinical context. This study is undertaken to clarify the vagueness concerning Guyon's canal both for educational and clinical purposes and to elaborate on the three "tunnels" to be seen in the carpus palmaris in an attempt to end the existing confusion.

2. Material and methods

The methodological approach consisted of three different issues:

- a dissection;
- an internet search and;
- a bibliometric survey of educational textbooks or atlases and of clinical and/or scientific publications. Seventy-four wrists ($n = 37$) were dissected and photographed. The dissections were used to illustrate the findings. The Internet search went over all available years till 2006. Each time we found different synonyms to define Guyon's canal, we entered that particular synonym in the scientific search engine. The same keywords were used on different internet sites and in the bibliometric survey of clinical and research papers. In the student textbooks and atlases we verified the descriptive detail of the regional anatomy of the wrist.

3. Results and discussion

3.1. Dissection

The dissection ($n = 37$) corresponding to 74 wrists confirmed for 100% Guyon's original description (Fig. 1). The citation is a literal translation of the original description in French (Guyon, 1861),

> "*I call this space intra-aponeurotic as it seemed evident to me that its anterior wall is part of the fibrous bed of the area; its posterior wall is formed by the anterior ligament of the carpus. It cannot be said that there were any lateral layers; however, medially, the pisiform forms a sort of wall covered in aponeurotic tissue; above, below and distally, the anterior wall simply merges with the palmar aponeurosis, of which it is only a part. Its size, although not large, is about one centimetre to one and a half centimetres in each direction; above and below, it is approximately equal to the size of the fold at the wrist; distally, it stops roughly at the middle of the anterior ligament of the carpus, so that this little space is only part of the internal section and inspection through the skin takes this particular circumstance into account*"[10].

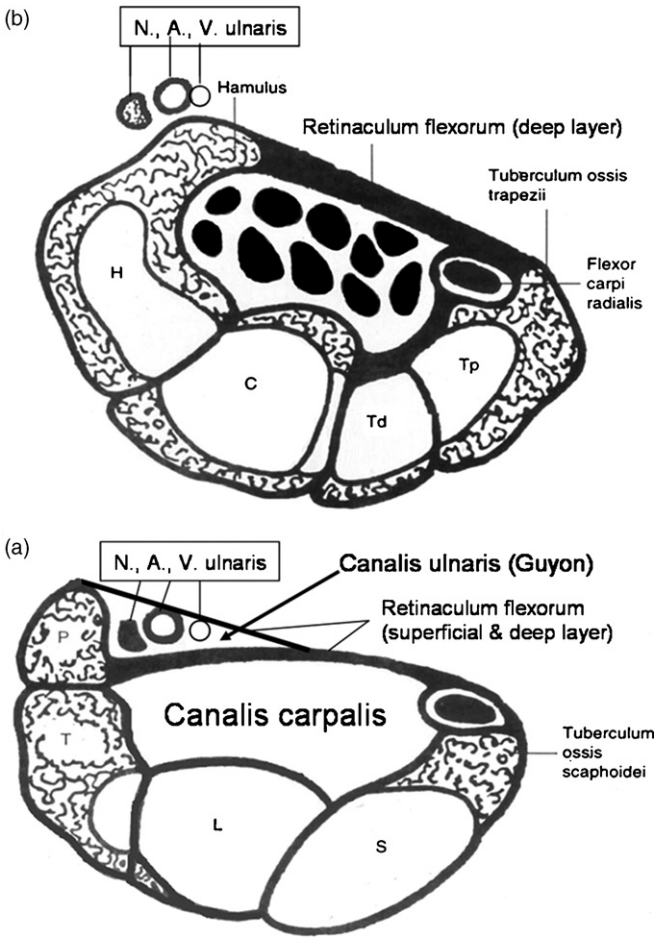

Fig. 1. Transversal drawing of the proximal carpus (a); including the canalis ulnaris and the distal carpus (b).

