Mandibular canal vs. inferior alveolar canal: Evidence-based terminology analysis

Joe Iwanaga¹-³, Yuki Matsushita⁴⁵, Tess Decater¹⁷, Soichiro Ibaragi⁶, R. Shane Tubbs¹⁷⁹

The affiliations and addresses of the authors

1. Department of Neurosurgery, Tulane Center for Clinical Neurosciences, Tulane University School of Medicine
2. Dental and Oral Medical Center, Kurume University School of Medicine, Kurume, Fukuoka Japan
3. Division of Gross and Clinical Anatomy, Department of Anatomy, Kurume University School of Medicine, Kurume, Fukuoka Japan
4. University of Michigan School of Dentistry, 1011 N. University, Ann Arbor, MI 48109, USA
5. Department of Clinical Oral Oncology, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, Japan
6. Department of Oral and Maxillofacial Surgery, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama, Japan
7. Department of Anatomical Sciences, St. George’s University, St. George’s, Grenada, West Indies
8. Department of Structural & Cellular Biology, Tulane University School of Medicine, New Orleans, LA, USA
9. Department of Neurosurgery and Ochsner Neuroscience Institute, Ochsner Health System, New Orleans, LA

**Running Head:** Mandibular canal vs. inferior alveolar canal

**The affiliation and address of the corresponding author:**

Joe Iwanaga  
Department of Neurosurgery, Tulane Center for Clinical Neurosciences, Tulane University School of Medicine, 131 S. Robertson St. Suite 1300, New Orleans, LA 70112, USA  
iwanagajoeca@gmail.com  
Tel: 5049885565 Fax: 5049885793  
**Financial Disclosure Statement:** None of the authors has any potential conflict of interest.
Original article

Mandibular canal vs. inferior alveolar canal: Evidence-based terminology analysis

Joe Iwanaga¹-³, Yuki Matsushita⁴,⁵, Tess Decater¹,⁷, Soichiro Ibaragi⁶, R. Shane Tubbs¹,⁷-⁹

The affiliations and addresses of the authors

1. Department of Neurosurgery, Tulane Center for Clinical Neurosciences, Tulane
   University School of Medicine
2. Dental and Oral Medical Center, Kurume University School of Medicine, Kurume,
   Fukuoka Japan
3. Division of Gross and Clinical Anatomy, Department of Anatomy, Kurume University
   School of Medicine, Kurume, Fukuoka Japan
4. University of Michigan School of Dentistry, 1011 N. University, Ann Arbor, MI 48109,
   USA
5. Department of Clinical Oral Oncology, Nagasaki University Graduate School of
   Biomedical Sciences, Nagasaki, Japan
6. Department of Oral and Maxillofacial Surgery, Okayama University Graduate School of
   Medicine, Dentistry and Pharmaceutical Sciences, Okayama, Japan
7. Department of Anatomical Sciences, St. George’s University, St. George’s, Grenada, West
   Indies

This article is protected by copyright. All rights reserved.
8. Department of Structural & Cellular Biology, Tulane University School of Medicine, New Orleans, LA, USA

9. Department of Neurosurgery and Ochsner Neuroscience Institute, Ochsner Health System, New Orleans, LA

Running Head: Mandibular canal vs. inferior alveolar canal

The affiliation and address of the corresponding author:

Joe Iwanaga
Department of Neurosurgery, Tulane Center for Clinical Neurosciences, Tulane University School of Medicine, 131 S. Robertson St. Suite 1300, New Orleans, LA 70112, USA
iwanagajoeca@gmail.com
Tel: 5049885565 Fax: 5049885793

Financial Disclosure Statement: None of the authors has any potential conflict of interest.

