Original Article

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Dentistry Section

Evaluation of the Anatomical Limit for Mandibular Arch Distalisation in Skeletal Class III Patients with Different Growth Patterns: A Systematic Review

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ABSTRACT

Introduction: Temporary Anchorage Devices (TADs) enable distalisation of the mandibular dentition in patients with mild to moderate Class III jaw bases. The extent of distalisation is influenced by the Mandibular Posterior Anatomical Limit (MPAL), which varies with growth patterns.

Aim: To evaluate and compare the MPAL across different growth patterns in skeletal Class III patients.

Materials and Methods: The present systematic review followed PRISMA 2020 guidelines and was registered in PROSPERO (CRD42024616501). A comprehensive search of PubMed, Web of Science, Embase, Scopus, Cochrane Library, Google Scholar, and OpenGrey was conducted from inception up to December 2024. Following the PICOS framework: (P) adult patients with skeletal Class III malocclusion and varying vertical growth patterns; (I) no intervention, grouping by growth pattern; (C) comparisons between normodivergent, hypodivergent, and hyperdivergent patterns; (O) MPAL measured on Cone Beam Computed Tomography (CBCT); (S) observational cross-sectional studies. Extracted data was used to study measurements of MPAL in different growth patterns included reference planes, reference point and reference levels; additional parameters were third molar status, sex distribution, and racial background. Risk of bias was assessed using the Critical Appraisal Checklist of the Joanna Briggs Institute (JBI).

Results: Out of 5117 studies 11 studies on class III malocclusion with varying growth patterns, used the mandibular occlusal plane as the reference. Nine studies used the Posterior Occlusal Plane (POL) as the reference line and the most lingual point of the second molar's distal root as the reference point; five measured at the subfurcation level and six at the sub-CEJ level.

Conclusion: In class III malocclusion, the MPAL distance decreases from the furcation to the apex, making apical distance critical during distalisation. The racial group of the subjects, third molar status, vertical pattern and skeletal sagittal pattern all had an impact on MPAL. Of the three development patterns, patients with hyperdivergent growth patterns have the smallest MPAL and the highest risk of cortical contact in molar distalisation, whereas those with hypodivergent growth patterns have the lowest risk.

Keywords: Anchorage devices, Malocclusion, Retromolar space

INTRODUCTION

Class III skeletal deformity is characterised by maxillary retrognathism, mandibular prognathism, or the concomitant presence of both skeletal discrepancies [1]. Class III malocclusion exhibits a variable prevalence worldwide, estimated between 3% and 26% depending on the population studied [2]. Clinically characterised by reverse overjet, mesio-occlusion of the molars, and a concave facial profile, Class III malocclusion can lead to significant functional limitations, aesthetic concerns, and psychosocial morbidity; consequently, its correction is a principal objective in contemporary orthodontic practice [1]. Recent advancements have revised the "envelope of discrepancy" concept to include TADs [3], which enable the correction of mild to moderate Class III malocclusion by distalisation of the mandibular dentition without the need for orthognathic surgery.

Much like any other movement in orthodontics, distalisation is also subjected to anatomical and physiological constraints. Three anatomical landmarks that has been described in the literature as the distal limit of the mandible are, the anterior border of the ramus [4-6], the alveolar bone housing that houses the inner and outer lingual cortexes of the mandibular body [7], and the superior border of inferior alveolar canal [8].

The MPAL has been shown to be influenced by race, gender, skeletal jaw base, growth pattern, and the presence of third molars, with skeletal jaw base and growth pattern being considered the most significant factors [7,9]. Since mandibular arch distalisation is a commonly used camouflage treatment for adult patients with Class III malocclusion [1,10-12], it becomes clinically relevant to assess the posterior anatomical limit that may affect distalisation of the mandibular dentition. MPAL is defined as the linear distance between the distal root of the mandibular second molar and the inner lingual cortical plate and serves as a critical parameter in determining the safety and feasibility of molar distalisation [7,13-15]. This anatomical limit is influenced by vertical growth patterns, classified as hypodivergent (horizontal growth pattern), normodivergent, or hyperdivergent (vertical growth pattern) [16]. These skeletal patterns affect mandibular morphology and can alter the posterior alveolar limit, thereby influencing the extent to which distalisation is possible [14,15,17-19].