3.2. Bibliographic search

Of the 2559 hits on the Internet, only the results written in English, French, German and Dutch clearly describing Guyon's canal were retained. Unfortunately, almost all information referred to personal, for this study irrelevant observations about the person Guyon. The results of the three different types of bibliographic survey, example books, web, papers, ($n = 117$) are presented in Fig. 2. In total of 21,4% of these sources, Guyon's canal was erroneously presented as the pisohamatum tunnel. In another 25,6% of all sources, Guyon or its synonyms were not mentioned, nor described, nor drawn at all. Twenty-four percent (24%) mentioned a canalis ulnaris or a synonym but did not describe the canal or tunnel topography as such. Of the remaining 28,2 only 12% of the references presented a

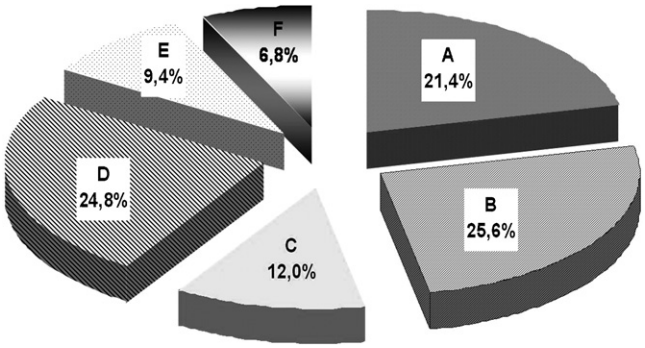

Fig. 2. Presentation of Guyon's canal according to different sources. A = Erroneous presentation; B = No Guyon/synonym mentioned; C = Description fully correct; D = Guyon/synonym nomination no description; E = Correct description no Guyon/synonym nomination; F = Guyon/synonym nomination no drawing.

fully correct description (nomination plus topographic description including a clear illustration) and in 6,8% the Guyon tunnel or its synonym was indicated on a drawing or other image presentation only. The remaining 9,4% gave a correct description of the canalis ulnaris as part of the retinaculum flexorum but with no nomination. Within these A to F fragmented findings, with the exception of C 12% fully correct descriptions, the highest rate of erroneous descriptions is found in the scientific and clinical papers with 44 against 30% on the web and 20% in educational reference volumes.

Most publications describing clinical, biomechanical or other aspects the retinaculum flexorum area start with an anatomical description however confusion is created by the multiple designations/names. Table 1 shows the different terminology that authors have been using to define Guyon's canal. But most confusion derives from the pisohamatum tunnel description. At a certain point the pisohamatum tunnel was assumed to be the Guyon's space or part of it [11,12]. McFarlane et al. (1976) precised, we cite: *"The term used by Enna et al. (1974) – the pisohamate tunnel – is descriptive and appealing alternative to the eponym "Loge de Guyon"* [11]". But at the same time they recognised that dissection and surgery in the wrist area without appreciation of the fact that the passage of the N. ulnaris ramus profundus to the hypothenar is ignoring a major mechanism of compression. Although Hayes et al. (1969) [13] and Lotem et al. (1973) [14] already referred to the importance of pressure neuropathy of the deep branch of the N. ulnaris to the hypothenar, one can deduct from the discussion and the drawings in McFarland et al. (1976) [12] that he combined the canalis ulnaris and the canalis pisohamatum into one continuing tunnel. The proximal entrance of the so-called pisohamatum tunnel is in reality the correct canalis ulnaris (Guyon) and the distal exit (of the same tunnel) is the correct pisohamatum tunnel with slant walls, example the os pisiforme, the hamulus with the ligament pisohamatum as its roof [14]. Thereafter, a too liberal use of the term "pisohamate tunnel or canal" has lead to confusion in particular in scientific/clinical papers and on the Internet sites, resulting in erroneous representations, explanation and even topographical manipulations to demonstrate Guyon's canal. The fact that 25,6% (Fig. 2) of the reference sources do not describe Guyon

