

Three Dimensional Position of Condyle Following Face Mask Therapy In Skeletal Class III Malocclusion: A Systematic Review

N.M. Sreeram¹, Krishan Guaba²

¹Post-Senior Resident, Macherla, Andhra Pradesh, India

²Professor (Retired), Chandigarh

Abstract

Objective: (1) To evaluate position of condyle following face mask therapy using MRI imaging in growing skeletal Class III malocclusion (2) To evaluate position of condyle following face mask therapy using CBCT in growing skeletal Class III malocclusion (3) To evaluate position of condyle following face mask therapy using various articulators (Fully adjustable/ Semi adjustable articulators)

Material and Methods: All skeletal Class III malocclusion growing patients underwent Face mask therapy. Data bases like Google scholar, PubMed, Science direct, Cochrane, Lilac data base retrieved studies.

Results: All patients showed change in condylar position

Conclusion: Condyle changes to posterior and superior after face mask therapy due to bone remodeling at glenoid fossa

Keywords: Face mask, Condyle, Cone beam computed tomography, 3-dimensional image, Magnetic resonance imaging, CBCT.

1. Introduction

Face mask homogenous force treat Skeletal Class III malocclusion in Maxillary deficiency cases, but impact on mandible too. Since both jaws are inter connected with muscle, ligaments & nerve supply.^{1,2} Face mask enhance counter clockwise rotation of maxilla & backward, downward rotation of mandible.² Current systematic study evaluated position of condyle in relation to face mask homogenous force that helps in reprogramming Temporomandibular Joint & neuro muscular coordination.³⁻⁵

The objectives of systematic study include (1) To evaluate position of condyle following face mask therapy using MRI imaging in growing skeletal Class III malocclusion (2) To evaluate position of condyle following face mask therapy using CBCT in growing skeletal Class III malocclusion (3) To evaluate position of condyle following face mask therapy using various articulators (Fully adjustable/ Semi adjustable articulators)

2. NEED OF THE STUDY.

To evaluate condylar position after face mask homogenous force, which helps in elimination of Centric relation & Centric occlusion relationship effective in reprogramming neuromuscular system.

3. MATERIAL AND METHODS

3.1 Population and Sample

All skeletal Class III malocclusion patient growing age between 7 years to 13 years underwent face mask therapy.

3.2 Data and Sources of Data

Source of data included Goggle scholar, PubMed, Science direct, Cochrane, Lilac data base.

Table 1. Search Strategy for this systematic review

S. No	Search Engine	Keywords used in combinations	No. of articles found
1	Google scholar	1. Face mask	62
2	PubMed	2. Condyle	272
3	Science direct	3. Cone beam computed tomography	1198
4	Cochrane	4. 3-dimensional image	39
5	Lilac data base	5. MRI	26
Total			1597

3.3 Theoretical framework

Table 2. PICO FORMAT frame work for conducting systematic review

Population	Growing patients of skeletal Class III malocclusion (ANB angle $<1^0$) in the age range of 7 -13 years
Intervention	Intervention of position of condyle following face mask therapy with 3 -dimensional tools in skeletal Class III patients
Control group	Untreated normal healthy patients
Outcome	Directional change of position of condyle

3.4 Research methodology

All skeletal Class III malocclusion with maxillary deficiency with anterior crossbite (ANB angle 1 or less than degrees). Study design include studies of prospective, longitudinal studies, retrospective, case-control, cross-sectional, randomized clinical trials studies included. All animal studies, case reports, review of literatures, systematic reviews excluded. Inclusive study criteria growing patients of skeletal Class III malocclusion with Cone beam computed tomography tool or Magnetic Resonance Imaging tool or Articulators for measurement of condyle. Exclusion criteria: (1) Adults cases of Orthognathic surgical cases (2) Craniofacial anomalies like cleft face deformities (3) History of traumatic injuries cases & history of Temporomandibular joint disorder (4) History of systemic diseases. PRISMA flow chart mentioned in Figure 1. Inclusive and exclusive studies mentioned in Table 3,4.