Therefore, the present systematic review aimed to evaluate and compare the MPAL in skeletal Class III malocclusion cases with different growth patterns. The null hypothesis was that no difference exists in MPAL among vertical growth patterns in skeletal Class III patients.

MATERIALS AND METHODS

The present systematic review protocol was registered with PROSPERO before the review was conducted (registration number: CRD42024616501) and was in accordance with the PRISMA 2020 guidelines [20]. Study selection was based on the PICOS questions, that included the following components:

P- Population- Adult patients belonging to either normodivergent, hypodivergent or hyperdivergent growth pattern with class III malocclusion.

I- Intervention- No active intervention; grouping according to growth pattern.

C- Comparison- Comparing between normodivergent, hypodivergent, and hyperdivergent growth patterns.

O- Outcome- MPAL measured on CBCT.

S- Type of study- Observational cross-sectional CBCT study.

Inclusion and Exclusion criteria: Studies were included if they met the following criteria:

- Cross-sectional CBCT studies was chosen as they allow precise, three-dimensional assessment of the MPAL at a single time point, minimising confounding factors.
- Adult patients (≥18 years) with skeletal Class III malocclusion.
- Quantification of the amount of space required for distalisation.

Studies not in English were excluded. No case series, review, comments, conference abstracts or letters were included for this systematic review.

Information Source and Study Selection

Seven databases (Pubmed, Web of Science, Embase, Scopus, Cochrane Library, Google Scholar, and OpenGrey) were searched from their inception until 19 December 2024. The search strategy combined both MeSH terms and free-text keywords, and Boolean operators (AND, OR) were applied to refine sensitivity and specificity. The detailed search queries for each database are presented in [Table/Fig-1]. Additionally, the reference lists of the studies were identified and examined, as well as other relevant articles, to locate additional studies. Duplicates were removed using Ryaan software. On the basis of the inclusion and exclusion criteria, two researchers (AK,AK) independently evaluated published full texts, study titles, and abstracts.

Database Searched	Query	Number of Study
PubMed	(((molar[MeSH Terms]) OR (molar[Title/Abstract])) AND (distalisation[Title/Abstract] OR distalisation[Title/Abstract] OR distalise[Title/Abstract] OR distalise[Title/Abstract] OR distal[Title/Abstract] OR distally[Title/Abstract])) AND (cone beam computed tomography[Title/Abstract] OR CBCT[Title/Abstract])	454
Web of science	1. (TS=(molar)) OR ALL=(molar) 2. (ALL=(distalisation OR distalisation OR distalise OR distalise OR distal OR distally)) AND ALL=(cone beam computed tomography OR CBCT) 3. #1 AND #2	571
Scopus	(ALL (molar) AND ALL (distalisation OR distalisation OR distalise OR distalise OR distal OR distally) AND ALL ((“cone beam computed tomography”) OR (cbct))	2430
Cochrane	1. Molar 2. Distalisation OR distalisation OR distalise OR distalise OR distal OR distally 3. cone-beam computed tomography OR CBCT 4. #2 AND #3 5. #1 AND #4	81
Google Scholar	Allintitle: ((“molar”) AND (“distalisation” OR “distalisation” OR “distalise” OR “distalise” OR “distal” OR “distally”) OR (“cone beam computed tomography” OR “cbct”))	1161
Embase	1. Molar 2. (distalisation OR distalisation OR distalise OR distalise OR distal OR distally) AND ('cone beam computed tomography' OR cbct) 3. #1 AND #2	419
Open grey	(Molar) AND (distalisation OR distalisation OR distalise OR distalise OR distal OR distally) AND (cone beam computed tomography OR CBCT)	1

[Table/Fig-1]: Search strategy.

