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Accessory Mental Foramen in Dry Mandibles: An Observational Study Along with Systematic Review and Meta-Analysis

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Abstract: **Background/Objectives**: Mental Foramen (MF) constitutes a passage for mental nerve and vessels, and is a crucial anatomical landmark in the body of the mandible. The Accessory Mental Foramen (AMF) is a small, addable foramen proximate to MF, mainly located posteriorly. AMF is a rare anatomical variation in human mandibles which must be taken into consideration throughout dental and surgical operations. We aimed to assess the incidence and perform a morphological and morphometric analysis of AMFs in human dry mandibles of Greek population in addition to a relevant systematic review and meta-analysis of worldwide data. **Methods**: We studied 114 human adult dry mandibles of unknown gender and age available in the Laboratory of Anatomy, Medical School, Democritus University of Thrace, Greece. Moreover, we used the search term "accessory mental foramen" in PubMed, Scopus, and Google Scholar databases to detect all publications reporting prevalence and morphology of AMF in dry mandibles. Quality assessment was performed with the relevant Johanna-Briggs Institute tool. **Results**: According to our data, the MF was present in all observed mandibles and it was bilateral. Nine AMFs (5 right/4 left; 5 round/4 oval; 6 posterior/3 anterior to MF), were found in 7 mandibles (5 single, 2 double), all unilateral. AMFs presented 0.96±0.43 mm mean diameter, 4.12±2.15 mm mean distance from MF, 12.68±4.10 mm from alveolar ridge, and 11.92±1.57 mm from mandible lower border. Furthermore, 27 publications were included in the meta-analysis; the combined AMF prevalence was 6.1% (95% CI: 4.8% - 7.6%; I^2 60%), the combined mean vertical axis was 1.18 ± 0.61 mm, and the combined mean distance from MF was 3.64 ± 2.29 mm. Bilateral AMFs were detected in 2.1% of AMF cases. Oval shape was described in 37.3% of AMFs. No publication bias was detected. **Conclusions**: Dental surgeons must have a comprehensive understanding of the anatomical variations in the mental foramen (MF) and the potential presence of accessory mental foramina (AMFs). This knowledge is essential to prevent or mitigate the risk of postoperative complications such as pain, anesthesia, injury, and other adverse outcomes. By incorporating this anatomical insight into surgical and anesthetic planning, clinicians can enhance patient safety and procedural success.

Keywords: accessory mental foramen; mental foramen; greek population; prevalence; meta-analysis

1. Introduction

Mental foramen (MF) is an oval or circular opening located on the body of the mandible, typically equidistant from its superior and inferior borders. It serves as a passage for the mental nerve, artery and vein, playing a vital role in innervating the lower face, including the lower teeth, lip, labial mucosa and gingiva.

The accessory mental foramen (AMF), when present, is identified as a smaller opening located alongside the MF, typically positioned posterior to it/. The AMF plays a critical role, particularly during operating procedures, making it essential for surgeons to recognize its presence and morphology. Precise knowledge of the variations in the anatomy, shape, size, and position of the MF, along with the presence of the AMF, is invaluable for performing mandibular surgical procedures.

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These include filling treatments, premolar curettage, root canal therapy, dental implant placement, orthognathic and periapical surgeries, jaw surgeries, and the enucleation of pathologies in the mental region. Given the frequency of dental and maxillofacial procedures involving the mental region, it is imperative for dental practitioners to be well-informed about these anatomical details to prevent postoperative complications such as lip numbness, a significant consequence of improper handling or violation of the AMF [1].

Saywer et al. demonstrated that the morphology, position, and incidence of AMFs vary among individuals and across ethnic groups [2]. Additionally, the position of the MF differs between edentulous and dentate subjects [3]. While many studies focus on dry mandibles, others have utilized data from Cone-Beam Computed Tomography (CBCT) and panoramic radiographs. Notably, linear measurements from CBCT have been shown to align closely with those obtained from dry mandibles using a digital caliper, the gold-standard method [4]. CBCT measurements of MF size have also been validated for accuracy [5]. However, comprehensive data on AMFs remain limited.

Although numerous observational studies, case series, and case reports have been published, a systematic review and meta-analysis focusing on dry mandibles has yet to be conducted. This study aims to assess the incidence and perform a morphological and morphometric analysis of AMFs in human dry mandibles from the Greek population, complemented by a systematic review and meta-analysis of available global data.

2. Materials and Methods

The present observational study was conducted on 114 dry adult human mandibles of unknown gender and age, derived from the osteological collection of the Anatomy Department, Democritus University of Thrace, Greece.

The study objectives were to measure the location, shape, incidence, diameter, as well as the distance between AMFs and MF, AMFs to the alveolar crest and AMFs to the inferior border in each mandible. For that purpose, we used a digimatic caliper (Mitutoyo Co., Japan) of 0.1 mm accuracy. Each distance was measured from the center of each foramen, either MF or AMF. The location of each AMF was determined using two imaginary lines (horizontal and vertical) intersecting at the MF, dividing the area into four quadrants: anterior superior, posterior superior, anterior inferior, and posterior inferior. The diameter of the AMF was measured using a single wire with a diameter ranging from 0.2 mm to 1.4 mm. For oval-shaped foramina, the horizontal distance was measured using up to two wires with diameters ranging from 0.02 mm to 3mm (**Figure 1**).

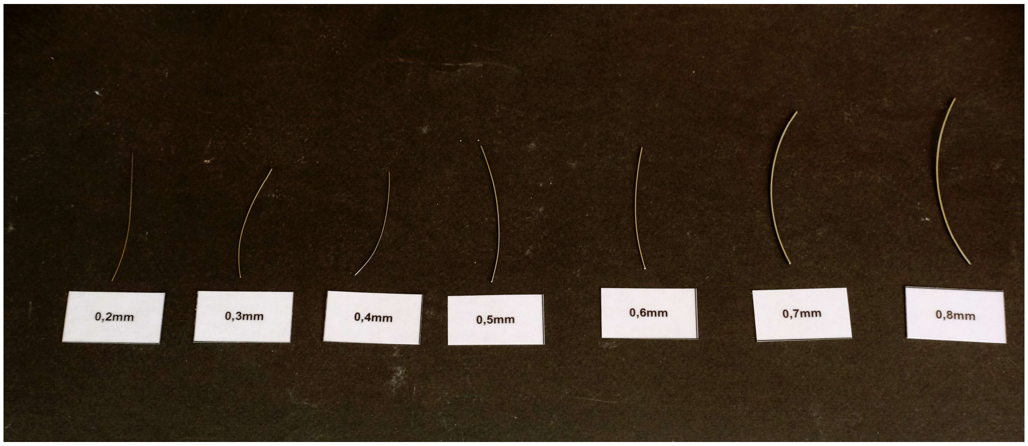

Figure 1. Wires used to additionally determine the diameter of AMFs.

