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EVALUATE MANDIBULAR RETROMOLAR SPACE BY USING CONE BEAM COMPUTED TOMOGRAPHY: A SYSTEMATIC REVIEW

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Abstract :

Objective of the study: 1. To measure retromolar space in all sagittal malocclusion (Skeletal Class I, Class II, Class III) patients by using cone beam computed tomography 2. To measure accurate retromolar space in all divergent growth pattern (Hypodivergent Growth pattern, Normodivergent Growth pattern, Hyperdivergent Growth Pattern by using cone beam computed tomography.

Material & Methods: Population of aged 18- 40 years taken of various sagittal malocclusion of skeletal class I, II, III & Vertical facial types of hypodivergent, Normodivergent, Hyper divergent growth patterns. PubMed, Google scholar, Science direct search engines taken to retrieve studies.

Results: Results showed that Skeletal Class III malocclusion has more retromolar space than Skeletal Class I, Skeletal Class II malocclusion. Hypodivergent growth patterns has more retromolar space than Normodivergent growth patterns

Conclusion: Skeletal Class III malocclusion & Hypodivergent growth pattern had more retromolar space.

Index Terms - Retromolar space, Cone beam computed tomography, Sagittal skeletal malocclusion, vertical face types

I. INTRODUCTION

Key to success & stability of mandibular molar distalization depends on the availability of retromolar space.[1] Maintaining retromolar space minimize risk of potential damage to adjacent molar root & alveolar bone.[2] Availability of retromolar space helps in correction of dental Class III malocclusion,[3] to relieve crowding in anterior and middle dental arch[4] to place ramal plates.

The concept of retromolar space analysis evolved from Merri-field's viewpoint of total space analysis.[4] The boundaries of retromolar space are cortical layer of alveolar bone[5] & anterior border of ramus of Mandible.[6] Anatomically Retromolar space defined as the distance between the distal contact point of the 2nd molar & junction of the anterior border of the ramus with the body of the mandible.[3]

In previous times, initially thought anatomically limits of mandibular arch thought to be anterior border of ramus of mandible.[7–9] However, studies with CBCT reported that anatomical limits of mandibular posterior anatomic limit were, a bone limitation of mandible was lingual cortex of mandibular body. Hence got the great importance to retromolar space with Cone beam computed tomography.

Some limited conducted on lateral cephalogram which had limitation of image error & reduction of available retromolar space than original anatomic given pathway to Cone beam computed tomography studies.

The primary aim of this systematic review to measure accurate retromolar space in sagittal skeletal malocclusion (Skeletal Class I, Class II, Class III) patients by using cone beam computed tomography. Secondary aim to measure accurate retromolar space in all divergent growth pattern (Hypodivergent, Normodivergent, Hyperdivergent growth Patterns by using cone beam computed tomography.

II. NEED OF THE STUDY.

The purpose & need of this systematic review to quantitatively measure retromolar space with cone beam computed tomography in sagittal skeletal malocclusion & vertical grower patients.

III. MATERIAL AND METHODOLOGY:

3.1. Population and Sample: Population of age between 18-40 years of all types of malocclusion i.e. Skeletal Class I,

Skeletal Class II malocclusion, Skeletal Class III malocclusion included. All types of vertical faces i.e., Normodivergent, Hypodivergent, Hyperdivergent growth pattern taken for measurement of retromolar space.

3.2 Data and Sources of Data: Data obtained from past to mid of February 2024. Search engine include Google scholar, PubMed, Science direct, Cochrane.

3.3 Framework for conduct of this study

Table 1: PICO format for current study

Population	Population of age between 18-40 years of all types of races
Intervention	To measure retromolar space between various Sagittal malocclusion (Skeletal Class I, Skeletal Class II, Skeletal Class III) & to measure retromolar space between various divergent growth pattern (Hypodivergent, Normodivergent, Hyperdivergent)
Control group	Comparison between sagittal malocclusion groups & comparison between vertical face growers
Outcome	Measure the Retromolar space by using Cone Beam Computed Tomography tool

Malocclusion for this study include Skeletal Class I, Skeletal Class II, Skeletal Class III malocclusion patients & Hypodivergent, Hyperdivergent growth pattern, Normodivergent growth pattern. All studies of Prospective, Retrospective, Case-control, cross-sectional studies, randomized and controlled clinical trials. All case reports, all animal studies, all systematic review cases excluded.