Table 1
Different designation for Guyon's canal used by authors

Terminology	Authors
Guyon's Canal/tunnel/loge or space	De Vecchi and Moller 1959 [15] Shea and McClain 1969 [16] Eckman et al. 1975 [17]; Uriburu et al. 1976 [18]; Kilgore and Graham 1977 [19]; Denman 1978 [20]; Spinner 1996 [21]; Pleet and Massey 1978 [22]; Sunderland 1981 [23]; Razemon 1982 [24]; Weeks and Young, 1982 [25]; Bonnel and Vila, 1985 [26]; Wu et al. 1985 [27]; Howard 1986 [28]; Bergfield and Aulicino1988 [29]; Dellon and Mackinnon 1988 [30]; Kuschner et al. 1988 [31]; Olney and Hanson 1988 [32]; Subin et al. 1989 [33]; Dodds et al. 1990 [34]; Thurman et al. 1991 [35]; Zeiss et al. 1992 [36]; Richards et al. 1993 [37]; Sanudo et al. 1993 [38]; Cobb et al. 1994 [39]; König et al. 1994 [40]; Pribyl and Moneim 1994 [41]; Cobb et al. 1996 [42]; Gonzalez et al. 1996 [43]; Kang et al. 1996 [44]; Lindsey and Watumull 1996 [45]; Muller et al. 1997 [46]; Tyrdal et al. 1997 [47]; Koch et al. 1998 [48]; Netscher and Cohen 1998 [49]; Kothari 1999 [50]; De Maeseneer et al. 2005 [51]. . .
Ulnar tunnel/canal	Merle d'Aubigné et al. 1956 [52]; Forshell and Hagstrom 1975 [53];
Canalis ulnaris	Eckman et al. 1975 [17]; Sunderland 1981 [23]; Gross and Gelberman 1985 [54]; Kuschner et al. 1988 [31]; Subin et al. 1989 [33]; Moneim 1992 [55]; Zeiss et al. 1992 [36]; Zeiss et al. 1995 [56]; Spinner et al. 1996 [21]; Olave et al. 1997 [57]; Balogh et al. 1999 [58]; Kothari 1999 [50]; Murata et al. [1]; Moutet 2004 [59]; Sturzenegger 2005 [8].
Carpal ulnar neurovascular space	Cobb et al. 1994 [39]; Cobb et al. 1996 [42]
Pisoretinaculair space	Denman 1978 [20]
Pisohamate tunnel	Enna et al. 1974 [11]; McFarlane et al. 1976 [12]

or its synonyms at all maybe another origin of confusion. It needs no argumentation that both the correct Guyon et al. (1861) [10] topography and its nomina anatomica (1998) [2], example canalis ulnaris, should be used in all kinesilogical and clinical studies. Without pretending to be complete, Table 1 gives an overview of synonyms of the original Guyon's canal associated with its authors.

A number of authors completed the description of Guyon (1861) into three zones [16,17], but according to Cobb et al. (1996) Guyon's anatomical description was correct but not complete enough. In their study they showed that Guyon's canal has no attachment with the hook of hamate (nor did Guyon state that it did). Lindsey et al. (1996) described this region more in detail and extended the canal both distally and proximally. They added that the roof of the canal is formed by the M. palmaris brevis, the hypothenar and that it is filled with adipose and fibrous tissue. The floor of the tunnel is made up of the Lig carpi transversum,

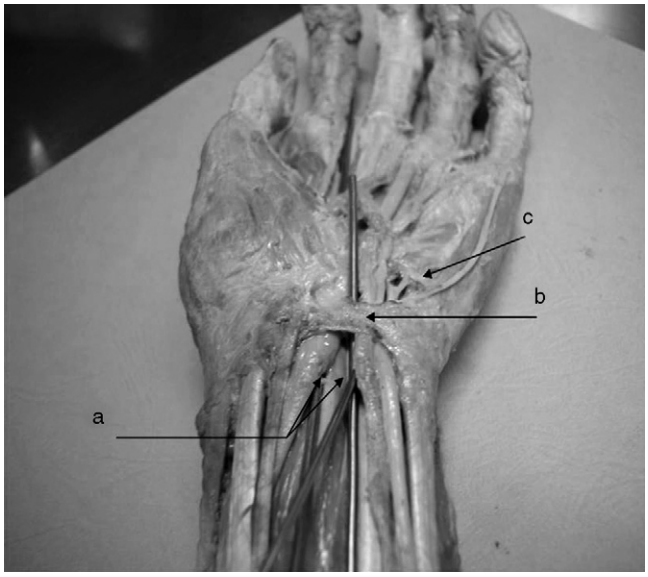

Fig. 3. Dissection of the canalis carpi (a); canalis ulnaris (b); canalis pisohamatum (c).