All measurements were performed independently by two investigators. Inter-rater reliability assessment for categorical variables was assessed using the Cohen's kappa estimates; in case of

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continuous variables, the intraclass correlation coefficients (ICC) estimates and their 95% confidence intervals (CI) based on a mean rating (n=2), absolute-agreement, two-way random model were alternatively applied. Means are accompanied by the relevant standard deviation (SD). Inter-rater reliability assessment for categorical variables was assessed using the Cohen's kappa estimates; in case of continuous variables, the intraclass correlation coefficients (ICC) estimates and their 95% confidence intervals (CI) based on a mean rating (n=2), absolute-agreement, two-way random model were alternatively applied [6]. Based on the 95% confident interval of the ICC estimate, values less than 0.5, between 0.5 and 0.75, between 0.75 and 0.9, and greater than 0.90 are indicative of poor, moderate, good, and excellent reliability, respectively [7]. The level of statistical significance was set to p=0.05. The SPSS software (version 26.0.0.0) was used for statistical analysis

For the purpose of meta-analysis, we implemented the PRISMA 2020 statement guidelines [8]. We used the search term "accessory mental foramen" in PubMed, Scopus, and Google Scholar databases to detect all publications reporting prevalence and morphology of AMF in dry mandibles. Inclusion and exclusion criteria followed the PICOTS framework (**Table 1**).

Table 1. A synopsis of the inclusion criteria using the PICOTS framework.

Parameters	Inclusion criteria	Exclusion criteria
(P) Population	Human dry mandibles	Cone-Beam Computed tomography; panoramic Rx
(I) Intervention	Measurements with digital caliper and wires	
(C) Comparison	Heterogeneity assessment; publication bias assessment	
(O) Outcome	AMF prevalence, location, shape, size, and distance from MF, alveolar ridge, and mandible lower border	Cases involving mandible pathology (fracture, tumor)
(T) Time	Papers published over the last 50 years (from 1974)	Previously published duplicates
(S) Setting	Universities (dissection rooms; osteological collections)	

Quality assessment was performed with the Johanna Briggs Institute (JBI) Critical Appraisal Checklist for analytical cross-sectional studies tool [9].

All data regarding author, year of publication, origin of population studied, sample size, number of cases presenting AMF, number of cases presenting unilateral AMF, number of cases presenting bilateral AMF, number of total AMFs detected, number of AMFs detected on the right side, number of AMFs detected on the left side, number of single AMFs, number of multiple AMFs, number of round-shaped AMFs, number of oval-shaped AMFs, diameter in mm (if round) or vertical axis in mm (if oval), distance from MF in mm, distance from alveolar ridge in mm, and distance from mandible lower border were recorded. Quantitative synthesis were performed in case that data were available from ≥5 sources.

All steps including literature search, records screening, and data extraction were performed independently by two authors (Z-M.T., and C.T.). In case of dispute, a third author (V.P.) was responsible for the final judgment.

Data were synthesized using STATA 18 Statistical Software version. Prevalence data were combined using the random-effects REML model after Freeman-Tuckey double arcsine transformation. Combination of means and standard deviations (SDs) were performed using the freely available online tool located at https://www.statstodo.com/CombineMeansSDs.php.

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Means and estimates based on sample size, median, range, and interquartile range were calculated using the freely available online tool located at https://www.math.hkbu.edu.hk/~tongt/papers/median2mean.html [10-12].

Heterogeneity was approached using the Q test and I^2 statistic; Q test P value < 0.10 was indicative of a statistically significant result. Furthermore, a value of $I^2 \leq 25\%$ was indicative of insignificant heterogeneity, 26%-50% of low heterogeneity, 51%-75% of moderate heterogeneity, and > 75% of high heterogeneity [13,14]. Sensitivity analysis was performed using the leave-one-out procedure to investigate the effect of each included study on heterogeneity.

3. Results

3.1. Our data

According to our data, the MF was present in all observed mandibles and it was bilateral. Nine AMFs were found in 7 mandibles (5 single, 2 double), all unilateral; 5 AMFs were located at the right hemimandible and 4 at the left (**Figure 2**).

Figure 2. Two small accessory mental foramina located the one very close to the main mental foramen and the other one in a far distance from it anterosuperiorly.

As far as the shape of AMFs is concerned, 5 were round and 4 oval (**Figure 3**).

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Figure 3. Double accessory mental foramina, round and oval, found superior and antero-superior to the main mental foramen.

As far as the location of the AMFs is concerned, 6 AMFs were located posterior and 3 anterior to MF (**Figure 4**).

Figure 4. Accessory mental foramen located immediately posterior to the main mental foramen.

Additionally, four AMFs were located inferior to the MF, three superior to it, and two at the same horizontal level as the MF (**Figure 5**).

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Figure 5. Accessory mental foramen located postero-inferior to the main mental foramen.

AMFs presented 0.96±0.43 mm mean diameter, ranging from 0.40 to 1.70 mm (**Figure 6**).

Figure 6. A wide accessory mental foramen located inferiorly to the main mental foramen.

Additionally, AMFs presented 4.12±2.15 mm mean distance from MF, ranging from 3.20 to 17.72 mm (**Figure 7**).

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Figure 7. Accessory mental foramen very close to the main mental foramen.

Of note, AMFs were measured to be located 12.68 ± 4.10 mm from alveolar ridge, and 11.92 ± 1.57 mm from mandible lower border (**Table 2**).

Table 2. Characteristics of accessory mental foramen (AMF) cases of the present study.

Sample size	
Mandibles	114
Sides	228
Mental Foramens	228
Accessory Mental Foramens	9
AMF cases (per mandible)	
Absent	107/114 (93.9%)
Present; Total	7/114 (6.1%)
Present; Unilateral	7/114 (6.1%)
Present; Bilateral	0/114 (0%)
Location	
Right side	5/9 (55.6%)
Left side	4/9 (44.4%)
Anterior to mental foramen	3/9 (33.3%)
Posterior to mental foramen	6/9 (66.7%)
Shape	
Round	5/9 (55.6%)
Oval	4/9 (44.4%)
Dimensions (mean ± SD)	
Diameter / Vertical axis[1] (mm)	0.96 ± 0.43
Horizontal axis (mm)†	1.33 ± 0.55
Area (mm^2)	0.94 ± 0.87

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Dimensions (mean ± SD)	
from mental foramen (mm)	4.12 ± 2.15
from alveolar ridge (mm)	12.68 ± 4.10
from lower border of mandible (mm)	11.92 ± 1.57

[1]in case of oval-shaped AMF.

Lastly, in one mandible, the AMF was located at the same horizontal level as the MF but did not fall within any quadrant (**Table 3**).

