

Use of “Bicondylar” as a Descriptive Term for the Temporomandibular Joint: A Scoping Review

Uso de "Bicondíleo" Como Término Descriptivo de la Articulación Temporomandibular: Una Revisión de Alcance

Paulina Gutiérrez-Tiznado^{1,2}; Sandra López-Lázaro^{1,2,3} & Gabriel M. Fonseca^{1,2}

GUTIÉRREZ-TIZNADO, P.; LÓPEZ-LÁZARO, S. & FONSECA, G. M. Use of “bicondylar” as a descriptive term for the temporomandibular joint: A scoping review. *Int. J. Morphol.*, 40(4):1054-1059, 2022.

SUMMARY: The temporomandibular joint (TMJ) is the joint between the mandibular condyles, the mandibular fossa and the articular tubercle of the temporal bone. TMJ has been described as a “bicondylar” joint, a term that in current literature is used in multiple and dissimilar contexts. We present a scoping review of the term “bicondylar” as a descriptive term for TMJ in the scientific literature of the last 5 years. After selection according to the inclusion/exclusion criteria, 24 articles were selected for further analysis. The countries with the most publications were Brazil, India and Turkey with 3 articles each. Seven articles (29.17 %) were published by Spanish-speaking authors, six of these written in Spanish. Regarding the use of the term “bicondylar”, 50 % of the articles referred to this term but did not explain it; 25 % cited this term to refer to the location in the left and right mandibular condyles; and 25 % the articles use the term and explain it according to the morphology of the articular surfaces. Discrepancies were also detected regarding as to how to consider TMJ: 54.17 % considered that TMJ is a single joint between a single bone (the jaw) and two bones of the cranium, while 45.83 % considered that TMJ are actually two different TMJs that work at the same time. We suggest discussing the appropriate use of the term “bicondylar” to avoid confusion and to be able to adapt and satisfy the needs of both anatomists and clinicians.

KEY WORDS: Anatomy; Temporomandibular joint; Bicondylar; Terminology.

INTRODUCTION

The temporomandibular joint (TMJ) is the joint between the mandibular condyles with the mandibular fossa and the articular tubercle of the temporal bone (Duman *et al.*, 2020). TMJ is a ginglymoarthrodial joint formed by the glenoid fossa of the temporal bone and the mandibular condyle; it is a composite anatomical joint that allows both hinge motion (inferior joint between the articular disc and condyle) and gliding motion (superior joint between articular disc and temporal bone) (Moore *et al.*, 2014; Baral *et al.*, 2020). Pai *et al.* (2019) describe the TMJ as a compound joint made up of two different TMJs connected to the same bone (the mandible), carry out both different functions but always influencing one another.

TMJ has been described as a “bicondylar joint” (Dag[~] *et al.*, 2019; Sakul *et al.*, 2019; Veras *et al.*, 2021). In arthrology, a joint is considered ellipsoid (condylar) when the joint surfaces

are represented by two ellipsoidal segments. A bicondylar joint is usually considered when two convex surfaces slide together, as it happens in TMJ and the knee joint (Sakul *et al.*, 2019). However, the term “bicondylar” is used in multiple contexts in the current scientific literature reporting dissimilar forms and disagreements in the correct use of the term; while for some authors this term refers to two ellipsoidal condyles facing each other in the same joint (Sakul *et al.*, 2019; Meyvaci *et al.*, 2020), for others “bicondylar” refers to a TMJ is composed by right and a left condyle (Pai *et al.*, 2019; Duman *et al.*, 2020; Veras *et al.*, 2021).

Anatomical terminology is the basis for medical terminology and it is important that clinicians and researchers around the world use the same nomenclature to refer to the same structure (Federative Committee of Anatomical

¹ Programa de Magister en Odontología, Facultad de Odontología, Universidad de La Frontera, Temuco, Chile.

² Centro de Investigación en Odontología Legal y Forense -CIO-, Facultad de Odontología, Universidad de La Frontera, Temuco, Chile.

³ Departamento de Antropología Facultad de Ciencias Sociales, Universidad de Chile, Santiago, Chile.

FUNDING: Funded (partially) by the Dirección de Investigación, Universidad de La Frontera”, Chile..

