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ORIGINAL RESEARCH

Cephalometric Study of the Effect of "Maxillary Splint with High Pull Headgear" for the Treatment of Class II Division 1 Malocclusion – A 12–18 Months Retrospective Matched-Control Study

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Purpose: To compare the effect of maxillary splint high pull head gear (MSHPH) on dentoskeletal structures in growing Class II division 1 patients with a matched control group.

Methods: The treatment group (MSHPH) comprised 20 patients who were evaluated at two stages: pretreatment (T1) and post orthopaedic (T2). The control group consisted of 20 untreated class II patients under observation. Intra-group comparisons were done with paired *t* test and the inter-group comparisons were analyzed with "Mann–Whitney *U*-test".

Results: Intra-group comparisons in the treated group showed significant decrease in the mean SNA, ANB, N perpendicular to Point A, Point A vertical, PNS vertical, U1 – NA (angular), U1 – SN, U1 – NA (linear), U1 – NF, PtV – U6, overjet and overbite at T2 when compared to T1. However, there was a significant increase in the mean SNB, N-Pog, EMnL, LAFH, at T2. The control group showed significant increase in the mean SNA, ANB, N perpendicular to Pogonion, Effective MxL, Effective MnL, LAFH, Point A vertical, ANS vertical, PNS vertical, U1 – NA (angular), U1 – SN, U1 – NA (linear), U1 – NF, PtV – U6, and overjet at T2 when compared to T1. Inter-group comparisons (T2-T1) showed significantly higher mean in treated group for SNA, SNB, ANB, N perpendicular to Point A, N perpendicular to Pogonion, Effective MnL, U1 – NA (angular), U1 – SN, U1 – NA (linear), U1 – NF, PtV – U6, overjet, overbite, S line Upper Lip and S line to Lower Lil. However, significantly lower values were seen in treated group for Effective MxL, LAFH, Point A vertical, ANS vertical, and PNS vertical.

Conclusion: MSHPH held the maxilla without changes in the palatal plane. Thus, normal skeletal relationships resulted from inhibiting maxillary growth and preserving natural mandibular development in the treatment group.

Keywords: dental, malocclusion, maxillary traction splint, skeletal change, maxillary prognathism, SDG 3, SDG 4

Introduction

The traditional belief was that the skeletal malocclusions were a pure sagittal pattern that is problem only in anteroposterior dimension. The vertical and transverse dimensions demand critical attention as well. The interplay of these plays a major role in the development of a malocclusion.

The growth of the dentofacial complex is mainly affected by three factors the anteroposterior, vertical and transverse. The vertical maxillary descent growth tries to carry the pogonion downward and backward while the anteroposterior growth at the condyles is trying to carry it forward. The interplay of the vertical facial growth together with anteroposterior growth is responsible for the normal/retrognathic/prognathic facial types. Any imbalance in these two planes would lead to skeletal jaw

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dysplasia. One such skeletal jaw dysplasia is Class II skeletal malocclusion, abnormal antero-posterior relationship of the maxilla to the mandible and the cranial base. Class II malocclusions could be because of a retrognathic mandible/prognathic maxilla/combination of both approximating to 60% of all orthodontic patients.

For Class II skeletal jaw irregularities involving vertical maxillary overgrowth that disrupts normal anteroposterior relationships, treatment must prioritize curbing downward and forward maxillary growth rather than relying exclusively on tooth movement, as this risks displacing teeth into positions of neuromuscular disharmony.[1]

The growth modulation procedures were introduced by Norman Kingsley (1879) and proposed a bite jumping appliance to treat class II skeletal malocclusion followed by Angle who incorporated Kingsley's headgear into his evolving system. Later which many combined extraoral-intraoral appliances (removable/fixed) were introduced like "Andreasen's activator", "Balters bionator", "Stockfish's kinetor", "Frankel's functional regulator", "Kloehn's cervical headgear" and "Schudy's high pull headgear".