Table 3. Inter-rater reliability assessment for categorical variables; Cohen's kappa estimates.

Samples	Side; 1st rater	Side; 2nd rater	Position regarding MF; 1st rater	Position regarding MF; 2nd rater	Shape; 1st rater	Shape; 2nd rater
1	left	left	posterior; same horizontal level	posterior; same horizontal level	oval	oval
2	right	right	posterior inferior	posterior inferior	circle	circle
3	right	right	posterior inferior	posterior inferior	oval	oval
4	left	left	posterior inferior	posterior inferior	oval	oval
5A	right	right	posterior inferior	posterior inferior	oval	oval
5B	right	right	anterior superior	anterior superior	circle	circle
6	right	right	posterior inferior	posterior; same horizontal level	circle	circle
7A	left	left	anterior superior	anterior superior	circle	circle
7B	left	left	anterior superior	anterior superior	circle	circle
Cohen's kappa	1.000		0.805		1.000	
p-value	0.008		0.001		0.008	

Considerable interrater agreement was observed for all measurements (**Table 4**).

Table 4. Inter-rater reliability assessment for continuous variables; intraclass correlation coefficients (ICC) estimates and their 95% confidence intervals (CI) based on a mean rating (n=2), absolute-agreement, two-way random model.

Parameter	Mean ±SD (average)	Mean ±SD (1st rater)	Mean ±SD (2nd rater)	ICC; 95% CI	ICC p-value
Diameter / Vertical axis† (mm)	0.96 ± 0.43	0.97 ± 0.42	0.94 ± 0.43	0.997; 0.987 – 0.999	<0.001
Horizontal axis (mm)†	1.33 ± 0.55	1.34 ± 0.56	1.32 ± 0.53	0.997; 0.970 – 1.000	<0.001
Area (mm^2)	0.94 ± 0.87	0.96 ± 0.87	0.93 ± 0.86	1.000; 0.996 – 1.000	<0.001
Distance from mental foramen (mm)	4.12 ± 2.15	4.09 ± 2.15	4.14 ± 2.15	1.000; 0.998 – 1.000	<0.001
Distance from alveolar ridge (mm)	12.68 ± 4.10	12.66 ± 4.03	12.69 ± 4.17	0.999; 0.998 – 1.000	<0.001
Distance from lower border of mandible (mm)	11.92 ± 1.57	11.90 ± 1.56	11.93 ± 1.58	0.998; 0.991 – 1.000	<0.001
Diameter / Vertical axis† (mm)	0.96 ± 0.43	0.97 ± 0.42	0.94 ± 0.43	0.997; 0.987 – 0.999	<0.001

[1]in case of oval-shaped AMF.

3.2. Meta-analysis

For the purpose of the meta-analysis, 252 publications were identified from search in PubMed and Scopus databases; ten additional publications were retrieved through citation searching (**Figure 8**).

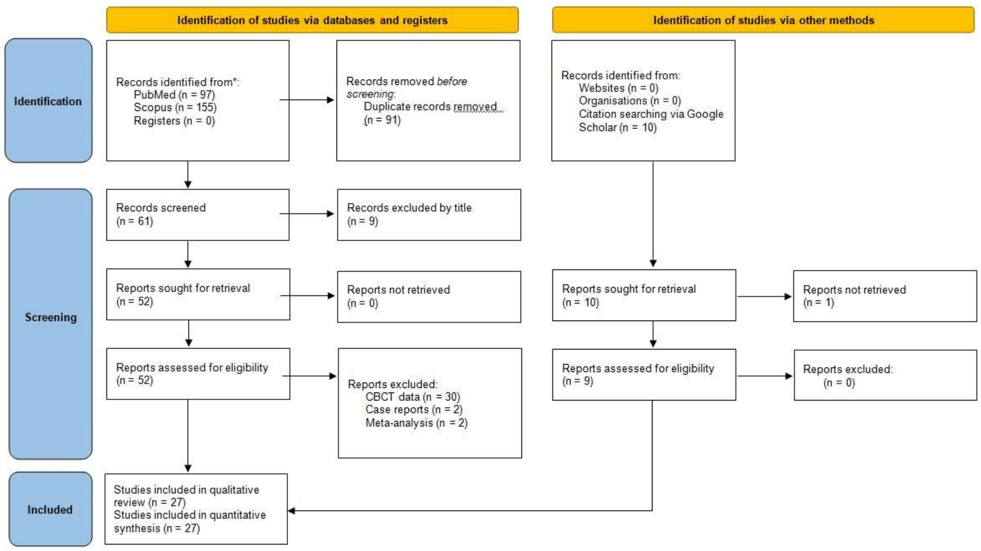

Figure 8. Meta-analysis: PRISMA 2020 flow diagram.

After screening, 27 publications were included in qualitative review and in quantitative synthesis, along with data obtained from the present observational study (**Table 5**; **Table 6**).

Table 5. Prevalence meta-analysis; included studies.

Study	Origin	Size	Cases with AMF	Total AMF	Right AMF	Left AMF	Unilateral AMF	Bilateral AMF	Single AMF	Multiple AMFs
Agthong, 2005 [15]	Thailand	110	2	4	2	2	0	2	4	0
Budhiraja, 2013 [16]	India	105	7	7			7	0		
Chrcanovic, 2010 [17]	Brazil	80	5	5			5	0	5	0
Dave, 2019 [18]	India	300	50	51	8	43	49	1		
Gershenshon, 1986 [19]	Israel; India	575	28	39					23	5
Gupta, 2012 [20]	India	120	8	8	5	3	8	0	8	0
Igbigbi, 2005 [21]	Malawi	70	1	1	0	1	1	0	1	0
Kadel, 2018 [22]	Nepal	100	7	7	3	4	7	0		
Kokten, 2004 [23]	Turkey	45	1	1			1	0	1	0
Kumari, 2018 [24]	India	50	5	6	2	4	3	1		
Lal, 2018 [25]	India	50	4	5	4	1	5	0	5	0
Nalbantoglu, 2024 [26]	Turkey	249	11	12			10	1		
Paraskevas, 2015 [27]	Greece	96	4	5	3	2	3	1	5	0
Prabodha, 2006 [28]	Sri Lanka	24	2	2			2	0	2	0
Raikohila, 2018 [29]	India	260	23	27	16	11	19	4	27	0

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Sakalem, 2024 [30]	Brazil	63	4	6			2	2		
Sawyer, 1998 [2]	USA	705	42	46	22	20	38	4		
Shukla, 2015 [31]	India	70	6	5	2	3				
Singh, 2010 [32]	India	100	13	13	5	8	13	0	13	0
Subramanian, 2019 [33]	Zambia	33	2	2	1	1	2	0	2	0
Suman, 2020 [34]	India	61	4	5	3	2	3	1		
Tiwari, 2022 [35]	Nepal	47	4	4	0	4	4	0		
Toh, 1992 [36]	Japan			3	2	1	3	0	3	0
Udhaya, 2013 [37]	India	90	4	5	2	3	3	1		
Vimala, 2015 [38]	India	35	2	2	2	0	2	0	2	0
Voljevica, 2015 [39]	Bosnia-Herz.	150	4	4	4	0	4	0	4	0
Zografos, 1989 [40]	Greece	464	31							
Present study	Greece	114	7	9	5	4	7	0	5	2

Table 6. Meta-analysis of shape, size, and distance from mental foramen; included studies. Combined mean vertical axis is 1.18 ± 0.61 mm, while combined mean distance from MF 3.64 ± 2.29 mm.