Risk of Bias Assessment

Study quality was appraised with the critical appraisal checklist of Joanna Briggs Institute (JBI) [21], which comprises eight domains rated as “yes,” “no,” “unclear,” or “not applicable.” Risk of bias was then evaluated per the Cochrane Handbook’s criteria, categorising each study as low, high, or unclear risk. A study was classified as having a low overall risk of bias if all criteria were rated ‘yes’, unclear if any criteria were rated as ‘unclear’, and high if any criteria were rated ‘no’. The bias level was determined by the percentage of ‘yes’ scores in each study. Studies with up to 49% ‘yes’ scores were categorised as high risk of bias, those with 50% to 69% ‘yes’ scores as moderate risk, and studies with over 70% ‘yes’ scores as low risk [22]. The assessment was performed independently and in duplicate by two authors (AK,AK), and any disagreements were resolved through discussion with the other authors.

Data Extraction And Synthesis

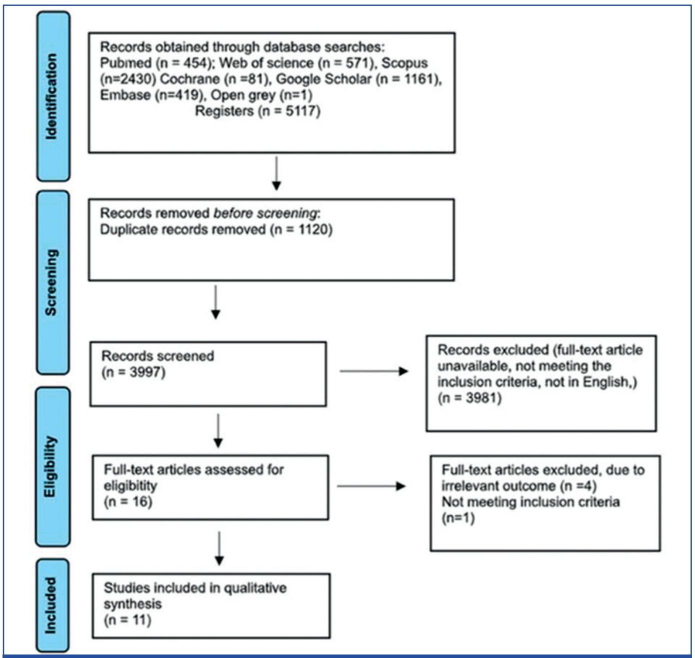
From the included studies, two reviewers (AK,AK) systematically extracted following information:

- Study details: first author, publication year.
- Population characteristics: total sample size, number of Class III patients, mean age, gender distribution, and racial/ethnic background.
- Skeletal and dental classifications: vertical facial growth type (hypodivergent, normodivergent, hyperdivergent), and third molar status.
- Methodological characteristics: reference planes, reference lines, and reference points used for MPAL assessment.
- Outcome measures: MPAL values at various measurement levels.

The extracted data were organised into summary tables to allow structured comparison of study characteristics and MPAL outcomes across different growth patterns.

RESULTS

Selection of study: Various databases were searched, and 11 studies were included as per PRISMA [Table/Fig-2].



[Table/Fig-2]: PRISMA flowchart.

Characteristics of the included studies: All participants were adults (18-30 years) of Asian (Japanese, Korean, and Chinese) or Egyptian descent. Eleven studies examined individuals with class III malocclusion and different growth patterns, with or without third molars. Each study used the mandibular occlusal plane as the reference plane, with nine studies employing the POL as the reference line and the most lingual point of the distal root of the second molar as the reference point. Of these, five studies measured at the subfurcation level, while six studies measured at the sub-CEJ level along the POL. [Table/Fig-3,4] [8,13-15,17,18,23-27].