3.4 Methodology of study

Inclusive criteria of study (1) All population with age range of 18 years to 40 years (2) Crowding of mandibular arch < 5 mm (3) Single or combination of malocclusion cases (Skeletal Class I malocclusion (ANB angle 1^0 - 4^0), Skeletal Class II malocclusion (ANB angle > 4^0), Skeletal Class III malocclusion (ANB angle Less than or Equal 1^0) included in this study (4) Healthy periodontal status (5) Hypodivergent growth Pattern cases (SN-MP angle <27^0), Normodivergent Growth pattern (SN-MP angle 27^0-37^0), Hyperdivergent Growth pattern (SN-MP angle >37^0). Exclusion criteria include (1) History of Orthodontic treatment / Orthopedic / or/ Orthognathic treated case (2) Missing Teeth excluding 3rd molars (3) Skeletal Deviation <4 mm deviation of mandible (Gross skeletal Asymmetry Cases) (4) All Congenital cranio-facial anomalies cases like Cleft Lip & Palate etc. (5) All syndromic cases (6)Prosthetic rehabilitation of Molar (7) Periodontally compromised cases with Bony defect (8) Root anomalies of mandibular 2nd molars (9) Presence of cyst or tumors, fracturs in mandible. Search strategy was mentioned for this study mentioned in Table 2. Included & excluded studies mentioned in Table 3,4 respectively.

Table 2. Search Strategy for this study

S. No	Search Engine	Keywords used in combinations	No. Of articles retrieved
1	Google scholar	Retromolar space/ Mandibular retromolar space/third molar eruption space/ mandibular anatomic limit	705
2	Pubmed		323
3	Science direct		681
4	Cohrane	Cone beam computed tomography/ CBCT/ 3-d image	3
5	ILLAC data base	Vertical growers/ Divergent growth pattern/ Divergent growth/ Vertical face Skeletal malocclusion/ Sagittal skeletal malocclusion/	193
Total			1905

Figure 1. PRISMA FLOW chart mentioned.

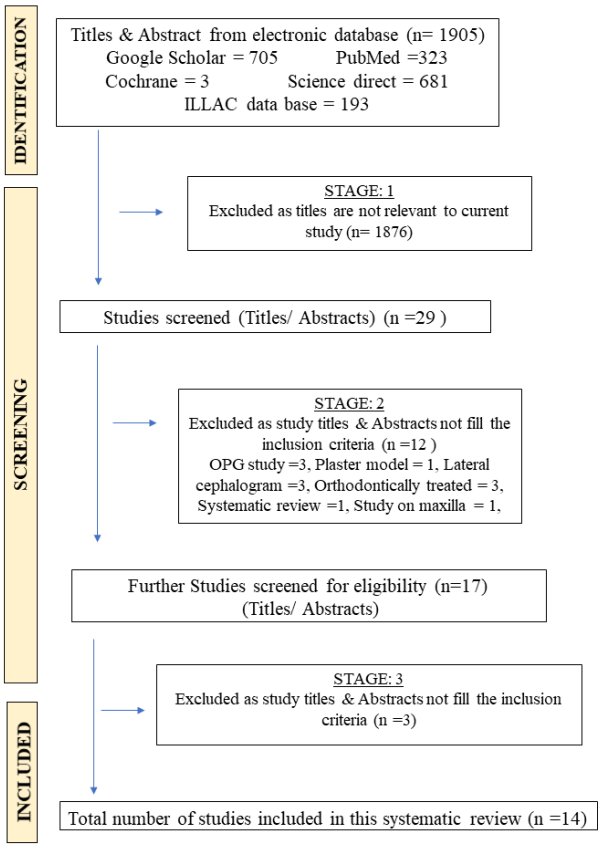

FIGURE 1. PRISMA FLOW CHART

Table 3. Studies included in this systematic review

S. No	Year, Author	Study design
1	Kim et al.[6] 2014	Retrospective study
2	Choi et al.[3] 2018	Retrospective study
3	Zhao et al.[2] 2020	Prospective study
4	Kim et al.[10] 2021	Retrospective study
5	Aoun et al.[11] 2022	Retrospective study
6	Guo et al.[12] 2022	Prospective study
7	Hui et al.[13] 2022	Cross-sectional retrospective study
8	Kim et al.[14] 2022	Prospective study
9	Huang et al.[5] 2022	Prospective study
10	Fan et al.[1] 2022	Prospective study
11	Ozden et al.[15] 2022	Retrospective study
12	Rajamanickam & Sundari[16] 2023	Prospective study
13	Huang et al.[5] 2023	Retrospective study
14	Seol et al.[17] 2023	Retrospective study