Abstract

Introduction: The mandibular canal, as it was formerly named in Terminologia Anatomica (TA), has also been called the inferior alveolar (nerve) canal in many scientific publications. This study
was conducted to investigate how these terms have been understood in different regions and
different areas of expertise and to discuss the appropriate future application of the term
“mandibular canal.” Methods: A literature search was conducted using PubMed, and articles
using different terms for this structure were classified into two groups, inferior alveolar
canal/inferior alveolar nerve canal (IAC/IANC) and mandibular canal (MC). The 50 most recent
articles in each group were included. Publication year, journal title, country of the first author,
and affiliation of all authors were recorded in both groups for all 100 articles. Results: There was
a significant difference between the IAC/IANC and MC groups in the numbers of anatomy
journals, other journals, and anatomy affiliations. Turkey published most frequently with a total
of 15 articles, followed by Iran with 10 articles, and China/India/ USA with seven each. When
the six countries of the first author that had three or more publications in each group were
compared, only Turkey appeared in both groups; otherwise, different countries were in the two
groups. Conclusions: Based on the results of this analysis, and considering that the tentative new
term “inferior alveolar foramen” is used in the latest TA, we suggest that the mandibular canal
should be renamed the “inferior alveolar canal.”

Keywords
Terminology; Terminologia Anatomica; mandibular canal; inferior alveolar canal; mandibular
foramen; inferior alveolar foramen; dentistry

Introduction
Physicians and anatomists often use different terms for the same structures (Gardner et al., 1947; Tubbs et al., 2005). The use of different terms, which can vary from region and discipline, might result in miscommunication, translation issues or potentially, medical complications. One example of diverse anatomical term usage is the mandibular canal versus the inferior alveolar canal.

The mandibular canal is the pathway for the inferior alveolar neurovascular bundles in the mandible. It has the mandibular foramen and mental foramen as entrance and exit, respectively (Standring, 2015). “Mandibular canal” has long been the accepted anatomical term for this bony canal. However, many dentists and anatomists realize that the “inferior alveolar canal” (or even the “inferior alveolar nerve canal”) is also a well-known term for this canal and is accepted in many scientific journals (Mortazavi et al., 2019b; Sánchez-Torres et al., 2019). Thus, the terminology for this bony canal is often confusing. In general, a bony canal is named after the neurovascular bundle that passes through it, e.g., the infraorbital and obturator foramina, and hypoglossal canals. The “mandibular canal” is a clear exception to this rule, so some believe it should be termed the “inferior alveolar canal” consistent with other bony canals. Notably, the Federative International Programme for Anatomical Terminology (FIPAT), which prescribes international anatomical terminology, recently decided to use “inferior alveolar foramen” tentatively instead of “mandibular foramen” with the logic “there are other foramina in the mandible” in Terminologia Anatomica second edition published in 2019 (Fig. 1) (FIPAT, 2019). Therefore, we believed now was a good time to align the term of the foramen with the term used
for the canal. However, “mandibular canal” is still the term of choice for this bony canal such that the following description is used: the inferior alveolar foramen is the entrance of the mandibular canal through which the inferior neurovascular bundles pass (FIPAT, 2019). Such a description could lead to potential misunderstanding and, thus, should be simplified. Therefore, the goal of this study was to investigate how these terms are used and understood in different regions and areas of expertise and to discuss the appropriate future application of the term “mandibular canal.”

Materials and Methods

Screening

A literature search was conducted using PubMed on February 10, 2020. The following search words were used: “inferior alveolar canal” OR “inferior alveolar nerve canal” and “inferior alveolar canal” OR “inferior alveolar nerve canal” OR “mandibular canal.” These searches resulted in 277 and 1223 articles, respectively. From the latest article in the list on PubMed, the Title, Abstract, Manuscript, Figure, and Figure Legends were reviewed. Terms in the Keywords and References were not reviewed.