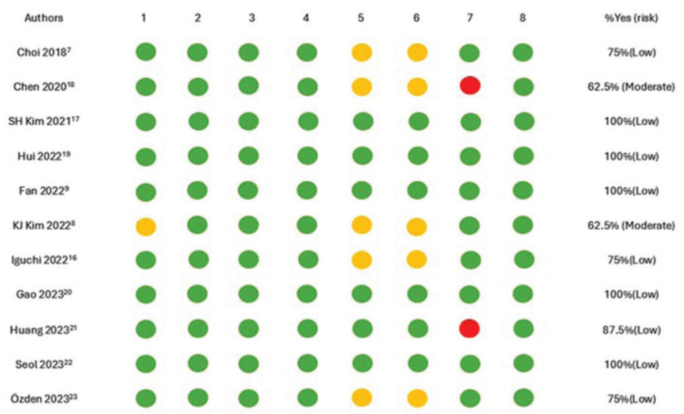
Risk of bias in the included studies: The quality assessment results of the included studies are presented in the [Table/Fig-5]. Green, red, and yellow dots represent 'yes', 'no', and 'unclear' scores, respectively, indicating low, high, and unclear risks of bias.

Author and year	Population (Total, Class III)	Race	Age (years) (Class III patients mean age)	Gender	Sagittal pattern	Vertical facial type	Third molar space
Choi YT et al., 2018 [8]	110, 61	Korean	26.4±4.4	M= 22 F=39	Class I and III	Normodivergent	Present or absent allowed
Chen CL et al., 2020 [15]	67, 25	Chinese	23.9±2.72	M=34 F=33	Class I, II, III	Unspecified	Present or absent allowed
Kim SH et al., 2021 [14]	48, 16	Korean	22.8±3.1	M=34 F=14	Class III	All three types	Present or absent allowed
Kim KJ et al., 2022 [17]	114, 38	Korean	22±3.0	M=19 F=19	All	All three types	unspecified
Hui VLZ et al., 2022 [25]	120, 60	Chinese	23.6±3.9	M=30 F=30	Class II and III	All three types	Present or absent allowed
Fan Z et al., 2022 [18]	120, 36	Chinese	21.50±3.30	M=16 F=20	All	Normodivergent	Present or absent allowed
Gao Q et al., 2022 [23]	105, 35	Chinese	24.09±3.87	M=8 F=27	All	Normodivergent	Present or absent allowed
Iguchi K et al., 2022 [13]	230, 50	Japanese Egyptians Koreans	>18	Unspecified	Class I, II, III	Unspecified	unspecified
Huang Y et al., 2023 [26]	103, 51	Chinese	28.39	M=52 F=51	Class I and III	Normodivergent and hypodivergent	Present only
Samet Özden et al., 2023 [24]	120, 60	Unspecified	18-30 (18.5-19.4)	M= 32 F= 28	Class I and III	Normodivergent and hyperdivergent	Present or absent allowed
Seol J et al., 2023 [27]	118, 60	Korean	22.2±4.5	M=17 F=13	Class I and III	All three types	Present or absent allowed

[Table/Fig-3]: Study Characteristics [8,13-15,17,18,23-27].