Extraoral forces on maxillary teeth create skeletal effects; stronger basal bone engagement maximizes orthopaedic maxillary restraint over tooth-only displacement. A face-bow and parietal headgear on a removable appliance delivers strong force to the vertically growing maxilla via upper teeth.

The treatment of Class II malocclusions with maxillary protrusion, labially inclined incisors, and gummy smiles, involves Raymond C. Thurow's splint headgear - a removable intraoral splint paired with extraoral traction for effective correction during active growth phases.[2]

By combining a removable maxillary splint with headgear, vertical dimension is regulated as a distal force acting on both the maxilla and its dentition. Correcting skeletal bases orthopedically during active growth reduces strain on dental structures while improving aesthetics, function, and neuromuscular stability.

The ongoing controversy over headgear's growth-modulation efficacy persists today, driven by its flexible application in orthodontics. A significant source of ambiguity arises from its frequent combination with multiple intraoral appliances for Class II skeletal and dental corrections. Although a minority of clinicians doubt headgear's clinical utility, clear evidence of its skeletal growth-altering capabilities is still elusive. Maxillary splint high pull headgear (MSHPH) is one such appliance which is used for the orthopaedic and orthodontic correction of the class II discrepancies.[3]

We aimed to compare the effect of MSHPH with an age matched control group of untreated class II division 1 malocclusion patients. The objective of this study was to compare the effect of MSHPH on skeletal, dental and soft tissues with an age matched control group of untreated class II division 1 malocclusion.

The null hypothesis was that there would be no significant difference between the treated and age matched control group.

Materials and Methods

This retrospective study was conducted on the cephalometric records of Dentofacial Orthopaedics at Bapuji Dental College and Hospital and hence the parental consent and informed consent statements were not obtained. However, all the patients and parents had given general consent for treatment and were aware that their records would be used for research purposes as per the institutional policy. This study was conducted as per the Declaration of Helsinki and its later amendments. The confidentiality of the data was maintained throughout the study. Approximately 1500 patient records were available who were in the growing age and have undergone at least 6 months of orthopaedic correction procedures in the Department of Orthodontics and Dentofacial Orthopaedics at Bapuji Dental College and Hospital. Among these, 56 patients had undergone treatment with MSHPH of which 20 patients had complete records pre and post-treatment (T1 and T2). The sample size was calculated using Gpower software, version 3.1.9.4. (Franz Faul, Universitat Kiel, Germany). Based on the findings of ANB for the treated group by Amini et al an effect size of 0.7 was obtained. With a power of 80% and 95% confidence interval, the sample size was estimated to be 19. A matched control group of 20 patients who had class II profile and were unwilling for Orthopaedic appliance therapy but reported for the fixed appliance therapy later (maximum recall of 4 years) were selected from the department archives. The past and the recent records during the latest follow-up were utilized. The protocol was approved by the Institutional Ethics Committee of Bapuji Dental College and Hospital, Davangere.

Inclusion criteria: For both the groups patients in the growing phase with an age range of 10 to 14 years. The skeletal maturity age of all the participants using hand wrist radiograph was stage 3/4 (Julian Singer maturity assessment), demonstrating skeletal Class II division 1 malocclusion with ANB ≥5° and having end on to Class II molar relationship with increased overjet, overbite and average to vertical growth pattern. All subjects have a greater degree of incisor display and gummy smile. The Visual Treatment Objective was not definitely positive.

The participants (Treatment and Control sample) were observed at least for a period of 12 to 18 months.

Lateral cephalograms were captured in occlusion using standardized protocols with a GENDEX Orthoralix 9200 X-ray cephalostat. Tracings were completed on 0.003-inch acetate sheets using a 0.3 mm lead pencil, followed by landmark identification. All cephalograms were recorded by a single trained investigator. The reference lines or planes used were Sella-nasion plane (SN plane), Frankfort horizontal (FH) plane, Mandibular plane (MP), NF (nasal floor), Pterygoid vertical line, Nasion perpendicular line Palatal Plane (Pal), S line (Steiner's), Co – Pt A (Effective maxillary length), Co – Gn (Effective mandibular length) and Sn + 7°.