“inferior alveolar canal” OR “inferior alveolar nerve canal” (277 article hits)

Commentaries and letters to the editor were excluded first.
The most recent, consecutive 50 articles containing “inferior alveolar canal” or “inferior alveolar nerve canal” were included (defined as the IAC/IANC group) (Sirin et al., 2020; Kablan et al., 2020; Patil et al., 2019; Pour et al., 2020; Uzun et al., 2019; He et al., 2019; Vidya et al., 2019; Demirel and Akbulut, 2020; Zirk et al., 2019; Yong et al., 2019; Al-Ekrish et al., 2020; Shokry et al., 2019; Qi et al., 2019; Arbel et al., 2019; Khojastepour et al., 2019; Saha, 2019; Mortazavi et al., 2019a; Mortazavi et al., 2019b; Kubota et al., 2020; Lee et al., 2019b; Tabrizi et al., 2019; Xie et al., 2019; Tudtiam et al., 2019; Şahin et al., 2019; Aljarbou et al., 2019; Luangchana et al., 2019; Dutra et al., 2019; Prakash et al., 2018; Mortazavi et al., 2018; Sharifi et al., 2018; Ali et al., 2018; Al-Ekrish et al., 2018; Goller Bulut and Köse, 2018; Wang et al., 2018; Ghai and Choudhury, 2018; Elkhateeb and Awad, 2018; Liu et al., 2018; Zahedi et al., 2018; Atef and Mounir, 2018; Rytkönen and Ventä, 2018; Chen et al., 2018; Afşa and Rahmati, 2017; Adibi et al., 2017; Gumusok et al., 2016; Ishii et al., 2017; Česaitienė et al., 2017; Uchida et al., 2017; Clark et al., 2017; Tachinami et al., 2017; Patrick et al., 2017).

“inferior alveolar canal” OR “inferior alveolar nerve canal” OR “mandibular canal” (1223 article hits)

Commentaries and letters to the editor were excluded first.

The articles that were included in the IAC/IANC group were excluded from this group. The most recent, consecutive 50 articles containing “mandibular canal” but neither “inferior alveolar canal” nor “inferior alveolar nerve canal” were included (defined as the MC group) (Ngeow and Chai, 2020a; 2020b; Abd Fattah et al., 2019; Komal et al., 2020; Cărstocea et al., 2020; Yalcin
and Artas, 2020; Pucilo et al., 2020; Ozdede, 2020; Chen et al., 2019; Alves et al., 2020; Yalcin and Akyol, 2020; Matzen et al., 2020; Munhoz et al., 2019; Valdec et al., 2019; Nicol et al., 2019; Burian et al., 2019; Fistarol et al., 2019; Iwanaga et al., 2019; Arias et al., 2019; Iwanaga et al., 2020a; 2020b; Raju et al., 2019; Sun et al., 2019; Costa et al., 2019; Kalabalik and Aytuğar, 2019; Friedrich et al., 2019; Koç et al., 2019; Bozkurt and Görürgöz, 2019; Al-Shayyab et al., 2019; Pedersen et al., 2019; Okumuş and Duml, 2019; Sinha et al., 2019; Lee et al., 2019a; Felice et al., 2019a; 2019b; Esposito et al., 2019; Predoiu et al., 2019; Na et al., 2019; Matsuda et al., 2019; Freire et al., 2019; Bosykh et al., 2019; Sholapurkar and Davies, 2019; Matzen et al., 2019; Oliveira et al., 2019; Liye et al., 2019; Tereshchuk and Sukharev, 2019; Satir, 2019; Vranckx et al., 2019; Sahl et al., 2018; Uğur Aydın and Göller Bulut, 2019).

IAC/IANC group and MC group reviewed

The full text for both groups (100 articles) was reviewed again to confirm that the IAC/IANC group included the papers that used the term “inferior alveolar canal” and/or “inferior alveolar nerve canal” (either with or without mandibular canal), and the MC group included papers that used the term “mandibular canal” but neither “inferior alveolar canal” nor “inferior alveolar nerve canal” (Fig. 2).

Data collection
Publication year, journal title, country of the first author, and affiliations of all authors were recorded in both groups for all 100 articles.

Statistical analysis was made comparing the two groups using Student t-tests with $p<0.05$ considered significant.

