

Review of the Tanaka Ligament in the Temporomandibular Joint. Analyzing its Scientific Validity

Revisión del Ligamento de Tanaka en la Articulación Temporomandibular. Analizando su Validez Científica

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FUENTES, R.; DIAS, F.; SALAMANCA, C.; BORIE-ECHEVARRÍA, E. & OTTONE, N. E. Review of the tanaka ligament in the temporomandibular joint. Analyzing its scientific validity. *Int. J. Morphol.*, 36(1):87-91, 2018.

SUMMARY: The temporomandibular joint (TMJ) is composed of bony structures, cartilage, capsule, articular disc, synovial membrane and ligaments. Some authors consider the "Tanaka ligament" described in the 1980s by Terry Tanaka as an intra-capsular ligament of the TMJ that unites medially the articular disc and mandibular fossa. The aim of the present study was to analyze the use of the term "Tanaka ligament" in the literature evaluating the scientific support of its existence. A literature review was carried out under the terms "Tanaka Ligament [AND] TMJ" and "Ligamento Tanaka [AND] ATM" (Spanish and Portuguese) in the search engines: MEDLINE-Pubmed, Science Direct, Google Scholar, LILACS-Bireme and SciELO. Scientific articles and theses were considered in English, Spanish and Portuguese. A total of 1,355 studies were found, summing up the results of all the search engines, of which 8 studies (5 articles and 3 theses) were selected after applying inclusion and exclusion criteria, selection by title, abstract and content. Most of these studies were discarded because they had contents related to the TMJ and/or ligaments wherein an author used the surname "Tanaka", that were not related to the Tanaka ligament. Among the 8 selected studies, 6 of them cite text books, 1 cites a video published by Terry Tanaka and 1 cites a thesis. Most of these textbooks cited also refer to videos by Terry Tanaka and his books. Moreover, most of the anatomical literature does not consider this ligament as an individualized structure. Although there are descriptions of Tanaka's ligament in textbooks, the scientific support of its existence is based only on videos and texts by Terry Tanaka. The dissemination of knowledge associated with this ligament must be cautious, as there is a need for further morphological and functional studies to confirm its existence.

KEY WORDS: TMJ; Ligaments; Tanaka ligament.

INTRODUCTION

The temporomandibular joint (TMJ) is formed by the condylar process of the mandible, the mandibular fossa and the articular tubercle of the temporal bone (Tortora & Derrickson, 2009). It is characterized as a bilateral hinge joint that allows special movements of opening and closing of the mouth, in addition to the excursion movements of protrusion, retrusion and mandibular laterality, all of these movements are associated with the masticatory function (Drake *et al.*, 2004).

The TMJ is one of the only movable joints of the head, along with the articulation of the ossicles of the ear, with a synovial characteristic that has its articular surfaces covered by fibrocartilage (Standring, 2008; Tortora & Derrickson).

Among the components of TMJ are the bone portions (mandibular fossa of the temporal bone, mandibular condyle), articular cartilage, joint capsule, articular disc, synovial membrane and its ligaments (Drake *et al.*; Standring; Tortora & Derrickson).

The TMJ ligaments help to limit their movements (Okenson, 2013). Among the classic extra-capsular ligaments associated with the TMJ, we can mention the temporomandibular (lateral), sphenomandibular and stylomandibular ligaments (Drake *et al.*; Standring; Tortora & Derrickson; Norton, 2012; Fuentes *et al.*, 2014). There are also the medial and lateral collateral ligaments that are intra-capsular and that connect the articular disc to the TMJ joint capsule (Norton).