The Skeletal Angular Parameters Used Were (Figure 1) as Follows

1. SNA
2. SNB
3. ANB
4. Mandibular plane angle
5. Angle of inclination (Pn to Palatal plane)
6. Basal plane angle (Pal -Mp)
7. Y-axis
8. Facial axis

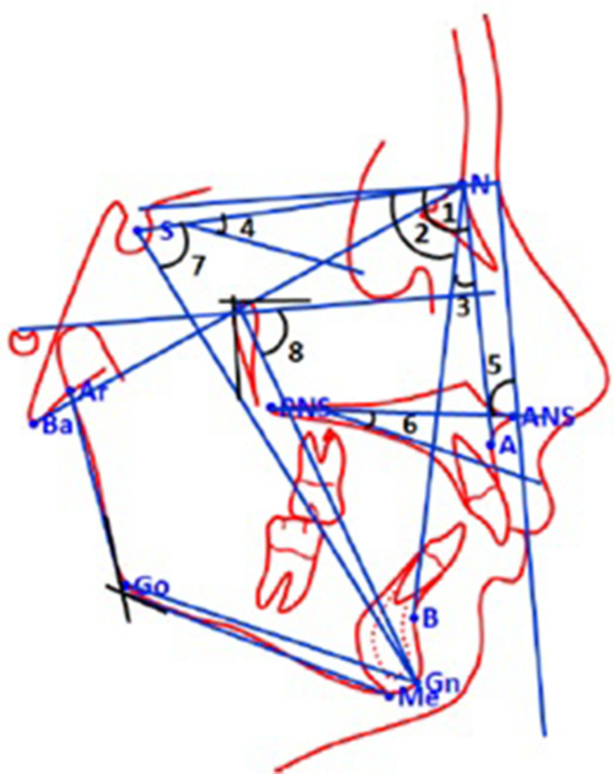

Figure 1 Skeletal angular parameters.

The Dental Angular Parameters Used Were (Figure 2) as Follows

1. U1 to NA
2. U1 to SN
3. L1 to MP

The Skeletal Linear Parameters Used Were (Figure 3) as Follows

1. Nasion perpendicular to point A
2. Nasion perpendicular to pogonion
3. Effective maxillary length
4. Effective mandibular length
5. Lower anterior face height (LAFH)
6. Point A vertical
7. Point ANS vertical
8. Point PNS vertical

The Dental Linear Parameters Used Were (Figure 4) as Follows

1. U1 to NA
2. U1 to NF
3. U6 to NF
4. Ptv to U6 (distal Surface) – It is the linear distance from the tangent perpendicular to FH to the posterior border of ptm to distal surface of the upper first molar.
5. L1 to NB