Terminology & Sociedad Anatómica Española, 2001). In 1989, the International Federation of Anatomical Associations developed the International Anatomical Terminology (IAT), which is written in Latin and from which the translation into the corresponding language must be made. For the TMJ, however, it was referred that there are ambiguous and few updated terms and anatomical descriptions; anatomy texts do not delve much into this subject, even though there are authors who claim that there are still structures that have not been included as official terms (Kachlik *et al.*, 2015; Fuentes *et al.* 2016a; Trost *et al.*, 2020; Neumann *et al.*, 2020).

We present a scoping review of the current scientific literature on the use of the term "bicondylar" as a descriptive term for the TMJ, and the morphological, clinical and research scope of this heterogeneity of use is discussed, contrasted with the classic definitions of the term.

MATERIAL AND METHOD

A scoping review of the literature was carried out in accordance with the Preferred Reporting Items for Systematic

reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco *et al.*, 2018). This type of review has been described as the most appropriate when seeking to answer broad research questions to understand the nature of the available evidence. Although scoping reviews do not assess the quality of the included documents, they can identify unexplored areas and guide the development of new focused research questions (Armstrong *et al.*, 2011). Given the aspects sought for evaluation in this study, we used a specific search strategy using the terms "Temporomandibular joint/anatomy and histology"[MeSH] OR "Temporomandibular joint" OR "craniocondibular joint" OR "tmj" AND ("bicondylar" OR "bicondyle") in both English and Spanish, using four electronic databases (PubMed/Medline, SciELO, LILACS and Google Scholar) between 6 and 10 June 2021. The combination in which these terms were used varied slightly according to the database, although the search terms themselves remained unchanged. All articles in which the term "bicondylar" was used as a descriptive term of TMJ, and that were published between January 1, 2017 and June 30, 2021, were included. Two calibrated researchers conducted the search and each article were analyzed according to specific categories: authors, year of publication, country of origin, language and the

category in which the term "bicondylar" has been used: I) the term is used without explaining or defining it; II) the term is used to refer to the joints being located in the left and right mandibular condyles; III) the term is used to describe a morphological feature of the articular components of the joint. It was also recorded if the articles describe the TMJ as a single joint complex (i) or if the articles considered the right and left joints as two different TMJs (ii). The differences in the evaluations were resolved by consensus of the researchers, and the data was contrasted with general data and resources provided by the system.

RESULTS

The initial search returned 138 published articles. After selection according to the inclusion/exclusion criteria, 24 articles were selected for further analysis (Fig. 1). These articles were published between 2017 and 2021, with 2020 being the year with the most publications (41.67 %) (Table I). The countries with the most publications were Brazil, India and Turkey with 3 articles each. Seven articles (29.17 %) were published by Spanish-speaking authors, six of them written in Spanish.

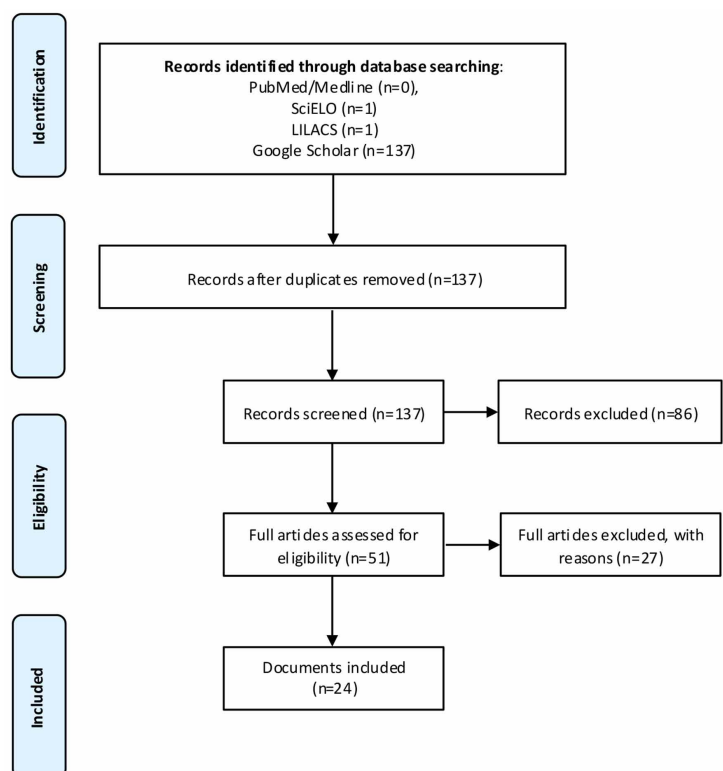


Fig. 1. PRISMA Flow Diagram for the scoping review process performed.