the Lig pisohamatum, the Lig pisometacarpalis and the M. opponens digiti minimi while. To complete the medial wall Lindsey et al. (1996) adds the M. flexor carpi ulnaris and the M. abductor digiti minimi, while the lateral boundary is formed by the tendons of the extrinsic flexors, the transverse carpal ligaments and the hook of the os hamatum. The least one can point out is that this is "unrealistically complicating" the wrist anatomy [45].

Studies related to muscular anomalies, neurological anomalies; vascular anomalies and pathological findings, often become difficult to understand because elementary knowledge is ignored, complicated or transformed [18–20]. But we must end the confusion. Anatomists, orthopaedists, radiologists and hand surgeons must accept that there are three different tunnels in the wrist:

- the carpal tunnel deep under the main sheet of the retinaculum flexorum and medial above;
- the canalis ulnaris between two layers of the retinaculum flexorum that respectively originate from the top of the os pisiforme and from the top of the os triquetrum (e.g. bottom of the os pisiforme) (Fig. 1). Both the canalis carpi (carpal tunnel) and the canalis ulnaris (Guyon) are oriented in the prolongation of the forearm (and the A., V., N. ulnaris). The length of the canalis ulnaris equals the length of the proximal row of the carpus. At its exit and the level of the distal row, a fibrous arch formation indicates the lateral-proximal edge of the ligament pisohamatum on top of the os pisiforme and the hamulus;
- this third tunnel is the canalis pisohamatum that allows the N. ulnaris ramus profundus into the hypothenar. All three tunnels are illustrated via dissection (Fig. 3).

It needs to be reminded that anatomically this canalis pisohamatum is the logical site for neuropathic compression and this was already stated in the 1950s and the 1960s [13,21].

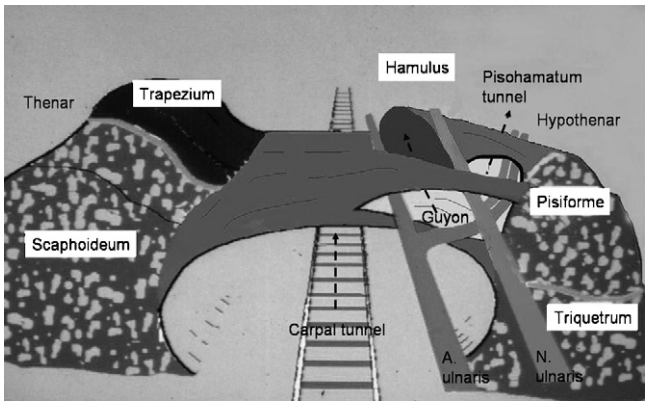

Fig. 4. Simplified model of the three tunnels for example, carpal, ulnar and pisohamatum.

A simplified drawing of the wrist will emphasise the three different canals/tunnels including the direction of the neurovascular passage namely the canalis carpi (carpal tunnel) the canalis ulnaris (Guyon) and the canalis pisohamatum are presented in Fig. 4 allows for a last criticism: "There is no mention of the canalis pisohamatum in the Terminologia anatomica of the federative committee on anatomical terminology (FCAT 1998) [2]".

4. Conclusion

The canalis ulnaris (Guyon) is often forgotten or described in an incomplete and/or erroneous manner.

The canalis ulnaris should not be confused with the canalis pisohamatum witch is another and third tunnel with other entrapment possibilities. Ending the existing confusion between the ulnar- and the pisohamatum tunnel will increase the accuracy of the ad hoc diagnosis.

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