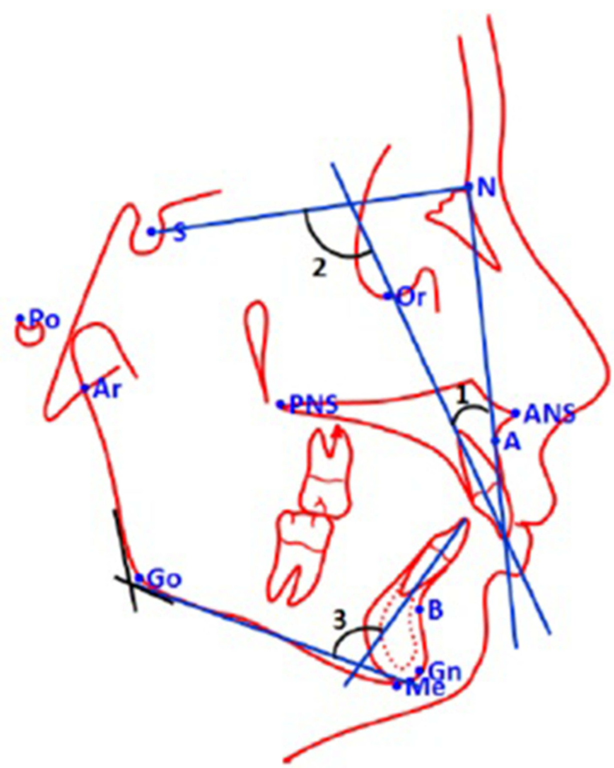

Figure 2 Dental angular parameters.

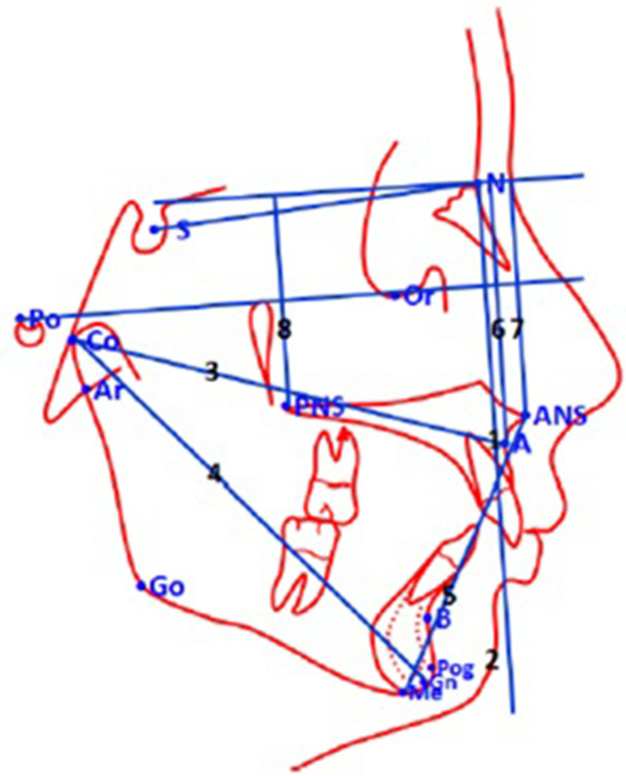

Figure 3 Skeletal linear parameters.

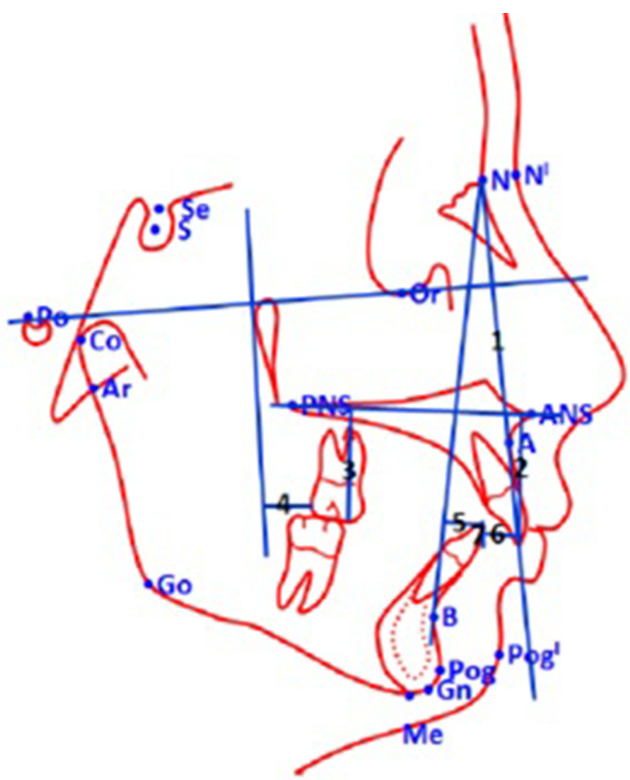

Figure 4 Dental linear parameters.