Table I. Articles identified in the review, discriminated variables.

Author / year	Country	Language	Use of the term*	Descriptive of TMJ**
Veras <i>et al.</i> (2021)	Brazil	English	II	i
Kent (2021)	USA	English	II	i
Baral <i>et al.</i> (2020)	Nepal	English	II	ii
Cazacu <i>et al.</i> (2020)	Republic of Moldova	English	I	i
Duman <i>et al.</i> (2020)	Turkey	English	II	i
Greven <i>et al.</i> (2020)	Germany and Austria	English	I	ii
Kusch & Gaspar (2020)	Peru and Chile	Spanish	III	ii
Meyvacı <i>et al.</i> (2020)	Turkey	English	III	i
Stangret <i>et al.</i> (2020)	Poland	English	II	ii
Subawari <i>et al.</i> (2020)	Pakistan	English	I	ii
Vijayendranath Nayak <i>et al.</i> (2020)	India	English	I	i
Lévano Loayza & Sovero Gaspar (2020)	Peru	Spanish	I	i
Pai <i>et al.</i> (2019)	India	English	II	ii
Alarcón-Ariza <i>et al.</i> (2019)	Colombia	Spanish	III	ii
Vite Vera <i>et al.</i> (2019)	Ecuador	Spanish	I	i
Bharat & Jagnade (2018)	India	English	I	i
Da_ <i>et al.</i> (2019)	Turkey	English	I	i
Lemos <i>et al.</i> (2018)	Brazil	English	I	ii
Sassi <i>et al.</i> (2018)	Brazil	English	I	i
Peláez <i>et al.</i> (2018)	Argentina	Spanish	I	i
Al-Bahrani (2017)	Iraq	English	III	ii
Iturriaga <i>et al.</i> (2017)	Chile	English	I	i
Nripendra <i>et al.</i> (2017)	Nepal	English	III	ii
Contreras <i>et al.</i> (2017)	Venezuela	Spanish	III	ii

*Use of term: I= the term is used without explaining or defining it; II= the term is used to refer to the joints being located in the left and right condyles of the jaw; III= the term is used to describe a morphological feature of the articular components of the joint

** Descriptive of TMJ: i) TMJ is considered as a single joint complex; ii) The right and left joints are considered as two different TMJs.

Regarding the use of the term "bicondylar", it was determined that 50 % of the articles referred to this term but did not explain it (category I); 25 % cited this term to refer to the location in the left and right mandibular condyles (category II); and 25 % the articles use the term and explain it according to the morphology of the articular surfaces (category III). In category II, the articles used phrases such as "The right and left TMJ form a bicondylar articulation" (Baral *et al.*, 2020) or "It is considered a bicondylar joint, since it works simultaneously at both ends of the mandible" (Veras *et al.*, 2021). In category III, the articles used phrases such as "(TMJ is) bicondylar (...) since the condyle of the mandible faces the condyle of the temporal bone" (Contreras *et al.*, 2017); "(TMJ) is a large bicondylar joint consisting of the osseous components which are the glenoid fossa and the mandibular condyle" (Al-Bahrani, 2017) and "the TMJ between the articular fossa of temporal bone above and the mandibular condyle is bicondylar variety of synovial joint" (Nripendra *et al.*, 2017).

Regarding the way TMJ is described, while 13 articles (54.17 %) considered (explicitly or implicitly) that TMJ is

a single joint between a single bone (the jaw) and two bones of the cranium (i), 11 articles (45.83 %) consider that TMJ are actually two different TMJs that work at the same time (ii). While in category (i), the articles referred to the TMJ as a single joint complex, in category (ii), the articles used phrases such as "the TMJs form a bilateral functional joint" (Contreras *et al.*, 2017); "there are two TMJs connected to the same bone (the mandible)" (Pai *et al.*, 2019), "Seventeenth patients (34 TMJs)" (Al-Bahrani *et al.*, 2017), "a bicondylar articulation (...) formed by the right and left TMJ" (Subawari *et al.*, 2020; Baral *et al.*, 2020) or "the left TMJ" (Nripendra *et al.*, 2017; Lemos *et al.*, 2018).