Table 4. Reason for Exclusion study in this systematic review

S. No	Author & Year	Reason for exclusion of study
1	Hattab et al.[18] 1999, Mollaoglu et al.[19] 2002, Uthman et al.[20] 2007, Alhaija[21] et al. 2010, Zelic et al.[22] 2013, Jakovljevic et al.[23] 2014	Orthopantomogram study (2, 3, 6, 7, 8, 9)
2	Richardson et al.[24] 1977, Alhaija et al.[21] 2011, Jakovljevic et al. [23]2014, Yeon et al.[25] 2021	Lateral cephalogram study (1,7,9,13)
3	Richardson et al.[24] 1977	Plaster model study (1)
4	Artun et al.[26] 2005, Behbehani et al.[27] 2006, Yeon et al.[25] 2021	Orthodontically treated case (4, 5, 13)
5	Behbehani et al.[27] 2006, Sisman et al.[28] 2015, Nookala et al.[29] 2023	No quantitative measurement of retromolar space (5, 10, 14)
6	Bayome et al.[30] 2021	Systematic review (11)
7	Liu et al.[31] 2021	Study of maxilla

Table 5. Material and methodology in this study

S. No	Author, Year	Design of study	Material & Methodology (Total, Males, Females, Malocclusion), Tool used	Reference line for measurement of Mandibular Retromolar space	Result & Conclusion
1	Kim et al.[6] 2014	Retrospective study	Total – 34 adults (68 mandibular 2nd molar molars) Total sample sub divided in to Molar Contact group (n= (molar root is in contact with Cortical bone) group & Non- contact group (Lower 2nd molar not in contact with Cortical bone) Tool – CBCT	Mandibular occlusal plane	Posterior available space is limited in Skeletal Class I Normodivergent growth pattern Posterior available space was smaller at the root level than that of crown level, due to limitation of lingual cortex of mandibular body
2	Choi et al.[3] 2018	Retrospective study	Total sample – 110 of Skeletal Class I, Skeletal Class III malocclusion case Skeletal Class I malocclusion 49 patients (Male were 18, female were 31) & Mean age 27.7 ± 9.5 years Skeletal Class IIII malocclusion 61 patients (Male were 22, female were 39) & Mean age was 26.4 ± 4.4 years	Mandibular occlusal plane mesiobuccal cusp of 1st lower molar & central incisor	The available space availability affected by age, sex, and skeletal & dental patterns. Skeletal class III malocclusion had greater retromolar space than Skeletal Class I malocclusion
3	Zhao et al.[2] 2020	Prospective study	Total sample – 123 Hypodivergent, Normodivergent, Hyperdivergent growth pattern od all Skeletal Class I malocclusion Age range 20-40 years Hypodivergent growth pattern case 41 patient with mean age of 24.00 ± 3.87years, mean mandibular plane angle 23.11 ± 3.10^0 (Males – 10, females – 31) Normodivergent growth pattern case 41 patient with mean age of 23.39 ± 2.79 years, mean mandibular plane angle 32.26 ± 2.70^0 (Males – 9, females – 32) Hyperdivergent growth pattern case 41 patient with mean age of 23.46 ± 3.98years, mean mandibular plane angle 41.36 ± 3.38^0 (Males – 7, females – 34)	The midsagittal reference (MSR) plane constructed using the Crista Galli, Anterior Nasal Spine, Opisthion	Skeletal Class I Hyperdivergent growth pattern had smallest retromolar space than normodivergent, Hypodivergent growth pattern
4	Kim et al.[10] 2021	Retrospective study	Total sample – 48 Hypodivergent, Normodivergent, Hyperdivergent growth pattern Males were 34 & Females were 14 patients Hypodivergent growth pattern case 16 patient with mean age of 22.5 ± 1.9 years, mean mandibular plane angle 25.3 ± 3.3^0 (Males – 12, females – 4) Normodivergent growth pattern case 16 patient with mean age of 22.9 ± 3.6 years, mean mandibular plane angle 33.0 ± 1.8^0 (Males – 11, females – 5) Hyperdivergent growth pattern case 16 patient with mean age of 23.1 ± 3.7 years, mean mandibular plane angle 39.8 ± 2.4^0 (Males – 11, females – 5)	Posterior occlusal line passing buccal aspects of 1st & 2nd molars	Shorter retromolar space in hyperdivergent growth pattern than in Normodivergent growth pattern patient Limited retromolar space available with female hyperdivergent growth pattern