6. Overjet
7. Overbite.

The Soft Tissue Parameters Used Were (Figure 5) as Follows

1. S line to upper lip
2. S line to lower lip

Fabrication of Maxillary Splint

A full coverage splint for maxilla was fabricated using 3-mm-thick Biocryl (Scheu-Dental, Iserlohn, Germany) on a Biostar (Scheu-Dental, Iserlohn) or heat cure acrylic (DPI Heat cure, Rudrapur, Uttarakhand, India) covering all the teeth. Partially erupted second maxillary molars were allowed to complete eruption and were included later. A bite plane was created from the acrylic, ensuring even lower anterior tooth contact and permitting mild eruption of lower molars and premolars. The acrylic splint contained headgear tubes (Jaypee headgear tubes, Kozhikode, Kerala, India) positioned mesial to the maxillary first molars. The arms of the facebow (Leone, Florentino, Italy) were shaped to the splint and a mesial offset bend added to block posterior sliding.

Head straps (Captain ortho, Libral traders Pvt Ltd, New Delhi, India) were customized according to individual's cephalic measurements. Force modules (Captain ortho, Libral traders Pvt Ltd, New Delhi, India) of medium force magnitude were used (Figure 6).

Headgear's impact on the maxilla and teeth was influenced by the relationship between the outer facebow arm and the centre of resistance of maxilla (posterosuperior zygomaticomaxillary suture; and maxillary dentition: premolar root apices) and the direction of force applied.[4] The outer arms were lengthened to position their hooks just behind the first permanent molars, then bent upward 20°–30° at the mouth corner, aligning the hook with the centre of resistance for the maxillary teeth and maxilla. The high (parietal) pull resulted in a force vector that aligns close to the centre of resistance

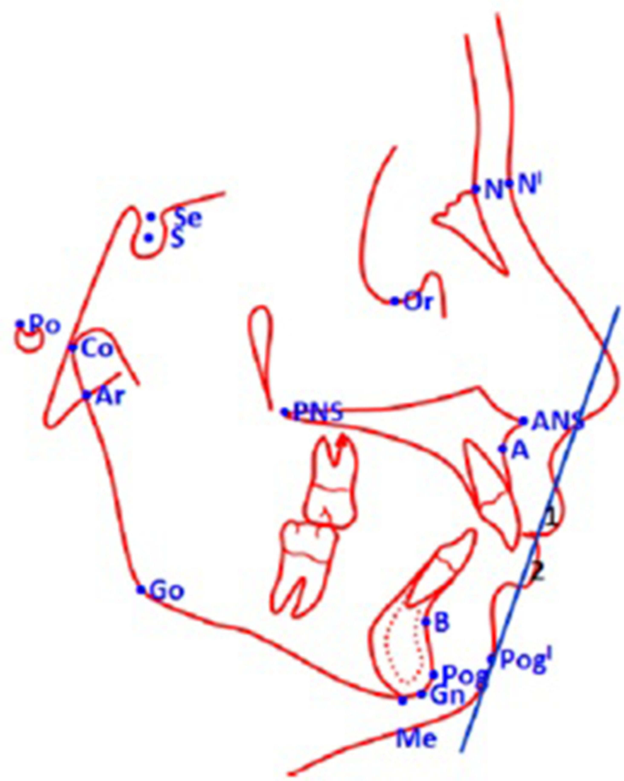

Figure 5 Soft tissue parameters.

Figure 6 Maxillary intrusion splint with facebow.

of the maxilla and its dentition, directed upward at roughly 45° to the occlusal plane, maintaining vertical stability and avoiding rotation of the occlusal plane[5,6] (Figure 7).

After the appliance insertion, the initial force levels were kept at 250 grams per side measured using a Corex (Haag Streit Diagnostics, Koeniz, Switzerland) gauge instrument. Individuals were instructed and motivated to wear the appliance all day except while eating, brushing and during sports, which resulted in a wear time of 18–20 hours/day.