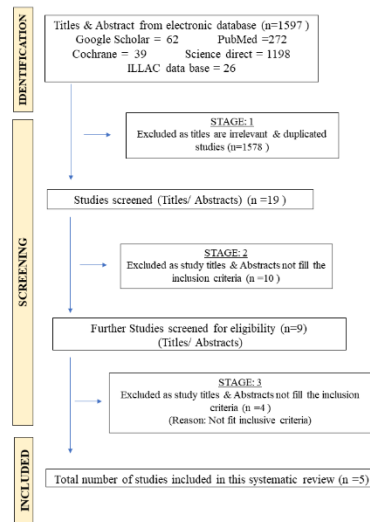


Figure 1. PRISMA flow chart

Table 3. Studies included in this systematic review

S. No	Study & Year	Study design
1	Yagci & Uysal ⁶ & 2010	Prospective Study
2	El & Ciger ⁷ & 2010	Prospective Study
3	Lee et al. ⁸ & 2016	Prospective Study
4	Feky & Rashid ⁹ & 2021	Prospective Study
5	Demirsoy & Yagci ¹⁰ & 2022	Prospective Study

Table 4. Studies excluded from this systematic review

S. No	Author, Year	Reason for exclusion of study
1	Kurt et al. ¹¹ 2011	TMJ Disorder
2	Myers et al. ¹² 1980, Wendl et al. ¹³ 2017, Fareen et al. ¹⁴ 2017, Minase et al. ¹⁵ 2019	Not evaluated condylar position
3	Havron et al. ¹⁶ 2018	Ortho-surgical case
4	Huang et al. ¹⁷ 2018	Systematic review
5	Baccetti et al. ¹⁸ 2000, Fareen et al. ¹⁹ 2021	Cephalometric study
6	David R. Myers 1980, Clerck et al. ²⁰ 2012, Havron et al. ¹⁶ 2018, Mohamed et al. ²¹ 2020, Huq et al. ²² 2021, Khwanda et al. ²³ 2022, Chen et al. ²⁴ 2022	No face mask treatment

Table 5. Material & methodology in this systematic review

S. No	Author & Year & Study design	Total sample size & mean age	Tool used for measure condyle position	Appliance used	Schedule of appliance wear (Average duration, hours/day, force given,	Result & Conclusion

					direction of vector force delivered	
1	Yagci & Uysal ⁶ & 2010 & Prospective Study	Total sample size 67 (34 girls & 33 boys) Average mean age of patients 9.35 years Group 1 Conventional facemask group (Total of 22 in which 11 girls, and 11 boys) (mean age: 9.3 ± 1.3 years); Group 2) the modified facemask group (Total of 22 in which 12 girls & 10 boys) (mean age: 9.4 ± 1.5 years); Group 3) the control group (Total of 21, 11 girls & 10 boys (mean age: 9.8 ± 1.9 years).	Articulator (SAM 3 fully adjustable articulator)	Conventional facemask and modified conventional face mask	Group I: Mean treatment duration 1.1 ± 0.3 year, 500g force/side, 20° below occlusal plane	The author concluded that posterior and backward in conventional face mask treatment
2	El & Ciger ⁷ & 2010 & Prospective Study	Total sample 34 patients (15 were girls	MG1 articulator (ARCON -	Delair face mask & Grummons	Mean treatment duration was	Author concluded that condyle

		<p>& 19 were boys)</p> <p>Delaire face mask consisted of 18 patients (10 were girls & 8 were boys)</p> <p>Grummons face mask group consisted of 16 patients (5 were girls, 11 were boys)</p> <p>Mean age for Delaire face mask 9.03±0.82 years & for Grummons face mask 9.2±1.1 years.</p>	<p>type Semi-adjustable articulator)</p>	<p>face mask</p>	<p>GFM group was 10.59±1.42 months, & For DFM 8.06±1.63 months</p> <p>Both groups wearer 14-16 hours/ day</p> <p>600-700 grams force delivered per side in both treatment groups</p>	<p>moved superiorly in the glenoid fossa after the use of Delaire face mask & on effect with Grummons face mask.</p>
3	Lee et al. ⁸ 2016 & Prospective Study	<p>Total of 18 (10 girls, 8 boys)</p> <p>Mean age of boys 9.1±1.4 years & for girls 8.8 ±0.8 years</p>	<p>Cone beam computed tomography Study</p>	<p>Delaire face mask</p>	<p>Mean duration of treatment was 10.8±24 months</p> <p>More than 16hours/day</p> <p>450 grams/ side & 15⁰-30⁰ below</p>	<p>Authors concluded that bone remodeling resulted in upward & backward, outside displacement of condyle (Mechanism of action: bone resorption at posterior wall, deposition at anterior wall</p>

					occlusal place	of Glenoid fossa.
4	Feky & Rashid ⁹ & 2021 & Prospective Study	Total sample size 18 ages ranging from 8- 11 years	Cone beam computed tomography Study	Petit – type Face mask	Average duration of treatment 10 months 12-16 hours/day (After school hours & During sleep) 400g/side 30° below to occlusal plane	Author concluded that condyle displaced upward and backward after face mask therapy. (Mechanism of action: Remodeling of glenoid fossa)
5	Demirsoy & Yagci ¹⁰ 2022 & Prospective Study	Total sample of 25 (15 experimental in which 10-girls, 5 boys & 10 control group in which 5 boys & 5 girls) Mean age of boys 10.5 ± 1.03 years & Mean age of girls 9.33 ± 0.83 years	Magnetic resonance imaging	RME/Face mask	Mean treatment time of 10.5±2.6 months Minimum 18 hours/ day 20° below occlusal plane	Authors concluded that significant increase in antero-posterior joint space & position of condyle in glenoid fossa changed