DISCUSSION

The TMJ is considered as one of the most complex joints of the human body (Pai *et al.*, 2019; Greven *et al.* 2020; Veras *et al.*, 2021) and this same complexity seems to carry over into the way of describing TMJ terminologically. As early as 2007, Vasconcellos *et al.*

(2007) stated that the aspects related to bone geometry, functional capacity and the way to describe and classify these, are all controversial and debatable elements, causing further doubts when applied in clinical research. In 2015 and 2016a, Fuentes *et al.* (2016a) stated that the description of TMJ uses a wide and different variety of terms, which makes communication between the scientific community and learning of undergraduate students difficult, especially in clinical and surgical settings. In 2017, two of those same authors carried out an analysis of the IAT in relation to the terms associated with the TMJ, considering that there are terms that should be eliminated, and others that are absent and should be incorporated (Fuentes & Ottone, 2017). In another study (Fuentes *et al.*, 2016b), these authors use the term "bicondylar" to classify TMJ, by citing Vasconcellos *et al.* (2007), the latter who affirm that it is the term that best adapts to TMJ due to the shape of its bony surfaces and the presence of two main axes of movement. We verified in this review that the term "bicondylar" continues to be used as a descriptive term of TMJ in the most current literature, it is often cited, but at the same time there is still no consensus on its meaning.

According to the specialized literature, bicondylar joints are those that are formed by two convex condyles (Category III), which may be encased by a fibrous capsule; examples of bicondylar joints are the knee and the TMJ (Lampignano & Kendrick, 2018). This conception of the term "bicondylar", specifically for TMJ, has been recorded since the most classical literature: in his *Traité d'anatomie topographique*, Tillaux (1879) stated that the TMJ is a double condyle as it is the result of a unique arrangement in the economy, where two articular surfaces are convex, with a biconcave meniscus interposed between them. This is especially remarkable when form and function are associated: the adjective "bicondylar" not only describes the morphological characteristics of the anatomical elements involved in each joint (articular tubercle and mandibular condyle) but also establishes that these are the "functional" surfaces, differentiating them from other "non-functional" ones, not developed to resist forces and that are only passive structures in the TMJ (eg the roof of the mandibular fossa). These anatomofunctional orientations not only determine specific histomorphological characteristics, but also powerful concepts to consider in research, teaching and clinical practice (Pai *et al.*, 2019). In our review, and following this conception, the descriptive term "bicondylar" is used correctly (category III) in only 6 articles (25 %), considering that other 6 articles (25 %) explicitly use it incorrectly (category II), and 12 articles (50 %) prefer to use the term without going into depth its meaning (category I).

Taking into account that the adjective "bicondylar", beyond its use as a descriptive term of the TMJ, means "relating to, or between two condyles" (Merriam-Webster, 2022), it is not surprising that this adjective is used interchangeably to describe the TMJ by the confrontation between the mandibular condyle and the tubercle articular, or simply by the two mandibular condyles in the same complex joint, as we have seen in this review. Some authors have sought to delve deeper into the source of these discrepancies. Fuentes *et al.* (2016a) called attention to the misuse of the expression "condyle of the mandible" according to the IAT. Trost *et al.* (2020) affirm that the term "condyle", with more than 600,000 references on Pubmed® is used in a vague and confusing way from an imprecise translation that does not coincide with its use in the current anatomical nomenclature. For these authors, the adjective "bicondylar" is inaccurate when it designates, on the one hand, the two sites of joint contact, and on the other, it is offered as a synonym for "ellipsoid" joints; we agree with these authors in that this leads to the discrepancy of a notion of "bicondylar" joint due to the synergistic function of masticatory apparatus, and on the other, the need to consider two separate TMJs when taking this into clinical practice (which we have confirmed in this review). Neumann *et al.* (2020) recommend that although advances in medical knowledge can modify the concepts about the referent of some terms, they should maintain their relationship with the original referent. Trost *et al.* (2020), propose to remove the word "condyle" (and its derivations) to optimize the consistency of the IAT.