During the first visit after two months of appliance insertion, the compliance and the appliance wear was confirmed by analyzing the speech, swallowing pattern with the appliance on, and posterior disocclusion when the appliance is removed. Accordingly, the force levels were increased to 400–500 grams per side.

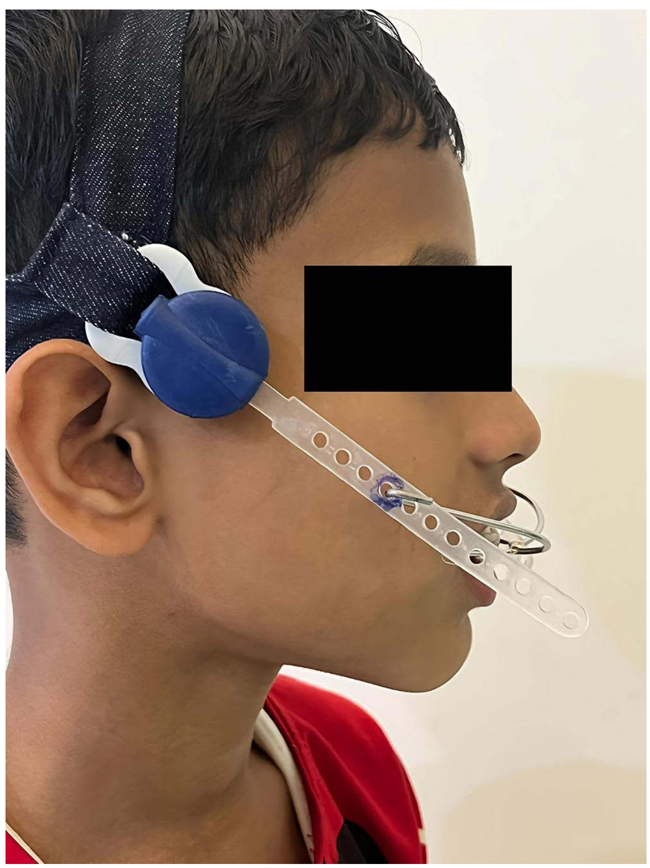

Figure 7 Maxillary intrusion splint with high pull headgear.

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Statistical Analysis and Results

All the analysis was done using SPSS version 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp). Normality was assessed using Shapiro–Wilk test. Intra-group comparisons were done using paired sample *t* test. The mean differences (T2-T1) for all the variables were non-normal in distribution. Inter-group comparisons of the mean differences were done using Mann-Whitney *U*-test.

The treatment group consisted of 20 lateral cephalograms (4 boys and 16 girls; mean age = 12.8 years). Similarly, control group consisted of 20 lateral cephalograms of the control group (3 boys and 17 girls; mean age = 12.6 years).

Intra-group comparisons in the treated group showed significant decrease in the mean values of SNA (P<0.001), ANB (P<0.001), N perpendicular to Point A (P=0.002), Point A vertical (P<0.001), PNS vertical (P=0.039), U1 – NA (angular) (P<0.001), U1 - SN (P<0.001), U1 – NA (linear) (P<0.001), U1 - NF (P<0.001), PtV- U6 (P<0.001), overjet (P<0.001), overbite (P<0.001), S line Upper Lip (P<0.001) and S line to Lower Lip (P<0.001) at T2 when compared to T1. However, there was a significant increase in the mean SNB (P<0.001), N-Pog (P<0.001), EMnL (P<0.001), LAFH (P<0.001), at T2 when compared to T1.

Intra-group comparisons in the control group showed significant increase in the mean values of SNA (P<0.001), ANB (P<0.001), N perpendicular to Pogonion (P=0.003), Effective Mx (P<0.001) L, Effective MnL (P<0.001), LAFH (P<0.001), Point A vertical (P<0.001), ANS vertical (P<0.001), PNS vertical (P<0.001), U1 – NA (angular) (P=0.005), U1 – SN (P=0.001), U1 – NA (linear) (P=0.011), U1 – NF (P=0.012), PtV - U6 (P<0.001), and overjet (P=0.039) at T2 when compared to T1. No other significant differences were seen in treated or control group (Table 1).