Study	Origin	Total AMF	Round	Oval	Vertical axis (mean)	Vertical axis (SD)	Distance from MF (mean)	Distance from MF (SD)
Paraskevas, 2015 [27]	Greece	5	5	0	1.09	0.15	5.24	3.21
Prabodha, 2006 [28]	Sri Lanka	2	0	2	1.70	0.28		
Raikohila, 2018 [29]	India	27	20	7	1.27	0.77	2.96	2.07
Singh, 2010 [32]	India	13	13	0				
Subramanian, 2019 [33]	Zambia	2	0	2	1.53	0.35		
Tiwari, 2022 [35]	Nepal	4	1	3	1.02	0.03	5.72	0.40
Toh, 1992 [36]	Japan	3			0.84	0.12	2.84	2.13
Present study	Greece	9	5	4	0.96	0.43	4.12	2.15

The quality assessment is presented in detail as depicted in **Table 7**. In detail, 8 domains were assessed using respective questions (Q1-Q8), as follows: Q1: "Were the criteria for inclusion in the sample clearly defined?"; Q2: "Were the study subjects and the setting described in detail?"; Q3: "Was the exposure measured in a valid and reliable way?"; Q4: "Were objective, standard criteria used for measurement of the condition?"; Q5: "Were confounding factors identified?"; Q6: "Were strategies to deal with confounding factors stated?"; Q7: "Were the outcomes measured in a valid and reliable way?"; Q8: "Was appropriate statistical analysis used?". The response options were recorded as "Yes" (Y), "No" (N), "Unclear (U)", and "Not Applicable" (NA).

Table 7. Quality assessment of the included studies using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for analytical cross-sectional study.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Overall appraisal
Agthong, 2005 [15]	Y	Y	NA	Y	N	N	Y	Y	Include

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Budhiraja, 2013 [16]	Y	Y	NA	Y	N	N	Y	NA	Include
Chrcanovic, 2010 [17]	Y	Y	NA	Y	N	N	Y	Y	Include
Dave, 2019 [18]	Y	Y	NA	Y	N	N	Y	NA	Include
Gershenshon, 1986 [19]	Y	Y	NA	Y	N	N	Y	NA	Include
Gupta, 2012 [20]	Y	Y	NA	Y	N	N	Y	NA	Include
Igbigbi, 2005 [21]	Y	Y	NA	Y	N	N	Y	Y	Include
Kadel, 2018 [22]	Y	Y	NA	Y	N	N	Y	NA	Include
Kokten, 2004 [23]	Y	Y	NA	Y	N	N	Y	NA	Include
Kumari, 2018 [24]	Y	Y	NA	Y	N	N	Y	NA	Include
Lal, 2018 [25]	Y	Y	NA	Y	N	N	Y	NA	Include
Nalbantoglu, 2024 [26]	Y	Y	NA	Y	N	N	Y	Y	Include
Paraskevas, 2015 [27]	Y	Y	NA	Y	N	N	Y	NA	Include
Prabodha, 2006 [28]	Y	Y	NA	Y	N	N	Y	NA	Include
Raikohila, 2018 [29]	Y	Y	NA	Y	N	N	Y	NA	Include
Sakalem, 2024 [30]	Y	Y	NA	Y	N	N	Y	Y	Include
Sawyer, 1998 [2]	Y	Y	NA	Y	Y	Y	Y	Y	Include
Shukla, 2015 [31]	Y	Y	NA	Y	N	N	Y	NA	Include
Singh, 2010 [32]	Y	Y	NA	Y	N	N	Y	NA	Include
Subramanian, 2019 [33]	Y	Y	NA	Y	N	N	Y	Y	Include
Suman, 2020 [34]	Y	Y	NA	Y	N	N	Y	NA	Include
Tiwari, 2022 [35]	Y	Y	NA	Y	N	N	Y	Y	Include
Toh, 1992 [36]	Y	Y	NA	Y	N	N	Y	Y	Include
Udhaya, 2013 [37]	Y	Y	NA	Y	N	N	Y	NA	Include
Vimala, 2015 [38]	Y	Y	NA	Y	N	N	Y	NA	Include
Voljevica, 2015 [39]	Y	Y	NA	Y	N	N	Y	Y	Include
Zografos, 1989 [40]	Y	Y	NA	Y	N	N	Y	U	Include
Present study	Y	Y	NA	Y	Y	Y	Y	Y	Include

The combined AMF prevalence was 6.1% (95% CI: 4.8% - 7.6%; I^2 60%) (**Figure 9**).