Author and year	Reference planes; reference lines	Reference points	Reference levels	Amount of retromolar space at different levels (in mm) (mean±SD) (Reference levels)
Choi YT et al., 2018 [8]	OP; SL (POL)	Shortest distance between lingual point on distal root of 2nd molar to inner cortex	Furcation - 0 level, 2,4,6 mm apical	(At 6-plane) Sagittal= 1.4±1.5 POL=2.7±2.8
Chen CL et al., 2020 [15]	OP; Unspecified	Most distal part of root	0=crest, 2,4,6,8,10,12 mm	(At 12-plane) 1.04±1.66
Kim SH et al., 2021 [14]	OP; POL	Shortest distance between lingual point on distal root of 2nd molar to inner cortex	4, 6, 8 mm from CEJ	(At 8-plane) POL Hypodivergent = 4.36±2.84 Normodivergent = 3.32±2.21 Hyperdivergent =1.79±1.19
Kim KJ et al., 2022 [17]	Planes perpendicular to second molar tooth axes; furcation line - connecting the furcation of the molars	Only said the shortest distance	L7 furcation, middle,apex	(At L7 apex) Hypodivergent = 3.63±2.79 Normodivergent = 5.89±3.67 Hyperdivergent = 4.81±4.14
Hui VLZ et al., 2022 [25]	MSP, FP, OP; POL	Distal root of 2nd molar to inner cortex	Laxial 0- CEJ, 3, 6, 9 mm; Lcoronal 0- distal most point on the distal root,1.5,3,4.5,6,7.5,9 mm	(At 9-plane) POL Hypodivergent = 3.42±2.31 Normodivergent = 3.13±1.84 Hyperdivergent = 1.94±1.41
Fan Z et al., 2022 [18]	OP, MSP; SL, CL(POL)	Most lingual to inner and outer cortex of mandibular body	0 plane- furcation, 2,4,6 mm	(At 6-plane) Sagittal= 2.49±1.13 POL= 3.87±1.66
Gao Q et al., 2022 [23]	OP, MSP; SL,CL	Most lingual to inner and outer cortex	Plane 0- furcation, 2,4,6 mm	(At 6-plane) Sagittal= 2.96±2.04 POL= 4.94±3.30
Iguchi K et al., 2022 [13]	OP, MSP; SL,CL	Mandibular right second molar to the mandibular cortex of the lingual bone	0=furcation, 2,4,6 mm	(At -6plane) Sagittal= 3.2±1.4 POL= 5.02±2.38
Huang Y et al., 2023 [26]	OP, WP, FH; WP, POL	Distal root to lingual cortical bone	1-2 mm: crown level 3-5 mm root level	(At L5) 4.23±1.77
Samet Özden et al., 2023 [24]	OP; POL	Shortest distance between lingual point on distal root of 2nd molar to inner and outer cortex	CEJ, 2, 4 , 6, 8, 10 mm	(At 10-plane)POL Normodivergent = 2.2±2.3 Hyperdivergent = 2.4±2.4
Seol J et al., 2023 [27]	OP,CP; the shortest line between the root of second molar and buccolingual bone width perpendicular to the lingual plate of bone	Most lingual to inner and outer cortex	2, 4, 6, 8 mm from CEJ	(At 11-plane) 11.14±2.92

[Table/Fig-4]: Summary of Results [8,13-15,17,18,23-27]
M:Male, F:Female, POL: Posterior Occlusal plane, OP: Occlusal plane,
MSP: midsagittal plane, CP: Cuspal Plane, FP: Frontal Plane, WP: Wala Ridge Line,
FHP: Frankfort horizontal plane, SL: Sagittal line, CL: Cuspal line, FR: furcation, A: Apex



[Table/Fig-5]: Risk of bias in the included studies.

Two studies were considered to have an unclear risk of bias due to the lack of a description of the third molars status in the inclusion criteria [13,17]. Additionally, five studies were also categorised with an unclear risk of bias because they did not identify or address confounding factors related to the initial third molars status or vertical pattern. Furthermore, two studies were classified as having a high risk of bias due to the absence of an accurate reference line or precise measurement levels.

Synthesis of results: The studies utilised various reference planes to determine the available minimum distance for molar distalisation. Most studies found that this distance decreased as the measurement plane moved closer to the root apex. The subfurcation-6 mm [8,13,18,23] and subCEJ-10 mm [15,24] planes were the most commonly employed horizontal reference planes at the apex in the studies. When MPAL was evaluated across different growth patterns, most studies found that hypodivergent patients exhibited the greatest MPAL, normodivergent patients had intermediate values, and hyperdivergent patients had the smallest distances [14,25,26]. However, one study reported larger MPAL in normodivergent than in hypodivergent subjects [17], and another found minimal differences between vertical types [24]. These patterns were consistent regardless of whether measurements were taken at subfurcation-6 mm or subCEJ-10 mm levels, with both showing reduced MPAL closer to the root apex.

DISCUSSION

Before the popularisation of Three-dimensional (3D) imaging, panoramic radiographs and lateral cephalograms were used to assess the posterior space available for distalisation. According to the presumption of these studies anterior border of ramus was the distal anatomic limit for distalisation of the mandibular arch [4-6]. However, 2-dimensional imaging lack the ability to completely represent the 3-dimensional morphological structures of the mandible. CBCT is a more reliable technique to assess the 3D structure of the mandible. A study conducted by Kim SJ et al., in 2014 established the superiority of CBCT, also highlighted a critical clinical finding that the distal limit of mandible was the lingual cortical plate [7]. Furthermore, Choi YT et al., in 2018 noted that the superior border of the inferior alveolar canal may impede distalisation at the second molar's apex, thereby serving as an anatomical limit [8].