5	Aoun et al.[11] 2022	Retrospective study	Total sample – 32 CBCT cases Males were 12 & females were 20 patients Mean age of study 20.97 ± 2.152 years (age range of 18 -25 years) Tool:- CBCT derived Orthopantomogram Tool – CBCT derived Orthopantomogram & CBCT derived Orthopantomogram	1. Occlusal plane line passing through lower molar and premolars 2. Tangent plane: - distal surface of mandibular 2nd molar & perpendicular to occlusal plane	CBCT derived orthopantomogram shown larger retromolar space due adopted techniques
6	Guo et al.[12] 2022	Prospective study	Total 186 patients categorized in to different status of 3rd molar analysed depth of 2mm, 4mm, 6mm,8mm, 10mm from Cemento-enamel junction	Parallel to Occlusal plane	No significant gender difference in retromolar space availability Patient with vertical impaction & normal eruption of lower wisdom tooth have larger retromolar space Different status of lower wisdom teeth effects the retromolar space availability
7	Hui et al.[13] 2022	Cross-sectional retrospective study	Total sample -120 CBCT Skeletal Class II malocclusion of 60 patients (30 Male + 30 Female) with age range of 18 -35 years Skeletal Class III malocclusion of 60 patients (30 Male + 30 females with age range of 18 -35 years	Mandibular occlusal plane passing Between central incisor & 2nd molar	Limit of retromolar space at coronal area is observed in Skeletal class II malocclusion Limit of retromolar space at Apical level in Skeletal Class III malocclusion
8	Kim et al.[14] 2022	Prospective study	Total sample – 114 patients with mean age 22 ± 3.0 years age range of 18 years to 29 years	Reference plane Parallel to Occlusal plane and perpendicular to lower 2nd molar tooth	Posterior retromolar space greater in Males than females in mandibular arch Normodivergent growth pattern has greater retromolar space than hypodivergent and Hyperdivergent growth pattern
9	Huang et al.[5] 2022	Prospective study	Total sample size – 103 patients in which 52 male + 51 Female with mean age of 28.39 years All 206 distal to 2nd lower 2nd molar retromolar space evaluated Age range of 18 - 40 years	Mandibular occlusal plane	Retromolar space at is higher at crown level and Minimum at root area
10	Fan et al.[1] 2022	Prospective study	Total sample – 120 all Normodivergent growth pattern patients Skeletal Class I 48 patient (17 Males + 31 Female) with mean age of 22.56 ± 3.31 years, mean ANB angle 2.64 ± 0.96 years Skeletal Class II 36 patient (12 Male + 24 Female) with mean age of 22.19 ± 3.92 years, mean ANB angle 6.04 ± 1.13 years Skeletal Class III 36 patient (16 Male + 20 Female) with mean age of 21.50 ± 3.30 years, mean ANB angle -2.34 ± 2.23 years Tool – CBCT	1. Mandibular occlusal plane connecting mesio-buccal cusp of 1st molar & Central Incisor tip 2. Midsagittal reference plane line passing through Crista Galli, Anterior Nasal Spine, Opistion.	Skeletal Class III malocclusion have larger retromolar space than Skeletal Class I, Skeletal Class II malocclusion.
11	Ozden et al.[15] 2022	Retrospective study	Total sample – 120 divided in Skeletal Class I & Skeletal Class III malocclusion Group;1 Class I with Normodivergent pattern (15 males + 15 Females with mean age of 21.7 years Group; 2 Class I with Hyperdivergent pattern (14 males + 16 Females with mean age of 20.4 years Group; 3 Class III with Normodivergent pattern (17 males + 13 Females with mean age of 19.4 years	Mandibular occlusal plane	Skeletal Class III malocclusion with Hyperdivergent growth pattern have large retromolar space ($p<0.001$)