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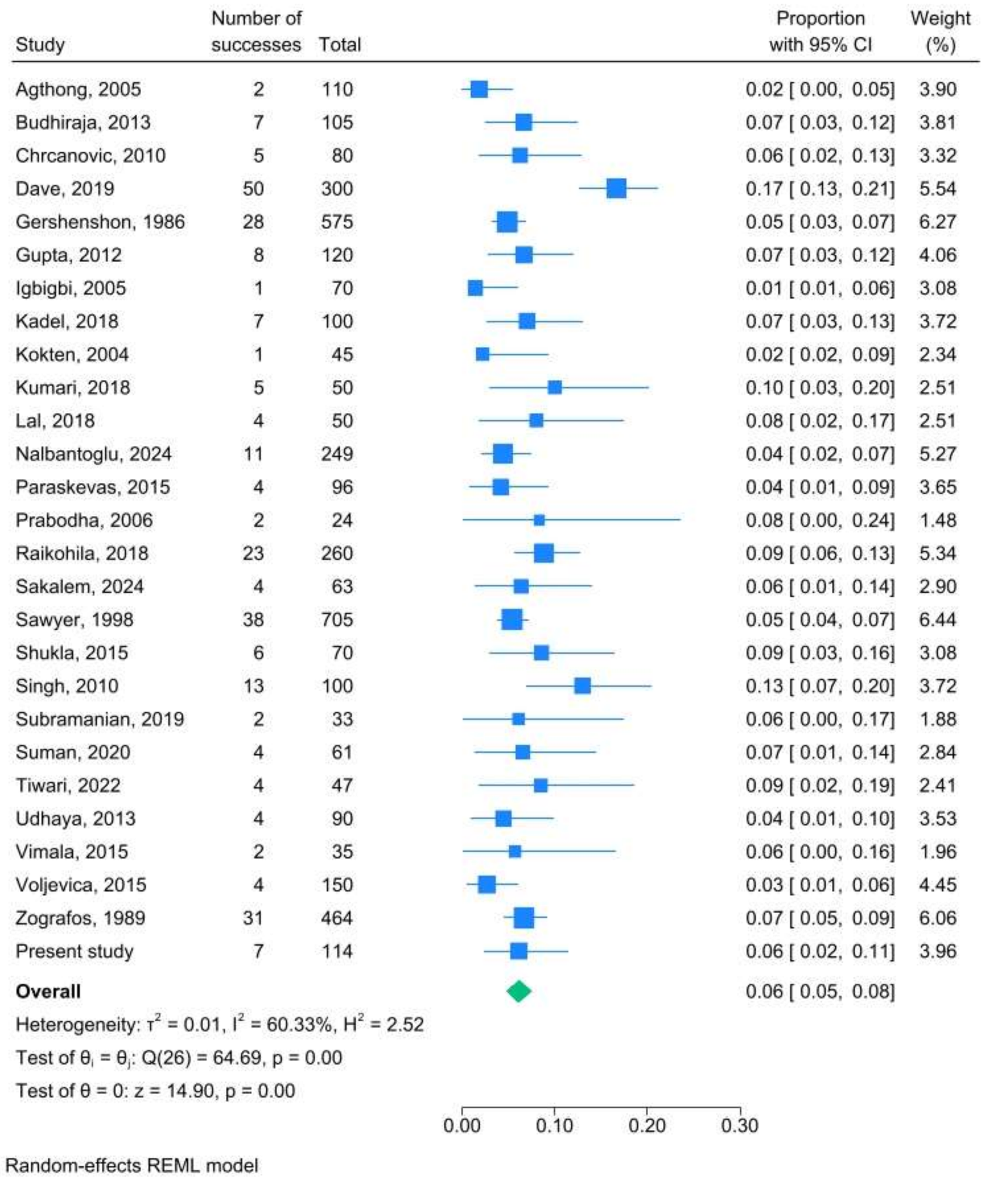

Figure 9. AMF prevalence meta-analysis; the combined prevalence of AMF in dry mandibles is 6.1% (95% CI: 4.8% - 7.6%;) with I^2 60%.

AMF were detected in 48.2% (95% CI: 35.2% - 61.2%; I^2 50%) on the right side (**Figure 10**), and in 51.8% (95% CI: 38.8% - 64.8%; I^2 50%) on the left side (**Figure 11**); no difference was documented as CIs referring to both sides overlapped.

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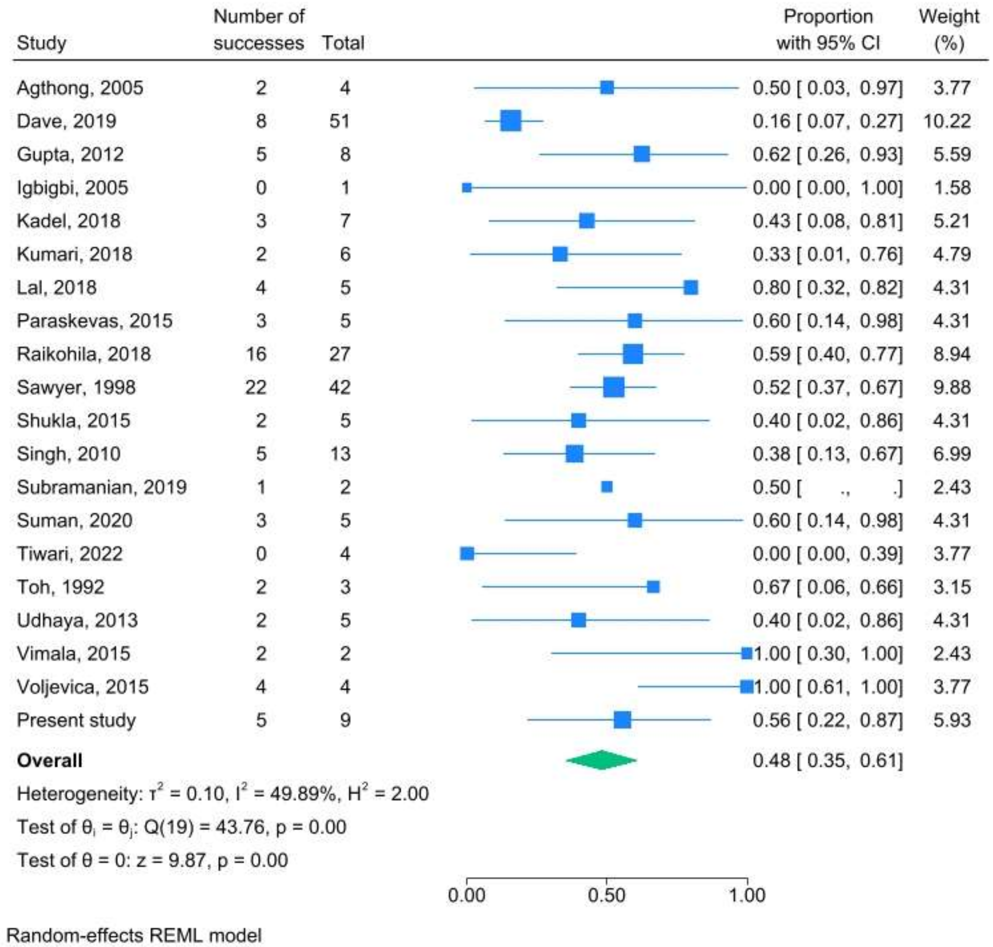

Figure 10. Right AMF prevalence meta-analysis; the combined prevalence of AMF in dry mandibles is 48.2% (95% CI: 35.2% - 61.2%) with I² 50%