The amount of space available for distalising the mandibular dentition, is known to be influenced by a combination of factors, among which the skeletal growth pattern and jaw relation of the individual is paramount [7,9]. In addition to the growth pattern, other factors such as the patient's age, racial background, and the presence of third molars further influence the amount of retromolar space.

According to the study conducted by Iguchi et al., Egyptians had a greater MPAL as compared to Asians [13]. Kim SH et al., [14] and Kim KJ et al., [17] reported that MPAL was greater in males when compared to females [14,17]. It could be related to sexual dimorphism in mandibular morphology, with males generally exhibiting greater mandibular body length, thicker lingual cortical bone, and variations in skeletal anteroposterior and vertical patterns [13]. Chen, Hui, Gao and Huang found no significant difference in MPAL distance according to the gender [15,23,25,26].

Choi YT et al., Seol J et al., Samet Ozden et al., and Rajamanickam et al., reported that patients with class III malocclusion had greater MPAL distance as compared to class I patients [8,24,27,28]. Kim SH et al., Fan J et al., and Gao Q et al., reported largest MPAL in Class III, followed by Class I and least was seen in Class II [17,18,23]. In contrast study conducted by Chen CL et al., found that Class II patients had the maximum MPAL distance followed by Class I and least was found in Class III [15]. These differences may be related to variations in mandibular morphology and skeletal relationships among the classes, Class III mandibles often have longer bodies and more lingually inclined molars, providing increased retromolar space, whereas Class II mandibles may have a more posteriorly positioned ramus limiting MPAL. Gao Q et al., classified individuals into groups with impacted and erupted molars and discovered that the MPAL was longer in the erupted group [23]. Huang Y et. al., discovered that when they moved from lower to higher categories, the MPAL significantly decreased for both the depth and ramus relationship classifications, according to the Pell and Gregory classification [26]. Additionally, the MPAL showed a notable upward trend when the mesial tilt degree dropped [13]. The buccolingual angle-based categorisation criteria did not reveal any statistically significant differences. Furthermore, Gao Q et al., found that individuals with vertically impacted or regularly erupting third molar had MPAL that were noticeably longer than those with absent, horizontally impacted, or mesially impacted third molars, likely due to the preservation of alveolar bone volume in the presence of normally oriented third molars. [23].

In terms of patient inclusion before measurement, one study did not consider the possible influence of mandibular third molars status on the outcome [13]. The potential bias associated with the presence of mandibular third molars could have influenced the accuracy of their findings. Similarly, some studies did not mention whether there were any differences in the distribution of patients with or without third molar among their respective groups, before measurements were taken [8,13,17].

Mandibular occlusal plane and the POL reference line were most used in the studies [8,13,14,18,23-26], only one study employed the WALA ridge plane and WALA ridge line [26]. The sagittal reference line was preferred because it is more precise and anatomically stable making it a reliable reference points. It is important to acknowledge that mandibular molars often distalise along the POL, making the retromolar space along the POL particularly significant for clinicians.

For reference points, several studies selected the most lingual point on the distal root of the lower second molar [8,14,18,23,24,26,27], but some studies did not specify a particular reference point [13,15,25]. Because these studies did not provide clear reference points, measurement errors may have occurred. Nonetheless, all studies demonstrated good intra-observer reliability.

Choi et al., [8] measured MPAL in Class I and Class III normodivergent subjects and found that, at the level of the furcation and up to 4 mm below the furcation, the mean distance along the POL was greater in subjects with Class III malocclusion compared to Class I. However, this distance decreased at 6 mm sub-furcation. This pattern was attributed to the mandibular morphology in Class III malocclusion patients, where the mandible typically exhibits a more divergent "V" shape at the apex than at the furcation. In these cases, the mandibular body is often lingually inclined, and the ramus is positioned more laterally.