Table 1 Pre Treatment and Post Orthopaedic/Post Observation Comparison in Study and Control Groups

		Treated				P-value	Control				P-value
		T1		T2			T1		T2		
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Skeletal	SNA	80.35	4	79.3	3.69	<0.001	81.1	3.4	82.1	3.15	<0.001
	SNB	73.4	3.75	74.75	3.54	<0.001	74.4	2.93	74.6	2.98	0.297
	ANB	6.95	1.82	4.65	1.76	<0.001	6.65	2.16	7.55	1.78	<0.001
	Go - Gn – Sn	36.1	5.04	35.95	4.9	0.379	33.45	4.5	33.57	4.47	0.555
	AOI	84	3.32	83.93	3.27	0.545	83.7	3.11	83.85	3.08	0.316
	BPA	26.8	5.08	26.8	4.97	>0.99	24.55	4.89	24.2	4.51	0.236
	Y	71.8	4.10	71.65	3.92	0.379	70.25	3.27	70.38	3.23	0.549
	Facial axis	−4.65	3.42	−4.5	3.32	0.379	−4.45	3.14	−4.45	3.07	>0.99
	NPtA	−0.45	2.96	−1.32	2.79	0.002	−3.78	2.99	−2.97	2.44	0.085
	N-Pog	−11.8	4.85	−9.5	4.89	<0.001	−16.65	5.07	−15.65	5.41	0.003
	EMxL	86.8	4.89	86.92	4.07	0.741	86.5	4.32	87.85	4.4	<0.001
	EMnL	103.4	5.36	106.73	6.16	<0.001	103.85	4.51	105.73	4.9	<0.001
	LAFH	64.85	3.45	66.02	3.57	<0.001	65.25	3.89	67.2	3.96	<0.001
	PtA Vertical	53.68	2.68	53.22	2.8	<0.001	51.75	2.74	53.65	2.58	<0.001
	ANS Vertical	49.53	2.53	49.69	2.61	0.116	47.58	2.66	49.38	2.72	<0.001
	PNS Vertical	47.68	2.12	47.55	2.12	0.039	46.42	3.61	48.17	3.61	<0.001

(*Continued*)

Table 1 (Continued).

		Treated				P-value	Control				P-value
		T1		T2			T1		T2		
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
	U1 NAA	32.5	5.7	26.17	5.42	<0.001	29.55	5.51	30.33	5.59	0.005
	U1 SN	111.9	5.88	105.93	6.27	<0.001	108.25	6.76	110.05	6.3	0.001
	L1 Mp	102.75	4.63	102.73	4.93	0.916	108.1	5.3	108.3	5.34	0.56
	U1 NA L	8.5	1.97	4.1	1.78	<0.001	7.85	2.98	8.55	3.14	0.011
	U1 NF	28.75	2	27.05	1.95	<0.001	29.25	2.49	29.58	2.42	0.012
	U6 NF	21	2.7	20.8	1.99	0.674	20.8	1.58	21.33	1.67	0.062
	PtV U6	13.88	2.39	11.8	2.45	<0.001	11.9	2.85	12.52	2.89	<0.001
	L1 NB	8.55	2.26	8.25	2.61	0.308	9.3	2.45	9.57	2.68	0.206
	Overjet	8.7	1.63	3.9	2.18	<0.001	6.7	2.32	7.1	2.11	0.039
	Overbite	4.65	1.14	2.65	1.5	<0.001	5	0.73	5.17	0.77	0.11
Soft tissue	S UpL	4.8	1.01	2.4	1.39	<0.001	4.8	2.02	4.88	2.28	0.748
	S LwL	5.45	2.76	3.75	1.92	0.002	6	2.68	6.2	2.78	0.258

Note: Paired *t* test.