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Some authors describe another intra-capsular ligament of TMJ called the Tanaka ligament (Langton & Eggleton, 1992; Sosa, 2006; Okeson, 2013) originally described by investigator Terry Tanaka in 1980 decade (Tanaka, 1986a; Tanaka, 1986b), this ligament would unite the articular disk firmly to the wall of the mandibular fossa in the temporal bone, which favors the disc to luxate medially in case of impacts (Langton & Eggleton; Sosa). However, the anatomical literature (Drake *et al.*; Dauber, 2007; Standing; Tortora & Derrickson; Norton; Moore *et al.*, 2014) does not consider this ligament as an individualized structure in TMJ.

The aim of the present study was to perform a literature review on the use of the Tanaka ligament, in order to seek scientific support for its existence.

MATERIAL AND METHOD

A literature review was conducted to obtain information about the Tanaka ligament in order to answer the following question: "Is the Tanaka ligament a scientifically supported structure?" The search for scientific literature identified articles identifying the anatomical structures associated with the temporomandibular joint.

Selection Criteria

Inclusive: Scientific articles and theses published in English, Spanish and Portuguese, articles that identified structures in humans, articles published between 1986 and 2017.

Exclusion: Scientific articles and theses of experimental design or quasi experimental that were realized in animals.

The selection of articles was carried out by two researchers independently; when there was controversy and differences in the application of the selection criteria, a third researcher performed the analysis and final determination for the incorporation or exclusion of the study.

Search strategy. The databases used were MEDLINE-Pubmed, ScienceDirect, Google Scholar, LILACS and SCieLO.

Limits were studies in humans. The search algorithms in the databases were:

- MEDLINE-Pubmed: Tanaka TT [Author] AND TMJ; Tanaka ligament AND TMJ.
- ScienceDirect: Tanaka ligament [AND] TMJ.
- Google Scholar: Tanaka Ligament TMJ.

- Google Scholar (Español): Ligamento Tanaka [AND] ATM.
- LILACS-Bireme: Ligamento [AND] ATM.
- SciELO: Ligamento [AND] ATM.

The search was finished with a manual review of the references of the selected articles.

RESULTS

The search strategy in the Google Scholar, MEDLINE-Pubmed, ScienceDirect, SciELO and LILACS databases found a total of 1355 items associated with the searched terms, of which only 5 articles and 3 theses met the selection criteria applied.

The items obtained using the terms used in each database are presented in Table I.

Table II lists the articles and theses found in the search results performed in the databases described previously, associating the description and the reference associated with the Tanaka ligament.

DISCUSSION

In the present study, a review was performed to evaluate the use of the term "Tanaka Ligament" in scientific literature, focusing on its description and interpretation, as well as reviewing which sources the authors of the studies found used to support the concept of this ligament.

The name of this structure is due to the researcher Terry Tanaka, who pioneered the description and individualization of this ligament in the medial region internally of the TMJ joint capsule, through a series of dissection videos (Tanaka, 1986a; Tanaka, 1988; Tanaka, 1992).

The eponym applied to this ligament associated with the name of the researcher Terry Tanaka can be understood as a problem, since the International Anatomical Terminology (Federative Committee on Anatomical Terminology, 2011), which regulates and standardizes the anatomical terms, seeks to eliminate structures named by eponyms. The tendency to eliminate eponyms is justified by the lack of relationship of the structure name with its shape, location and function, as it happens with most anatomical structures described.

Table I. Results obtained in each database for the "Tanaka Ligament".

Database	Founded items	Selected Items
MEDLINE-Pubmed	9	0
Science Direct	103	1 article
Google Scholar	1150	2 articles (1 repeated)
Google Scholar (Spanish)	72	3 articles; 3 theses
LILACS-Bireme	17	0
SciELO	4	0
TOTAL	1355	8 (5 articles, 3 theses)

Table II. Description of the Tanaka Ligament in the results found associated with the item's database and its source.