			Group; 4 Class III with Hyperdivergent pattern (15 males + 15 Females with mean age of 18.5 years) Tool – CBCT		
12	Rajamanickam & Sundari[16] 2023	Prospective study	Total sample 80 al skeletal Class III Normodivergent growth pattern malocclusion cases (No gender mentioned) Age range 18 years – 35 years	1. Mid sagittal plane passing Crista Galli 2.Posterior occlusal plane passing through buccal cusp tip of 1st and 2nd mandibular molars	Adequate space available for the purpose Molar distalization ((p<0.05) with 3.3 ± 0.9 mm)
13	Huang et al.[5] 2023	Retrospective study	Total sample – 103 patients (Males were 52, Female were 51) Age range (18-40) Mean age of 28.39 years Tool:- CBCT derived Panoramic radiographs	Occlusal plane	Retromolar space at crown level was longer than at the root level (p<0.05) Sufficient space available between Ramus of mandible & Distal aspects of 2nd molar Hence special attention needed for during molar Distalization process
14	Seol et al.[17] 2023	Retrospective study	Total sample – 30 patients of contained both skeletal Class I & skeletal Class III malocclusion Sample contained 17 were male & 13 were female with mean age of 22.2 ± 4.5 years. Tool - CBCT		Skeletal Class III malocclusion 11.1 mm retromolar space & Skeletal Class I malocclusion had 9.8 mm of retromolar space available location at 8 mm apical to CEJ

IV. RESULTS: -

Results of this study mentioned in Table 6, 7. that Skeletal Class III malocclusion had greater retromolar space among Skeletal Class III malocclusion and among divergent faces Hypodivergent growth pattern had larger retromolar space than Hyper divergent growth pattern patient and Normodivergent growth pattern patients.

Table 6. Measurement of Retromolar space in various sagittal malocclusions (Skeletal Class I, Skeletal Class II, Skeletal Class III)

S. No	Author, Year, type of study	Name of malocclusion & Age	Result & Conclusion
1	Choi et al.[3] 2018, Retrospective study	Total sample 110 contained both Skeletal Class I, Skeletal Class III malocclusion case Skeletal Class I malocclusion 49 patients (Male were 18, female were 31) & Mean age 27.7 ± 9.5 years Skeletal Class IIII malocclusion 61 patients (Male were 22, female were 39) & Mean age was 26.4 ± 4.4 years	The available space availability affected by age, sex, and skeletal & dental patterns. Skeletal class III malocclusion had greater retromolar space than Skeletal Class I malocclusion
2	Hui et al.[13] 2022, Cross-sectional retrospective study	120 skeletal class II, Skeletal Class III malocclusion Skeletal Class II malocclusion of 60 patients (30 Male + 30 Female) with age range of 18 -35 years Skeletal Class III malocclusion of 60 patients (30 Male + 30 females with age range of 18 -35 years	Limit of retromolar space at coronal area is observed in Skeletal class II malocclusion Limit of retromolar space at Apical level in Skeletal Class III malocclusion
3	Fan et al.[1] 2022, Prospective study	120 sample contained skeletal class I, Skeletal Class II, Skeletal Class III malocclusion Skeletal Class I 48 patient (17 Males + 31 Female) with mean age of 22.56 ± 3.31 years, mean Skeletal Class II 36 patient (12 Male + 24 Female) with mean age of 22.19 ± 3.92 years, mean Skeletal Class III 36 patient (16 Male + 20 Female) with mean age of 21.50 ± 3.30 years	Skeletal Class III malocclusion have larger retromolar space than Skeletal Class I, Skeletal Class II malocclusion.
4	Ozden et al.[15] 2022, Retrospective study	120 sample contained both Skeletal Class I & Skeletal Class III malocclusion Skeletal Class I 60 patient (29 males + 31 Females) age 26.06 years Skeletal Class III 60 patient (32 males + 28 Females) age of 37 years	Skeletal Class III malocclusion with Hyperdivergent growth pattern have large retromolar space (p<0.001)
5	Rajamanickam & Sundari[16] 2023 , Prospective study	Total sample of 80 contained skeletal Class III malocclusion cases (No gender mentioned) Age range 18 years – 35 years	Adequate space available for the purpose Molar distalization ((p<0.05) with 3.3 ± 0.9 mm)