Although less identified in this review, the Spanish variant of the term is also currently used: Although three articles do not delve into its meaning (category I), the other three use the term following the classical conception (category III) describing the TMJ as "bicondylar" because it articulates two convex bone surfaces, facing the condyle of the mandible with the condyle of the temporal bone (Contreras *et al.*, 2017; Alarcón-Ariza *et al.*, 2019; Kusch & Gaspar, 2020). This concept in Spanish aligned with the one given by the Real Academia Nacional de Medicina de España (RANME); in the award-winning 'Dictionary of medical terms', the RANME defines TMJ as a "... bicondylar joint between the mandibular fossa and the articular tubercle of the temporal bone above and the condyle of the mandible below" (<http://dtme.ranm.es>). As can be seen, the functional notion of the concept prevails, but the Spanish term *cóndilo* (condyle) continues to be used both in the expression «*cóndilo de la mandíbula*» (*Condylus mandibulae*) and in «*cóndilo del temporal*» (as a synonym for "articular tubercle" –*Tuberculum articulare*-) (Fuentes *et al.*, 2015). The descriptive term *bicondilar* is used both by the classical Spanish literature (Figún & Gariño, 1984;

Testut & Latarjet, 1996) and by the current Spanish literature (Contreras *et al.*, 2017) characterizing the TMJ by its two articular surfaces as "Condyles". Unfortunately, it is also used in clinical or therapeutic contexts to describe other conditions that involve both mandibular condyles as "bicondylar fractures" (Arboleda-Ariza *et al.*, 2017) or "bicondylar hyperplasias" (Sedano Balbin *et al.*, 2019), situation that also occurs for that use of the term in English (Cascone *et al.*, 2017; Viloría *et al.*, 2020). Fuentes *et al.* (2016a) had already reported these discrepancies in the terms used to describe the TMJ structures, both in the academic and clinical settings. Neumann *et al.* (2020), state that biomedical dynamics forces a permanent correction of terminological errors to be able to solve the needs of clinical medicine, this not only in English and the Romance languages, but even in the use of Latin or Greek.

Terminology is a unique communication tool in any specific area; particularly in anatomy, the terminology serves as the basis for other medical disciplines, both theoretical and clinical. However, and beyond the notable efforts made by prestigious associations to contribute to clarity in the use of terms, the lack of appropriate citations leads to discrepancies, errors or misuse of identical terms for different structures (Kachlik *et al.*, 2015). The "convenience" of describing the TMJ by using the term "bicondylar" from an erroneous meaning derived from the clinical setting (the two mandibular condyles) may, according to this review, exceed the consequences as a descriptive term, leading the discussion even to the area of morphofunction, academics and even research. We agree with Kachlik *et al.* (2015) that these discrepancies should be reported, published and discussed so that anatomical terminology can adapt and satisfy the needs of both anatomists and clinicians around the world.

Laskin (2009), citing Chesterton, states that "A man does not know what he is saying until he knows what he is not saying".

CONCLUSIONS

The term "bicondylar" is currently used in an ambiguous and confusing way both in Spanish and English, defining concepts that do not know their origins and classical terminological bases. The discrepancies originate mainly in the heterogeneous use of the term "condyle", and even in the description of TMJ in clinical and surgical settings. We suggest to discuss the appropriate use of the term "bicondylar" to avoid confusion and to be able to adapt and satisfy the needs of both anatomists and clinicians.

GUTIÉRREZ-TIZNADO, P.; LÓPEZ-LÁZARO, S. & FONSECA, G. M. Uso de "bicondíleo" como término descriptivo de la articulación temporomandibular: una revisión de alcance. *Int. J. Morphol.*, 40(4):1054-1059, 2022.