Author/Year	Database	Source	Description of the Tanaka Ligament / Reference
Fanghänel & Gedrange, 2007	Google Scholar / Science Direct	<i>Ann. Anat.</i>	<ul style="list-style-type: none"> • String-shaped reinforcement of the medial capsule (Tanaka, 1986a).
Cuccia <i>et al.</i> , 2011	Google Scholar	<i>J. Am. Osteopath. Assoc.</i>	<ul style="list-style-type: none"> • Only cites as an TMJ ligament (Williams <i>et al.</i>, 1989).
Fuentes <i>et al.</i> , 2015	Google Scholar (ESP)	<i>Int. J. Morphol.</i>	<ul style="list-style-type: none"> • It joins disc with the cranial articular surface (Sosa, 2006). • The upper portion of the bilaminar zone of the articular disc is inserted in the posterior zone of the fossa, superior to the area of the petrotympanic fissure (Langton & Eggleton, 1992).
Fuentes <i>et al.</i> , 2016	Google Scholar (ESP)	<i>Int. J. Morphol.</i>	<ul style="list-style-type: none"> • Ligament extending from the articular disc, medially and anteriorly, inserted into the inferomedial zone of the mandibular fossa. • Originally considered a medial fascicle of the medial collateral ligament. • Reinforcing the articular disc medially, contributing to form a medial reinforcing arch, around rotation during opening and buccal closure (Langton & Eggleton, 1992).
Fuentes & Ottone, 2017	Google Scholar (ESP)	<i>Int. J. Morphol.</i>	<ul style="list-style-type: none"> • Ligament located anterior to TMJ, and extending from the articular disc to the mandibular fossa (Langton & Eggleton, 1992; Fuentes <i>et al.</i>, 2016).
García, 2008	Google Scholar (ESP)	Thesis/Escuela de Osteopatía de Madrid	<ul style="list-style-type: none"> • It joins the articular disk to the superior bone surface, which favors the disc luxation medially in case of impact (Sosa, 2006).
Osma López, 2014	Google Scholar (ESP)	Thesis/ Universitat de Lérida	<ul style="list-style-type: none"> • Ligament is related to the disc in its antero medial part. This ligament is much more resistant than the collaterals, therefore promoting its dislocation anteromedially (Okeson, 1989).
Torres-Pazmiño, 2016	Google Scholar (ESP)	Thesis / Universidad Central del Ecuador	<ul style="list-style-type: none"> • Temporodiscal ligament. It extends from the medial pole of the disc, backwards and inwards, to the medial pole of the frontal region. It limits the anterolateral movement of the articular disc (Giambartolomei, 2005).

It is common for definitions of Tanaka's ligament to be accompanied by a brief explanation of the reason for its name, which adds no value to the structure. Only one study (Torres Pazmiño, 2016) presented an alternative for the use of this eponymy, naming it "temporodiscal ligament". However, the term temporodiscal is still broad and imprecise, as it would cover the temporal bone and the articular disc completely, thus making it difficult to relate to an intracapsular ligament in the medial region of the articular disc.

The scientific validity of the existence of the Tanaka ligament is controversial, as has been reported in previous studies (Sato *et al.*, 1995; Fuentes & Ottone, 2017). This structure may be considered a part of the medial collateral ligament (Fuentes *et al.*, 2016). Among the eight studies selected in this review that recognize the Tanaka ligament as an individualized structure, six of them (García, 2008; Cuccia *et al.*, 2011; Osma López, 2014; Fuentes *et al.*, 2015; Fuentes *et al.*, 2016; Fuentes & Ottone) refer basically to

textbooks (Langton & Eggleton; Okeson 1989; Williams *et al.*, 1989; Sosa) as a scientific basis; one study (Fanghänel & Gedrange, 2007) cites a dissection video published by Terry Tanaka (1986a) and another study (Torres-Pazmiño) cites a thesis (Giambartolomei, 2005). These text books (Langton & Eggleton; Sosa) also use Terry Tanaka's videos (Tanaka, 1986a; Tanaka 1988) to support the existence of this ligament.