**Results**

*Publication year*

The IAC/IANC group included six articles in 2020, 21 in 2019, 14 in 2018, eight in 2017, and one in 2016. The MC group included 12 articles in 2020, 37 in 2019, and one in 2018 (Fig. 3).

*Journal*

Journals were classified into three groups: Anatomy journals, Dental journals, and Other journals.

“Anatomy journals” included any journals that focus on anatomy and morphology. “Dental journal” included any journals with at least one of the following in the title; oral, dent, maxillofacial, craniofacial, periodont, odont, endod, or quintessence. The journals that were not included in either of the above were categorized as “Other journals.” The distribution of the journals is shown in Fig. 4.
There was a statistically significant difference between the IAC/IANC and MC groups in the numbers of Anatomy journals and Other journals in which they were included ($p<0.05$).

**Country**

Turkey was the country that published most frequently with 15 articles out of the total 100, followed by Iran with 10 articles, and China/India/USA with seven articles each (Fig. 5).

Iran, Turkey, and China were the countries that used the term “inferior alveolar canal” or “inferior alveolar nerve canal” most frequently. Turkey, the USA, and Brazil were the countries that used the term “mandibular canal” most frequently (Fig. 6).

When the countries of the first author that had three or more publications in each group were compared, only Turkey appeared in both groups; otherwise, the two groups were occupied by different countries.

**Affiliation**

Three categories of affiliation were distinguished: Anatomy, Dental, and Other.

Any article with anatomy or biology in the title or the affiliation of any co-authors was classified as an “anatomy affiliation.” Any that included oral, dent, maxillofacial, craniofacial, periodont, ortho, odont, or endod were categorized as a “dental affiliation.” If none of the above was included, the category applied was “other affiliation.”
The distribution of the affiliations is shown in Fig. 7.

There was a statistically significant difference in the number of anatomy affiliations between the IAC/IANC and MC groups ($p<0.05$).

**Discussion**

Anatomy has a long history with occasional changes in terminology. Terms for the mandibular canal are no exception and have changed many times over the years, e.g., inferior alveolar canal (IAC), inferior alveolar nerve canal (IANC), alveolar canal, dental canal, and inferior dental canal (Standring, 2015; Mortazavi et al., 2019b; Schäfer and Thane, 1890).

In general, anatomists are more familiar with *TA* and usually use this terminology more strictly than dentists or others. Therefore, anatomists prefer to use “mandibular canal” as this is the term in *TA*. This probably explains the significant difference between the IAC/IANC and MC groups in anatomy journals. There was also a significant difference between the groups in the number of “other journals,” which included non-anatomy and non-dental journals. In other words, the editors/reviewers and readers of “other journals” might be less familiar with the terminology in *TA* or use it less strictly than those of “anatomy journals.”

Countries of the first author that had five or more publications were: Turkey (15), Iran (10), China (seven), India (seven), USA (seven), Brazil (six), and Japan (five). Among these,
interestingly, no articles from Iran were categorized in the MC group; all ten were in the IAC/IANC group. Also, most of the publications from China, India, and Japan were in the IAC/IANC group. When the countries of the first author that had three or more publications in each group were compared (Fig. 6), only Turkey appeared in both groups; otherwise, the two groups were occupied by different countries. This implies a tendency to use only one of the two terms in those countries. However, this does not determine which country uses the “right” term for the mandibular canal.

The affiliations of the authors also affected the results. There was a significant difference between the IAC/IANC and MC groups in the number of publications with an anatomy (or anatomy-related) affiliation. This could be interpreted as mentioned earlier: those with an anatomy affiliation, who are supposed to be more familiar with TA and are likely to use the terminology more strictly, are more likely to be anatomists than those with a dental affiliation.