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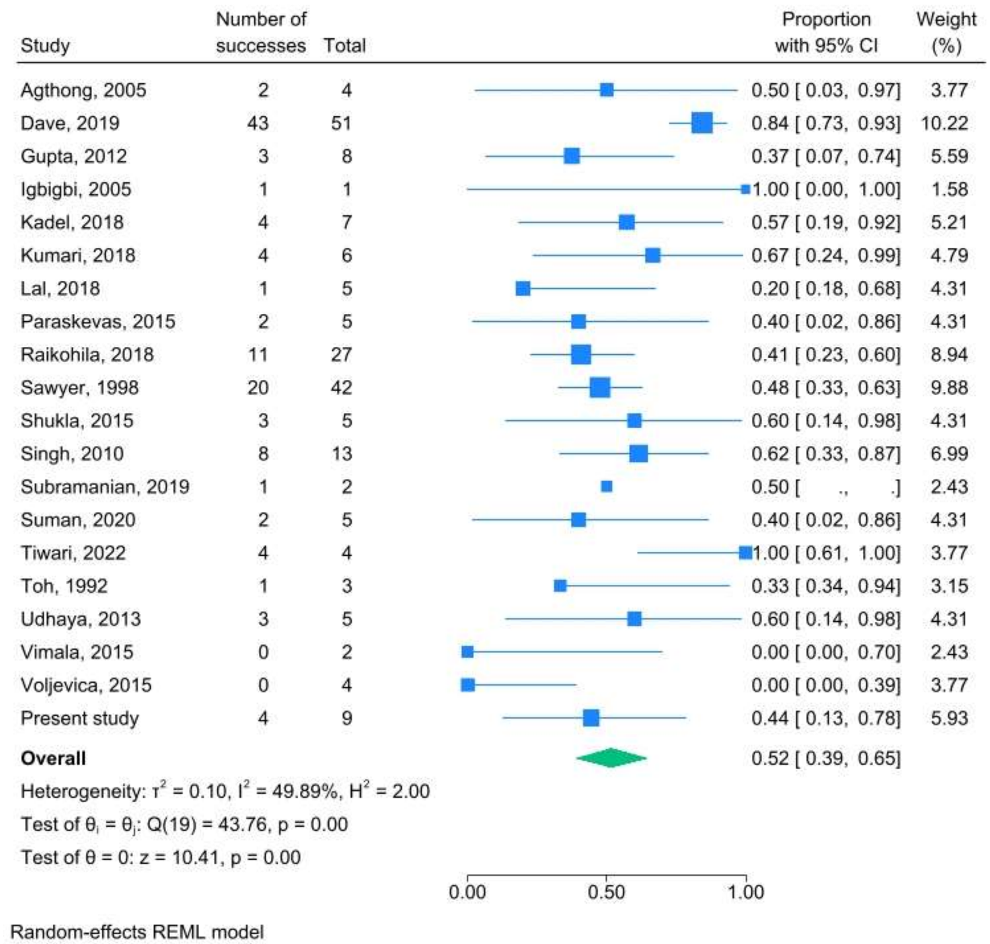

Figure 11. Left AMF prevalence meta-analysis; the combined prevalence of AMF in dry mandibles is 51.8% (95% CI: 38.8% - 64.8%) with I^2 50%.

The combined mean vertical axis was 1.18 ± 0.61 mm, and the combined mean distance from MF was 3.64 ± 2.29 mm. Bilateral AMFs were detected in 2.1% of AMF cases (95% CI: 0.0% - 7.3%; I^2 18%) (**Figure 12**).

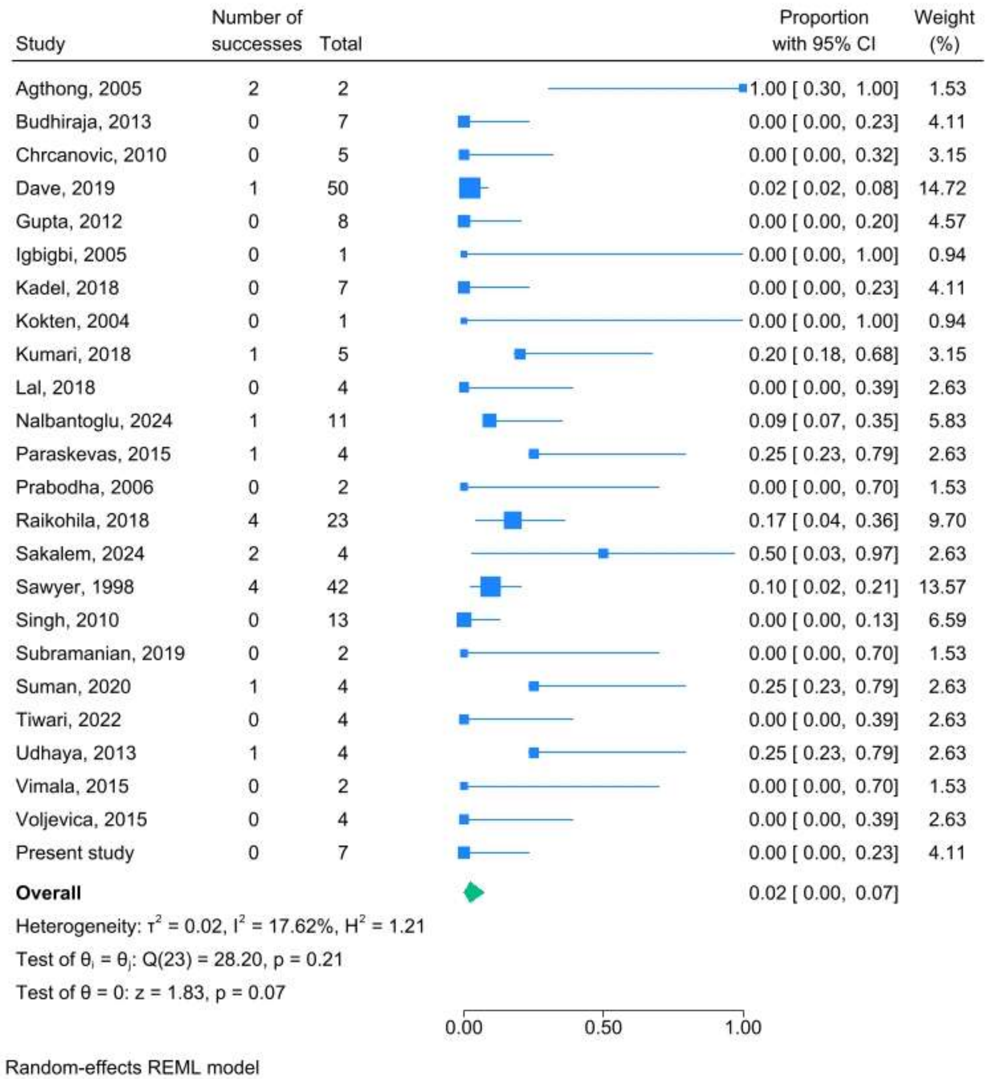

Figure 12. Bilateral AMF prevalence meta-analysis; the combined prevalence of AMF in dry mandibles is 2.1% (95% CI: 0.0% - 7.3%) with I^2 18%.

Oval shape was described in 37.0% of AMFs (95% CI: 5.1% - 75.8%; I^2 83%) (**Figure 13**).