Among the textbooks cited, only the Gray's Anatomy (Williams *et al.*) is a book of anatomical literature, however new editions of this same book (Drake *et al.*; Standring) no longer contain the description of this ligament. However, Okeson's book "Management of Temporomandibular Disorders and Occlusion" (Okeson, 2013) still recognizes this structure, however does not name it directly as "Tanaka Ligament" describing it as "an intra-capsular ligament of the medial TMJ described by Terry Tanaka" whose reference is also due to a video (Tanaka, 1992) and a book by Terry Tanaka (Tanaka, 1989).

The studies of TMJ found by authorship and co-authorship of Terry Tanaka (Tanaka, 1986b; McNeill *et al.*, 1990; Schwaighofer *et al.*, 1990) have never used the term "Tanaka Ligament" to refer to this alleged ligament in special.

The vast majority of the more than 1,300 studies found in the databases we surveyed were discarded for having some of the authors with Tanaka surnames who studied structures of the TMJ or ligaments in general, unrelated to the structure in question. It is noteworthy that in some studies about the TMJ there were researchers whose name was spelled as "T. Tanaka" (Tanaka *et al.*, 2002; Yamaza *et al.*, 2003), but that it was not Terry Tanaka.

The present study is in full agreement with the earlier study carried out 22 years ago by Sato *et al.*, that reported although there are conventional descriptions of TMJ ligaments in textbooks, there is still controversy and unanswered questions about their existence (Fuentes & Ottone). Since the anatomical and functional information of the Tanaka ligament is insufficient, heterogeneous and imprecise, it reveals the need for morphological and functional studies in a significant number of cadaveric samples.

Thus, it is concluded that the diffusion of the existence of this TMJ ligament should be carried out cautiously, especially in scientific literature and also in classes for students of all levels, until their existence, function and prevalence are confirmed by appropriate scientific studies.

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RESUMEN: La articulación temporomandibular (TMJ) se compone de estructuras óseas, cartílago, cápsula, disco articular, membrana sinovial y ligamentos. Algunos autores consideran el "ligamento de Tanaka" descrito en los años 80 por Terry Tanaka como un ligamento intra-capsular de la ATM que une medialmente el disco articular y la fosa mandibular. El objetivo del presente estudio fue analizar el uso del término "ligamento de Tanaka" en la literatura evaluando el soporte científico de su existencia. Se realizó una revisión de la literatura bajo los términos "Tanaka Ligament [AND] TMJ" y "Ligamento Tanaka [AND] ATM" (Español y Portugués) en los buscadores: MEDLINE-Pubmed, Science Direct, Google Académico, LILACS-Bireme y SciELO. Se consideraron artículos científicos y tesis en inglés, español y portugués. Se obtuvieron un total de 1.355 estudios, sumando los resultados de todos los motores de búsqueda, de los cuales se seleccionaron 8 estudios (5 artículos y 3 tesis) después de aplicar los criterios de inclusión y exclusión y la selección por título, resumen y contenido. La mayoría de estos estudios fueron descartados porque tenían contenidos relacionados con la ATM y/o ligamentos cuyo autor tenía el apellido "Tanaka", que no estaba relacionado con el ligamento de Tanaka. Entre los 8 estudios seleccionados, 6 de ellos citan libros de texto, uno cita un video publicado por Terry Tanaka y otro cita una tesis. La mayoría de estos libros citados también se refieren a los videos de Terry Tanaka y sus libros. Además, la mayor parte de la literatura anatómica no considera este ligamento como una estructura individualizada. Aunque hay descripciones del ligamento de Tanaka en los libros de texto, el apoyo científico de su existencia se basa sólo en videos y textos de Terry Tanaka. La difusión del conocimiento asociado a este ligamento debe ser cautelosa, revelando la necesidad de más estudios morfológicos y funcionales para confirmar su existencia.

PALABRAS CLAVE: ATM; Ligamentos; Ligamento de Tanaka.

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Received: 31-07-3027

Accepted: 13-10-2017