As shown earlier, 277 and 1223 articles in PubMed appeared in the “inferior alveolar canal” or “inferior alveolar nerve canal” and “inferior alveolar canal” or “inferior alveolar nerve canal” or “mandibular canal” searches, respectively. The number “277” is not small and should not be ignored. Both anatomists and dentists sometimes say “inferior alveolar canal is a wrong term” and refer to the TA as evidence, but they do not explore the matter. We believe that “the inferior alveolar canal” should not be considered a wrong term. It is probably used because of human nature/habit/comfort as the structure it denotes contains the inferior alveolar neurovascular bundles.
Our study shows the results of a small sampling (n=100) from a potentially large pool of articles. If we continue to avoid addressing this difference in terminologies, the choice of term selection could become more polarized, i.e., mandibular canal and inferior alveolar canal, in the near future depending on expertise or country.

**Conclusion**

Based on this analysis and considering that the new tentative term “inferior alveolar foramen” is used in the latest *TA*, we suggest mandibular canal be renamed as the “inferior alveolar canal.”

**Limitations**

There are limitations to this study. The data included were based only on a PubMed search. Some journals are not in PubMed, which could have affected the data analysis. As seen in the publication year data, the MC group had no articles published in either 2017 or 2016 and only one in 2018, due to the limited number of articles included. In 2020, the number is still increasing because the data search was conducted in February. Therefore, we might be able to compare the numbers of publications between the two groups only in 2019 (21 articles in the IAC/IANC group vs. 37 in the MC group). There could be differences between radiology affiliations and other clinical affiliations, but we could not differentiate them because of complexities in the names of departments and the existence of multiple authors in the same articles. Some countries have unique medical terms in their language, and sometimes the meanings of these terms differ from those in English. Therefore, if they were directly translated into English, the authors’ intended meaning could be lost.
Conflict of interest

The authors received no funding or grants for this work from any organization or foundation. The authors declare that they have no conflicts of interest.
References


Esposito, M., Barausse, C., Pistilli, R., et al. (2019) Posterior atrophic jaws rehabilitated with prostheses supported by 5 × 5 mm implants with a nanostructured calcium-incorporated titanium surface or by longer implants in augmented bone. Five-year results from a randomised controlled trial. *International Journal of Oral Implantology (New Malden)*, 12, 39–54.


Felice, P., Pistilli, R., Barausse, C., Piattelli, M., Buti, J. and Esposito, M. (2019b) Posterior atrophic jaws rehabilitated with prostheses supported by 6-mm-long 4-mm-wide implants or by longer implants in augmented bone. Five-year post-loading results from a within-person randomised controlled trial. *International Journal of Oral Implantology (New Malden)*, 12, 57–72.


Figure legends

Figure 1

Mandible with labeling according to current terminology in *Terminologia Anatomica* 2nd ed.

*According to *TA* 2nd ed., the mandibular foramen is tentatively categorized as a synonym of the inferior alveolar foramen.

**According to *TA* 2nd ed., the inferior alveolar canal is tentatively categorized as a synonym of the mandibular canal.

Figure 2

IAC/IANC group and MC group

Figure 3

Difference between IAC/IANC group and MC group for published year

Figure 4

Difference between IAC/IANC group and MC group for three journal types

Figure 5

Country of the first author including both IAC/IANC group and MC group

Figure 6

Country of the first author in IAC/IANC group (left) and MC group (right)
Figure 7

Difference between IAC/IANC group and MC group for three affiliation types
Articles containing "mandibular canal"

MC group

IAC/IANC group

Articles containing "inferior alveolar canal"

Articles containing "inferior alveolar nerve canal"

CA_23648_Figure 2.tiff
This article is protected by copyright. All rights reserved.
The figure shows the difference in affiliations between the IAC/IANC group and the MC group across Anatomy, Dental, and Other categories. The p-values indicate statistical significance: p=0.007* for Anatomy and p>0.05 for Other. The IAC/IANC group has a higher number of affiliations in Anatomy compared to the MC group (47 vs. 8), while the MC group has more affiliations in Dental compared to the IAC/IANC group (42 vs. 47).