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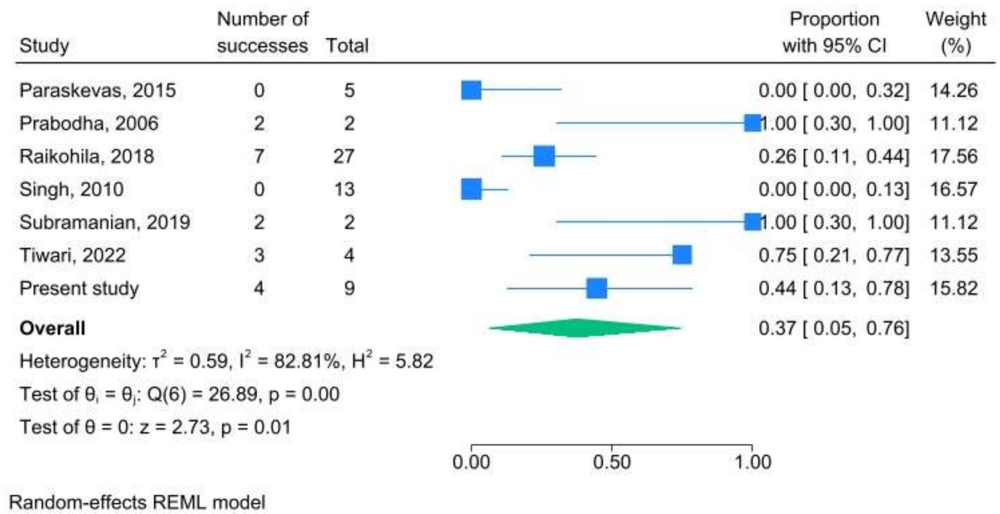

Figure 13. Oval-shaped AMF prevalence meta-analysis; the combined prevalence of AMF in dry mandibles is 37.3% (95% CI: 5.1% - 75.8%) with I^2 83%.

All but one study were close to the 95% confidence intervals of the Galbraith plot (**Figure 14**).

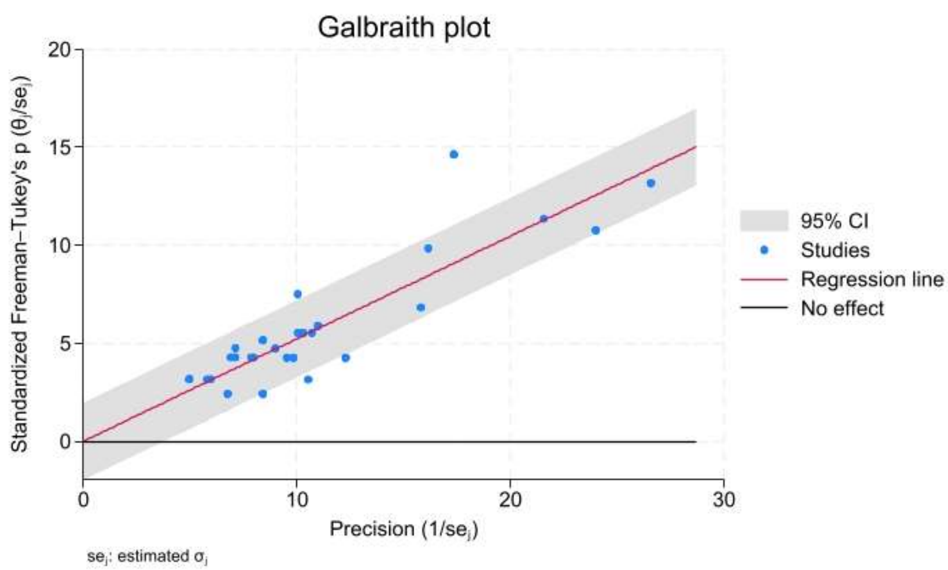

Figure 14. AMF prevalence meta-analysis; Galbraith plot.

No significant publication bias was detected; the funnel plot was symmetrical by visual inspection. Moreover, no additional study was imputed using the trim-and-fill method on either side (**Figure 15**); both Egger's and Begg's test yielded a non-significant result (p=0.914, and 0.234, respectively).

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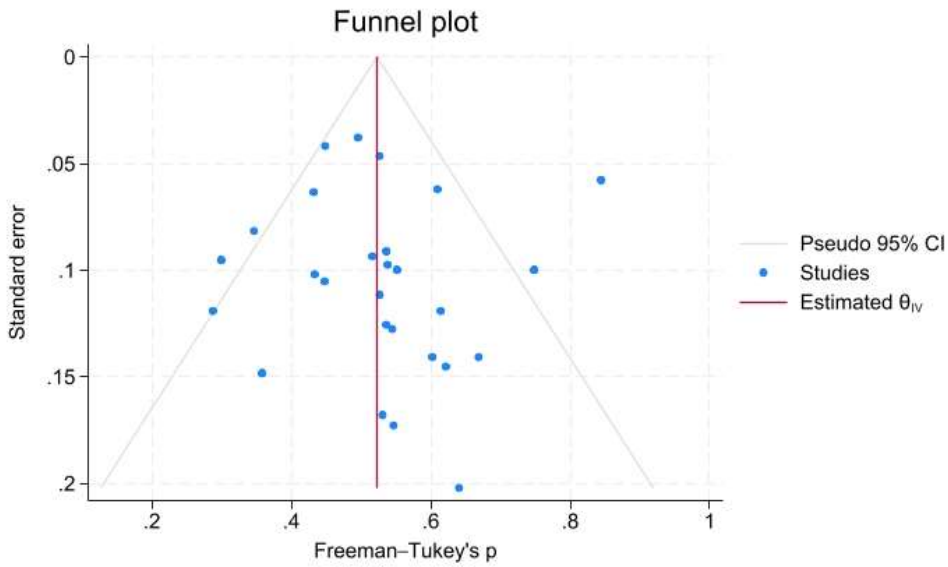

Figure 15. AMF prevalence meta-analysis; Funnel plot. Trim-and-fill analysis does not impute any studies on either side. Egger's p = 0.914; Begg's p = 0.234.

The leave-one-out sensitivity analysis revealed no critical effect on combined mean prevalence due to single publications (**Figure 16**).