Previous clinical reports indicate that the amount of molar distalisation performed in Class III malocclusion was about 6 mm [10-12,29,30]. This measurement is comparable to the MPAL distance assessed at the furcation level in studies conducted by Choi, Fan, and Gao, which reported values of 6±3.3 mm, 6.19±2.15 mm, 7.98±3.1 mm respectively [8,18,23]. These findings suggest that greater distalisation occurred at crown level as compared to the root, which can be attributed to the force vector passing above the centre of resistance of the mandibular dentition. This results in a tipping movement of the mandibular molars distally. This mechanical approach is particularly beneficial for patients with mesially tipped molars, as it facilitates uprighting of the molars to achieve proper occlusion.

According to most studies, MPAL decreases towards the apex. However, two studies Kim KJ et al., [17] and Gao et al., [23] reported exceptions to this trend, where MPAL did not follow the typical decrease towards the root apex. This discrepancy was attributed to variations in the sample populations used in these studies. Therefore, the apical region should be the primary focus when considering distalisation as a treatment option.

Three studies compared MPAL sub-CEJ for different growth patterns, all found that hypodivergent group showed the largest MPAL distance followed by normodivergent and least was found in hyperdivergent group [14,24,25]. This can be attributed to difference in mandibular morphology between the different growth patterns. Hypodivergent patterns involve stronger musculature producing stronger masticatory forces, which lead to a longer mandibular body and greater bone apposition in the lingual cortical area of the mandible [14]. Throckmorton's findings suggest that a larger gonial angle results in a reduced mechanical advantage for the mandibular elevator muscles. This leads to smaller functional loads, which produce less strain on the mandible, resulting in decreased bone apposition and increased endosteal resorption, ultimately resulting in a smaller bone architecture [16]. Kim SH et al., also suggests that the structure of the mandible, specifically the retromolar region, may be partially governed by genetic predispositions linked to an individual's vertical facial pattern (such as a longer or shorter face) [14]. These genetic factors could contribute to variations in the retromolar space, alongside other elements like growth patterns, masticatory forces, and mandibular plane angles.

This systematic review demonstrates that MPAL is influenced by multiple factors, with vertical growth pattern, sagittal skeletal patterns, and third molar status being the most significant. These findings reject the null hypothesis, as MPAL varied consistently among growth patterns, smallest in hyperdivergent and largest in hypodivergent patients. In Class III malocclusion, where distalisation is a common camouflage approach, careful pre-treatment evaluation of MPAL is critical to determine the realistic extent for distalisation. Clinically, MPAL assessment with CBCT is essential before planning mandibular distalisation in Class III patients. Reduced MPAL in hyperdivergent individuals may limit the amount of safe distalisation and increase the risk of cortical contact, whereas hypodivergent patients generally present with greater anatomical allowance. Individualised evaluation of these factors can guide treatment planning and improve the predictability of camouflage therapy.

Limitation(s)

There were several restrictions on this systematic review. The impact of the confounding variables such as gender, age, ethnicity, third molar presence or impaction status, and variations in mandibular morphology, on the MPAL distance was not clearly shown by all the included studies. To have a thorough knowledge of mandibular molar distalisation, future studies should examine possible contributory factors that could affect the MPAL. Other anatomical limitations that may restrict molar distalisation must also be considered. These include the size, concavity, and location of the submandibular fossa; the existence of the superior border of inferior alveolar nerve canal; thick soft tissue resistance; and lack of attached gingiva. A meta-analysis was not conducted due to substantial clinical and methodological heterogeneity among the included studies, including differences in reference planes, reference points, reference levels, and growth pattern categorisation. These variations limited the feasibility and validity of quantitative pooling. For this reason, more three-dimensional morphometric research with standard outcome reporting is required in order to produce high-quality findings.

CONCLUSION(S)

The present systematic review emphasises the significance of 3D imaging prior to distalisation and recommends focusing on the apical region when planning the procedure. The review also indicates that individuals with a hyperdivergent growth pattern have the smallest MPAL and the highest risk of cortex contact during molar distalisation, while the lowest risk is seen in those with a hypodivergent growth pattern. Therefore, in hyperdivergent Class III patients, the MPAL should be carefully assessed before proceeding with distalisation.

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