RESUMEN: La articulación temporomandibular (ATM) es la articulación entre los cóndilos mandibulares con la fosa mandibular y el tubérculo articular del hueso temporal. La ATM ha sido descrita como una articulación "bicondílea", término que en la literatura actual se utiliza en múltiples y disímiles contextos. Presentamos una revisión con búsqueda sistemática del término "bicondíleo" como término descriptivo de la ATM en la literatura científica de los últimos 5 años. Siguiendo criterios de inclusión/exclusión, se seleccionaron 24 artículos para su posterior análisis. Los países con más publicaciones fueron Brasil, India y Turquía con 3 artículos cada uno. Siete artículos (29,17 %) fueron publicados por autores de habla hispana, seis de ellos escritos en español. En cuanto al uso del término "bicondilar", el 50 % de los artículos se refieren a él, pero no lo explican; un 25 % citó este término para referirse a la ubicación en los cóndilos mandibulares izquierdo y derecho; y el 25 % de los artículos utilizan el término y lo explican según la morfología de las superficies articulares. También se detectaron discrepancias en cuanto a cómo considerar la ATM: el 54,17 % consideró que la ATM es una única articulación entre un solo hueso (la mandíbula) y dos huesos del cráneo, mientras que el 45,83 % consideró que la ATM son en realidad dos ATM diferentes que funcionan al mismo tiempo. Se sugiere discutir el uso adecuado del término "bicondilar" para evitar confusiones y poder adaptar y satisfacer las necesidades tanto de anatomistas como de clínicos.

PALABRAS CLAVE: Anatomía; Articulación temporomandibular; Bicondilar; Terminología.

REFERENCES

- Al-Bahrani, Z. M. Ultrasonographic evaluation for the normal disk position of the temporomandibular joint. *Int. J. Sci. Res. (Raipur)*, 6(10):2018-21, 2017.
- Alarcón-Ariza, D. F.; Zambrano-Jerez, L. C.; Sosa-Vesga, C. D. & Pardo-Parra, L. M. Luxación de la articulación temporomandibular: a propósito de un caso y su diagnóstico diferencial. *Med. UIS*, 32(3):49-54, 2019.
- Arboleda-Ariza, N.; Rodríguez-Cárdena, Y. A.; Ruiz-Mora, G. A. & Duran-Rodríguez, G. J. Tratamiento de fracturas mandibulares bicondilar y parasinfisiaria con reducción abierta y cerrada: Reporte de caso. *Rev. Cient. Odontol.*, 5(1):688-94, 2017.
- Armstrong, R.; Hall, B. J.; Doyle, J. & Waters, E. Cochrane Update. 'Scoping the scope' of a Cochrane review. *J. Public Health (Oxf)*, 33(1):147-150, 2011.
- Baral, P.; Awasthi, J.; Shrestha, R.; Sapkota, S.; Chaudhari, B. & Koju, S. Establishing surface projection of temporo-mandibular Joint using tragus of ear as landmark. *J.GMC-N.*, 13(1):39-44, 2020.
- Bharat, R. & Jagnade, R. S. Temporomandibular joint morphology in normal occlusion- a cone beam computed tomography study. *J. Adv. Med. Dent. Sci. Res.*, 6(9):74-9, 2018.
- Cascone, P.; Marra Marcozzi, M.; Ramieri, V.; Bosco, G.; Vellone, V. & Spallaccia, F. Mandibular condylar fractures in children: Morphofunctional results after treatment with external fixation. *J. Craniofac. Surg.*, 28(7):1742-5, 2017.