4. RESULTS

Total of 1597 studies screened. In stage 1, 1578 all irrelevant articles, duplicated articles excluded. In stage 2, 10 studies excluded as not given face mask. In stage 3, 4 articles excluded as not fit inclusive criteria. All-inclusive studies show change in condylar position as bone remodeling at glenoid fossa mentioned in Table 6.

Table 6. Evaluate position of condyle using various tools following face mask therapy

S. No	Study, Year & Study design	Tool	Position of condyle changes after face mask therapy	Remodeling changes
1	Demirsoy & Yagci ¹⁰ 2022 & Prospective Study	MRI	Superior displacement of condyle	Bone remodeling takes place & condylar positioned changes
2	Lee et al. ⁸ 2016 & Prospective Study	CBCT	Upward & backward displacement of condyle	Resorption at posterior wall of glenoid fossa Deposition at Anterior glenoid fossa
3	Feky & Rashid ⁹ 2021 & Prospective Study	CBCT	Upward & backward displacement of condyle	Bone remodeling at glenoid fossa
4	Yagci & Uysal ⁶ & 2010 & Prospective Study	Articulator	Posterior & backward displacement of condyle	No remodeling observed as study conducted on Mechanical Articulator
5	El & Ciger ⁷ 2010 & Prospective Study	Articulator	Condyle positioned superiorly	No remodeling observed as study conducted on Mechanical Articulator

Note: MRI – Magnetic Resonance Imaging, CBCT- Cone Beam Computed Tomography

5. DISCUSSION

Face mask therapy indicated in skeletal Class III malocclusion patients where deficient of maxilla present.^{9,25-29} Face mask force enhances maxillary component forward.³⁰ Since maxillary components attached to mandibular components with muscles, ligaments, nerves. The interaction of homogenous protraction force impact on mandibular condyle and remodeling of glenoid fossa.⁷⁻⁹ Face mask force enhance reactive force on chin effect position of condyle of mandible.^{5,6,9} Ultimately, face mask force stimulates clockwise rotation of mandible.^{8,28,31-37} But, no correlation between maxillary protraction & amount of displacement of condyle.⁸

In current systematic review in all studies, Face mask homogenous force enhance condyle in superior and backward position with 3-d imaging tools.

Bone remodeling process and condylar position change

Reactive force of facemask on mandible enhances bone remodeling process at glenoid fossa. Hence, bone apposition & deposition process involved phenomenon. Bone apposition at anterior border of glenoid fossa & bone resorption at posterior wall of glenoid fossa. Since it is attached with articular disc, leads to displacement in posterior and superior position i.e. upward & backward displacement of condyle.⁸

The main mechanism of change in condylar position with face mask force on heavy force application leads to increased activity of lateral pterygoid muscle. Hence leads to creation of tension at distal aspect of lateral pterygoid muscle.

Centric relation & Centric occlusion & face mask force application & Condyle position

In current systematic study, centric occlusion components not considered as acrylic component maintains the occlusal equilibrium during treatment with teeth.⁵ All studies showed that the condyle positioned posteriorly & superiorly after face mask application.^{2,6-9}

Disadvantage of other radiographic tools

In previous era, 2- dimensional radiographic image tools used for evaluation of position of condyle.^{38,39} These conventional tools limitations in the terms of reliability, accuracy, superimposition of anatomical landmarks.^{7,40,41} All these factors given path way to 3 -dimensional technique for evaluation of condyle recommended.⁴²⁻⁴⁴

Advantage of taking 3-dimensional image tools

3- Dimensional tools gives more reliable measurement than 2- Dimensional radiographic technique. Avoid problems of superimposition of anatomical land marks. Tools are accurate than 2-d tools.

6. CONCLUSION

Current systematic study concluded that condyle position changed to posterior and superior after face mask homogenous force due to bone remodeling at glenoid fossa in skeletal Class III malocclusion patients.

7. Conflict of Interest

No conflict of interest

8. Acknowledgement

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