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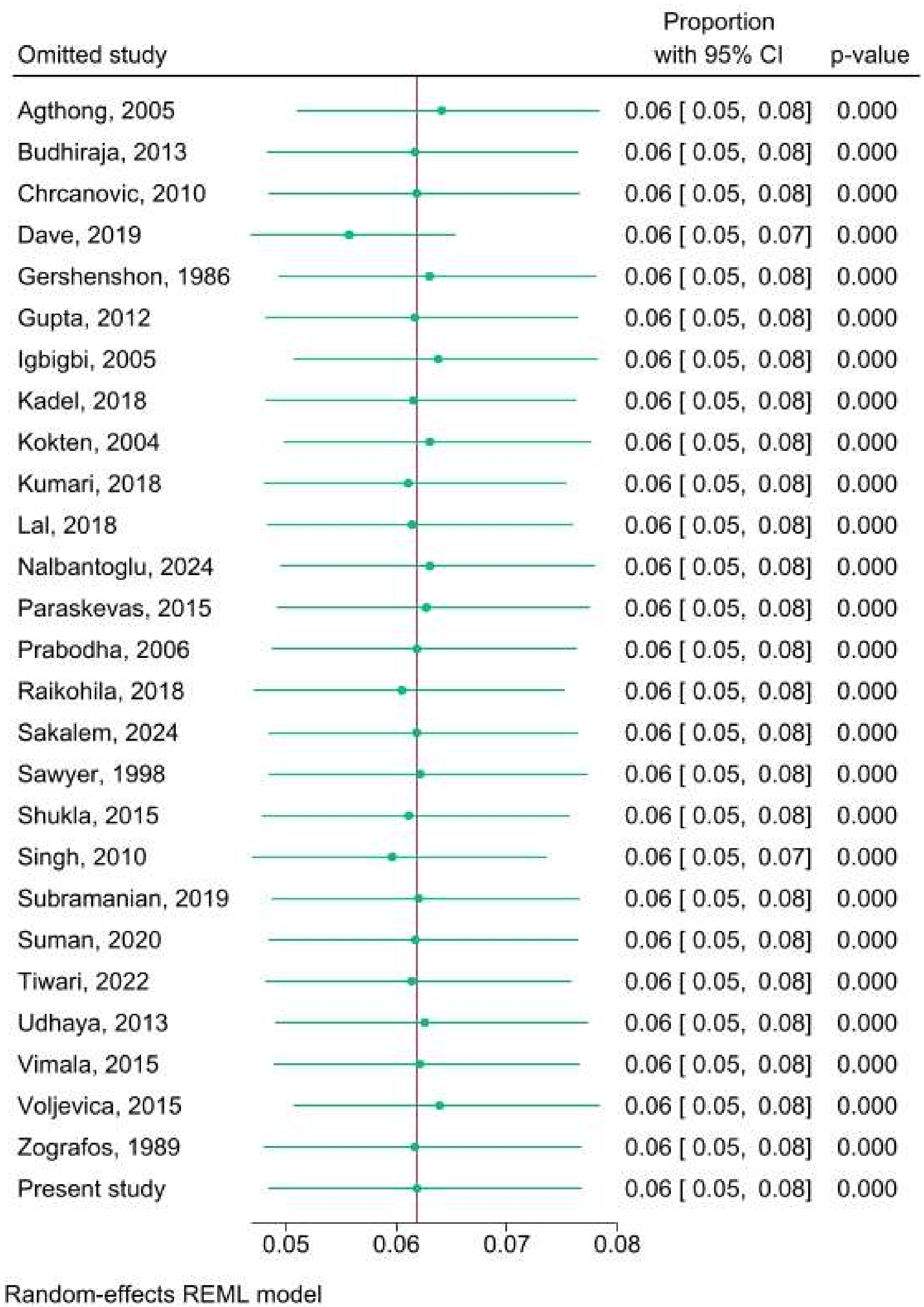

Figure 16. AMF prevalence meta-analysis; sensitivity analysis (leave-one-out analysis).

4. Discussion

This observational study investigates the location, shape, and dimensions of AMFs in dry adult human mandibles and, apart from the presentation of our own data, includes a systematic review and meta-analysis of worldwide data. Notably, this is the first meta-analysis focusing on AMF data obtained exclusively from dry mandibles. In contrast, three previously published meta-analyses primarily rely on CBCT data [41-43].

Our data is in keeping with the results of the consequent meta-analysis, thus rendering them credible and representative. Of note, we reported that the combined AMF prevalence is 6.1% (95%

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CI: 4.8% - 7.6%), and that there is no difference between right and left side. Moreover, AMFs were mostly rounded, while oval shape was described in 37.0% of cases; the combined mean AMF vertical axis was 1.18 ± 0.61 mm, and the combined mean distance from MF was 3.64 ± 2.29 mm. Lastly, AMFs were detected bilaterally in 2.1% of cases. The heterogeneity of our results, measured as I^2, ranged from unimportant to considerable, reaching 83% in case of AMF shape determination.

In this study, we assessed AMF locations by measuring distances from the AMFs to both the alveolar crest and the inferior border of the mandible. The latter measurement is considered more reliable, as it remains consistent regardless of whether the mandible is dentate or edentulous. In contrast, the distance between the AMF and the alveolar ridge can change due to resorption of the alveolar ridge with age [3].

The presence of AMF is a critical consideration in surgical procedures involving the mental region. These additional foramina house nerves and blood vessels that, if damaged during surgery, can result in complications such as lower lip numbness or bleeding. Consequently, understanding the location and content of AMFs is essential for planning and executing safe and effective surgical interventions. In their hallmark paper, Rahpeyma and Khajehahmadi have highlighted the impact of AMFs on the outcomes of various surgical procedures, including orthognathic, periapical, implant, inferior alveolar nerve repositioning, and trauma surgeries. This underscores the importance of incorporating AMF considerations into surgical planning to minimize complications and optimize patient outcomes [44].

The influence of AMFs on local anesthesia is another important aspect to consider. Their presence can affect the success of mental nerve blocks. If an AMF is located near the main mental foramen, a single anesthetic injection into the main foramen may suffice, as the anesthetic can diffuse into the AMF. However, if an AMF is located farther from the main foramen, an additional injection may be necessary to ensure effective anesthesia. Recognizing these anatomical variations allows dental professionals and anesthesiologists to tailor their techniques, ensuring patient comfort and procedural success.

The major strength of this study is its integration of primary data from the well-established osteological collection of the Anatomy Department at Democritus University of Thrace, Greece, with data from a systematic review and meta-analysis. To our knowledge, this is the first study of its kind. However, a certain limitation of the study is that the total heterogeneity, mostly attributable to ethnic-related variation, could not be further assessed, due to the lack of gender-specific information. Future research incorporating subgroup analyses or meta-regression could explore potential gender-related differences in AMF anatomy.

5. Conclusions

Dental surgeons must have a comprehensive understanding of the anatomical variations in the mental foramen (MF) and the potential presence of accessory mental foramina (AMFs). This knowledge is essential to prevent or mitigate the risk of postoperative complications such as pain, anesthesia, injury, and other adverse outcomes. By incorporating this anatomical insight into surgical and anesthetic planning, clinicians can enhance patient safety and procedural success.

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