- Cazacu, I.; Tighineanu, M.; Zumbreanu, I.; Trifan, V. & Fala, V. Corelatia dintre planul ocluzal superior, anterior i inferior cu disfuncțiile ATM. *Med. Stomatol.*, 1(54):98-112, 2020.
- Contreras, A.; González, B.; Parra, J.; Rivas, F.; Ulloa, J.; Vielma, I. & David, C. Elementos anatómicos del complejo articular cráneo-mandibular. *Kiru*, 14(2):157-65, 2017.
- Dag, C.; Demirel, A. & Özalp, N. Can temporomandibular joint disorders be diagnosed beforehand by assessment of postural irregularities? *J. P. R.*, 6(2):104-9, 2019.
- Duman, F.; Çiçekcibas, i, A.; Nesrin, A. T. C. I.; Keles, F. Ö.; Yucekaya, B.; Hüzmeli, E. D. & Damlar, I. Morphological changes in temporomandibular joint dysfunction and effectiveness of different treatment methods. *Anatomy*, 14(2):102-10, 2020.
- Federative Committee on Anatomical Terminology & Sociedad Anatómica Española. *Terminología anatómica: Terminología Anatómica Internacional*. Madrid, Médica Panamericana, 2001.
- Figún, M. E. & Gariño, R. R. *Anatomía Odontológica Funcional y Aplicada*. 2nd ed. Buenos Aires, El Ateneo, 1984.
- Fuentes, R. & Ottone, N. E. Proposal on inclusion and elimination of anatomical terms in *Terminologia Anatomica* corresponding to the temporomandibular joint. *Int. J. Morphol.*, 35(1):12-5, 2017.
- Fuentes, R.; Cantín, M.; Ottone, N. E. & Bucchi, C. Characterization of bone components of the temporomandibular joint. A literature review. *Int. J. Morphol.*, 33(4):1569-76, 2015.
- Fuentes, R.; Ottone, N. E.; Bucchi, C. & Cantín, M. Analysis of terms used in the literature to refer to temporomandibular joint capsule and joint ligaments. *Int. J. Morphol.*, 34(1):342-50, 2016a.
- Fuentes, R.; Ottone, N. E.; Saravia, D. & Bucchi, C. Irrigation and innervation of the temporomandibular joint. A literature review. *Int. J. Morphol.*, 34(3):1024-33, 2016b.
- Greven, G.; Piehslinger, E.; Haberl, T. & Betzl, C. Correlation between internal derangement of the temporo-mandibular joint and ipsi-lateral mediotrusive molar interferences-a condylographic study using virtual articulation. *Int. J. Dent. Oral Health*, 6(5):1-6, 2020.
- Iturriaga, V.; Vásquez, B.; Manterola, C. & del Sol, M. Role of hyaluronic acid in the homeostasis and therapeutics of temporomandibular joint osteoarthritis. *Int. J. Morphol.*, 35(3):870-6, 2017.
- Kachlik, D.; Musil, V. & Baca, V. Terminologia Anatomica after 17 years: inconsistencies, mistakes and new proposals. *Ann. Anat.*, 201:8-16.
- Kent, R. D. Developmental functional modules in infant vocalizations. *J. Speech Lang. Hear Res.*, 64(5):1581-604, 2021.
- Kusch, A. M. & Gaspar, A. S. Discrepancia estructural del disco y cápsula articular de la ATM en resonancia nuclear magnética. Revisión de la literatura. *Rev. Estomatol. Herediana*, 30(1):63-70, 2020.
- Lampignano, J. P. & Kendrick, L. E. *Bontrager's Textbook of Radiographic Positioning and related anatomy*. 9th ed. St. Louis, Elsevier, 2018.
- Laskin D. M. Temporomandibular Terminology: *Clarification of Confusion*. Oral Health Group, 2009. Available: from: <https://www.oralhealthgroup.com/features/temporomandibular-terminology-clarification-or-confusion/>
- Lemos, G. A.; da Silva, P. L. P.; Batista, A. U. D. & Palomari, E. T. Experimental model of temporomandibular joint arthritis: Evaluation of contralateral joint and masticatory muscles. *Arch. Oral Biol.*, 95:79-88, 2018.
- Lévano Loayza, S. A. & Sovero Gaspar, A. T. Evaluación anatómica de la articulación temporomandibular mediante resonancia magnética. Artículo de revisión. *Rev. Estomatol. Herediana*, 30(4):285-293, 2020.
- Merriam-Webster. *Bicondylar*. Merriam-Webster.com Dictionary, 2022 Available from: <https://www.merriam-webster.com/dictionary/bicondylar>