6	Seol et al.[17] 2023, Retrospective study	Total of 30 patients contained both Skeletal Class I & Skeletal Class III malocclusion Sample contained 17 were male & 13 were female with mean age of 22.2 ± 4.5 years.	Skeletal Class III malocclusion 11.1 mm retromolar space & Skeletal Class I malocclusion had 9.8 mm of retromolar space available location at 8 mm apical to CEJ

Table 7. Measurement of Retromolar space in various divergent growth patterns (Hypodivergent, Normodivergent, Hyper divergent patterns)

S. No	Author & Year	Sample size	Result & Conclusion
1	Zhao et al.[2] 2020 & Prospective study	Total sample – 123 Hypodivergent, Normodivergent, Hyperdivergent growth pattern of all Skeletal Class I malocclusion Age range 20-40 years Hypodivergent growth pattern case 41 patient with mean age of 24.00 ± 3.87years, mean mandibular plane angle 23.11 ± 3.10^0 (Males – 10, females – 31) Normodivergent growth pattern case 41 patient with mean age of 23.39 ± 2.79 years, mean mandibular plane angle 32.26 ± 2.70^0 (Males – 9, females – 32) Hyperdivergent growth pattern case 41 patient with mean age of 23.46 ± 3.98years, mean mandibular plane angle 41.36 ± 3.38^0 (Males – 7, females – 34)	Hyperdivergent growth pattern had smallest retromolar space than normodivergent, Hypodivergent growth pattern
2	Kim et al. 2021[10] & Retrospective study	Total sample 48 contained Hypodivergent, Normodivergent, Hyperdivergent growth patterns Males were 34 & Females were 14 patients Hypodivergent growth pattern case 16 patient with mean age of 22.5 ± 1.9 years, mean mandibular plane angle 25.3 ± 3.3^0 (Males – 12, females – 4) Normodivergent growth pattern case 16 patient with mean age of 22.9 ± 3.6 years, mean mandibular plane angle 33.0 ± 1.8^0 (Males – 11, females – 5) Hyperdivergent growth pattern case 16 patient with mean age of 23.1 ± 3.7 years, mean mandibular plane angle 39.8 ± 2.4^0 (Males – 11, females – 5)	Shorter retromolar space in hyperdivergent growth pattern than in Normodivergent growth pattern patient Limited retromolar space available with female hyperdivergent growth pattern
3	Fan et al.[1] 2022 & Prospective study	Total sample – 120 all Normodivergent growth pattern patients Skeletal Class I 48 patient (17 Males + 31 Female) with mean age of 22.56 ± 3.31 years, mean ANB angle 2.64 ± 0.96 years Skeletal Class II 36 patient (12 Male + 24 Female) with mean age of 22.19 ± 3.92 years, mean ANB angle 6.04 ± 1.13 years Skeletal Class III 36 patient (16 Male + 20 Female) with mean age of 21.50 ± 3.30 years, mean ANB angle -2.34 ± 2.23 years Tool – CBCT	Adequate retromolar space is available in Normodivergent growth pattern
4	Ozden et al.[15] 2022 & Retrospective study	Total sample – 120 divided in Skeletal Class I & Skeletal Class III malocclusion Group;1 Class I with Normodivergent pattern (15 males + 15 Females with mean age of 21.7 years Group; 2 Class I with Hyperdivergent pattern (14 males + 16 Females with mean age of 20.4 years Group; 3 Class III with Normodivergent pattern (17 males + 13 Females with mean age of 19.4 years Group; 4 Class III with Hyperdivergent pattern (15 males + 15 Females with mean age of 18.5 years) Tool – CBCT	Skeletal Class III malocclusion with Hyperdivergent growth pattern have large retromolar space ($p<0.001$)
5	Rajamanickam & Sundari[16] 2023 & Prospective study	Total sample 80 Normodivergent growth pattern malocclusion cases (No gender mentioned) Age range 18 years – 35 years	Adequate space available for the purpose Molar distalization (($p<0.05$) with 3.3 ± 0.9 mm)

V. **DISCUSSION**

The concept of retromolar space analysis evolved from Merri-field's viewpoint of total space analysis.[4] The boundaries of retromolar space are cortical layer of alveolar bone[6] & anterior border of ramus of Mandible.[32] Anatomically, retromolar space defined as the distance between the distal contact point of the 2nd molar & junction of the anterior border of the ramus with the body of the mandible[33]

This purpose of conducting study was retromolar space calculation which helps in space available for Molar distalization and application of Ramal plates & Relieve of crowding in anterior & middle aspect of dental arches. The main objective of doing this study was to measure retromolar space in various skeletal Class III malocclusion & retromolar space relation to divergent growth pattern.

Reason for selecting CBCT as tool why not other tools

More accurate measurement, high efficiency, precise quantification, high resolution, High maneuver, flexible to move in all direction during measurement given pathway for selection of 3 - dimensional diagnostic tools i.e. Cone beam computed tomography.[5] Reference plane used for the measuring retromolar space was Mandibular occlusal plane to get valid & reliable results[1,3,5,10–13,15–17,34] Some of the studies were conducted on Orthopantomogram[18–23,25] not included in this study because posterior accessible on lateral cephalogram is less than that of original anatomical structures. Hence, such errors might mislead the study.[16,34,35]

Effect of vertical growth relation & Retromolar space

Relationship of retromolar space availability strongly co - related to vertical skeletal pattern.[10,36] retromolar space strongly correlated with vertical growth pattern. Retromolar space availability is more in hypodivergent grower patient[10] because hypodivergent grower cases have greater occlusal forces[10,14,37] enhances bone resorption due to muscle activity leads to more availability of retromolar space & increased attachments of mandibular lingual cortical bone also one of the factor for retromolar space availability[38]Studies shown retromolar space availability is more in hypodivergent growth[2] pattern followed by Normodivergent growth pattern. [1,10,16] Least retromolar space available in hyperdivergent growth pattern.[2,10] In contrast to our study, Hyperdivergent patients had larger retromolar space reason behind that involvement of skeletal Class III pattern.[15]

Effect of Sagittal skeletal relation & Retromolar space

In current study, skeletal Class III pattern involved to size of mandible. Skeletal Class III malocclusion had large number of Retromolar space. The main reason was large size of mandible which leads to larger retromolar space[1,23] & other reason was mandibular molar were far from the inner cortex of mandible.[39]

Retromolar space availability is directly proportional to size of mandible. Retromolar space availability depends on size of body of mandible[10,14,23] In skeletal Class III malocclusion have large mandible indicate that more availability of retromolar space than skeletal Class I & Class II patients. Retromolar space also depends on buccolingual position of mandible. Skeletal Class III patients mandibular molars more lingually inclined suggested that roots of mandibular 2nd molar far from the inner cortex of mandible.[36,39] Choi.et al.[3] (2018) reported that in retromolar space available in skeletal class III malocclusion 2.7 ± 2.8 mm at 6 mm apical to furcation of adjacent teeth. Since amount of space for molar distalization varied from 3.2 mm to 4.9 mm including distal tipping.[35,40,41]

Studies shows retromolar space is larger in skeletal Class III malocclusion were Choi et al.[3] (2018), Hui et al.[13] (2022), Fan et al.[1] (2022), Ozden et al.[15] (2022), Iguchi et al.[36] (2022), Rajamanickam & Sundari [16] (2023), Seol et al. (2023).[17]

Existence of 3rd molar, age & retromolar space availability

Some studies strongly supported that presence of 3rd molar does not influence on the retromolar space availability.[1,2,10,34] sometimes, influence of age on retromolar space caused by periodontal disease or physiological alveolar bone ridge absorption[42] Huang et al.[5] found that retromolar space had no significant difference in gender & Angle's classification of malocclusion[36,43] Huang et al.[5] found that retromolar space had no significant difference in gender. Retromolar space availability depends on size of body of mandible[10,14] & buccolingual position of mandible[36]

Limitation of current systematic study are some strong evidence needs to supported gender does not influence retromolar space availability. The finding by Choi etal.[3] that the available space at the posterior boundary of molars is influenced by age supports our results.

Conclusion:

1. Retromolar space availability inversely proportional to Mandibular plane angle
2. Hypodivergent growth pattern had large retromolar space than hyperdivergent & Normodivergent growth pattern
3. Skeletal Class III malocclusion had large retromolar space than Skeletal Class I, Class II malocclusion
4. Gender had no effect retromolar space length or width. But Eruption stage of 3rd molar makes limiting factor for availability of retromolar space

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