- Meyvacı, S. S.; Bulut, D. G.; Öztürk, A. T. & Ankarali, H. Angular measurements of the mandible in adults with temporomandibular joint disorders: a CBCT study. *Anatomy*, 14(3):185-91, 2020.
- Moore, K. L.; Dalley, A. F. & Agur, A. *Clinically Oriented Anatomy*. 7th ed. Philadelphia., Lippincott Williams and Wilkins, 2014.
- Neumann, P. E.; Gest, T. R. & Tubbs, R. S. The principles of anatomical nomenclature revision: They're more like guidelines anyway. *Clin. Anat.*, 33(3):327-31, 2020.
- Nripendra, T.; Deepesh, B.; Sushil, K.; Kumar, K. P. & Khrishna, M. B. A study on temporomandibular joint disorders among Nepalese preclinical students studying at KMCTH. *IJBAMR*, 6(3):549-53, 2017.
- Pai, S. A.; Poojari, S. R.; Ramachandra, K.; Patel, R. K. V. & Jyothi, M. Temporomandibular joint-An anatomical view. *J. C. R. I.*, 6(1):1-5, 2019.
- Peláez, A. N.; Olivera, P. B.; Rosende, M. N. & Mazza, S. M. Relación entre los hábitos parafuncionales y las características clínicas de la articulación temporomandibular. *Odontol. Sanmarquina*, 21(3):181-7, 2018.
- Sakul, B. U.; Bilecenoglu, B. & Ocak, M. *Anatomy of the Temporomandibular Joint*. In: Rozylo-Kalinowska, I. & Orhan, K. (Eds). Imaging of the Temporomandibular Joint. Cham, Springer, 2019.
- Sassi, F. C.; Silva, A. P. D.; Santos, R. K. S. & Andrade, C. R. F. D. Oral motor rehabilitation for temporomandibular joint disorders: a systematic review. *A. C. R.*, 23:e1871, 2018.
- Sedano Balbin, G.; Pérez Vargas, F. & Romero Tapia, P. Hiperplasia condilar, un enfoque actual del diagnóstico y tratamiento. Revisión de la literatura. *Odontol. Sanmarquina*, 22(2):132-9, 2019.
- Stangret, A.; Mularczyk, A.; Szczesniak, A.; Topczewska, K. & Rogulska K. Congenital Abnormalities of the Temporomandibular Joint - single conditions. *J. Educ. Health Sport*, 10(8):393-7, 2020.
- Subawari, S. A. B.; Awais, L.; Afzal, M. W.; Hanif, K.; Sarfraz, A.; Saleem, M. & Kashif, M. Frequency and level of disability among patients wearing complete dentures. *Health Sci. J.*, 14(2):703, 2020.
- Testut, L. & Latarjet, A. *Compendio de Anatomía Descriptiva*. 22nd ed. Madrid, Salvat Editores, 1996.
- Tillaux, P. *Traité d'Anatomie topographique avec Applications à la Chirurgie*. Paris, P. Assesin, Libraire de la Faculté de Médecine, 1879.
- Tricco, A. C.; Lillie, E.; Zarin, W.; O'Brien, K. K.; Colquhoun, H.; Levac, D.; Moher, D.; Peters, M. D. J.; Horsley, T.; Weeks, L.; et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann. Int. Med.*, 169(7):467-73, 2018.
- Trost, O.; Crampon, F.; Prum, G.; Trouilloud, P. & Duparc, F. A plea to remove the word "condyle" from the international anatomical nomenclature. *Surg. Radiol. Anat.*, 42(1):95-6, 2020.
- Vasconcellos, A. H.; Sousa, A. E. M. & Cavalcante, H. M. L. T. M. Temporomandibular joint classification: functional and anatomic aspects. *Int. J. Odontostomat.*, 1(1):25-8, 2007.
- Veras, N. K. S.; Brandão, A. M. C.; Arruda, F. L.; Sousa, F. M. S. & Gouveia, G. P. M. The effect of low-level laser therapy on functional improvements in the temporomandibular joints: randomized clinical trial. *Res. Soc. Dev.*, 10(4):e46110414387, 2021.
- Vijayendranath Nayak, S.; Gunasheela, S.; Karthik, M. & Aparna Hegde. Healing by inflammation – prolotherapy. *Case Rep. Dent. Sci.*, 1(1):9-14, 2020.
- Viloria, A.; Mendiñeta, M.; Borrero, L. A. & Bonerge Pineda, O. Prediction of Mandibular Morphology through Artificial Neural Networks. *Procedia Comput. Sci.*, 170:370-5, 2020.
- Vite Vera, E. F.; Zúñiga Domínguez, H. J.; Moreira Cedeño, L., D.; Escala Parker, C. L.; Rivera Salas, C. R. & Marín Ferrín, R. E. Anquilosis de la articulación temporomandibular. *Rev. Cuba. Reumatol.*, 21(3):e1-e9, 2019.

Corresponding author:
Gabriel M. Fonseca
Faculty of Dentistry
Universidad de La Frontera
Francisco Salazar 01145
Temuco
4780000
CHILE

E-mail: gabriel.fonseca@ufrontera.cl