Inter-group differences of T2-T1 values showed significantly higher mean difference in treated group than control group for various parameters like SNA (P<0.001), SNB (P=0.003), ANB (P<0.001), N perpendicular to Point A (P<0.001), N perpendicular to Pogonion (P<0.037), U1 – NA (angular) (P<0.001), U1 – SN (P<0.001), U1 – NA (linear) (P<0.001), U1 – NF (P<0.001), PtV - U6 (P<0.001), overjet (P<0.001), overbite (P<0.001), S line Upper Lip (P<0.001) and S line to Lower Lip (P<0.001). However, inter-group differences of T2-T1 values showed significantly lower mean difference in treated group than control group for Effective MxL (P=0.002), LAFH (P=0.001), Point A vertical (P<0.001), ANS vertical (P<0.001), and PNS vertical (P<0.001). No other significant differences were seen (Table 2).

Table 2 T2-T1 Inter-Group Differences

	Treated Mean±SD	Control Mean±SD	P-value	Effect Size
SNA	−1.05±0.76	1±0.71	<0.001	0.95
SNB	1.35±1.23	0.2±0.83	0.003	−0.52
ANB	−2.3±1.53	0.9±0.93	<0.001	0.96
Go - Gn – Sn	−0.15±0.75	0.12±0.93	0.435	0.14
AOI	−0.07±0.54	0.15±0.65	0.283	0.18
BPA	0±0.46	−0.35±1.28	0.439	−0.13
Y	−0.15±0.75	0.12±0.92	0.451	0.13
Facial axis	0.15±0.75	0±0.76	0.646	−0.08

(*Continued*)

Table 2 (Continued).

	Treated Mean±SD	Control Mean±SD	P-value	Effect Size
NPtA	−0.87±1.1	0.8±1.97	<0.001	0.83
N-Pog	2.3±1.92	1±1.3	0.037	−0.38
EMxL	0.13±1.67	1.35±0.75	0.002	0.56
EMnL	3.33±2.37	1.87±1.21	0.097	−0.30
LAFH	1.17±0.57	1.95±0.86	0.001	0.61
PtA Vertical	−0.46±0.3	1.91±0.38	<0.001	1.00
ANS Vertical	0.17±0.46	1.8±0.22	<0.001	1.00
PNS Vertical	−0.13±0.26	1.75±0.19	<0.001	1.00
U1 NAA	−6.33±2.57	0.78±1.09	<0.001	1.00
U1 SN	−5.97±2.85	1.8±1.94	<0.001	1.00
L1 Mp	−0.02±1.04	0.2±1.51	0.74	0.06
U1 NA L	−4.4±1.32	0.7±1.12	<0.001	1.00
U1 NF	−1.7±0.44	0.32±0.52	<0.001	0.99
U6 NF	−0.2±2.09	0.53±1.19	0.295	0.19
PtV U6	−2.07±0.92	0.63±0.65	<0.001	0.97
L1 NB	−0.3±1.28	0.28±0.94	0.22	0.22
Overjet	−4.8±2.02	0.4±0.8	<0.001	1.00
Overbite	−2±1.52	0.18±0.47	<0.001	0.78
S UpL	−2.4±0.75	0.07±1.03	<0.001	0.95
S LwL	−1.7±2.05	0.2±0.77	<0.001	0.70

Note: Mann–Whitney *U*-test.

Discussion

Class II division 1 malocclusion with large overjet, visible incisors when lips are at rest and gummy smile represents the most common skeletal discrepancy which orthodontists see in daily practice. The most acceptable objective in treatment of skeletal Class II division 1 malocclusion with vertical maxillary excess is the inhibition of the forward and downward maxillary growth during puberty. During that growth period, the compensatory development of the mandible reduces the sagittal dysplasia. The forward and downward growth of the maxilla can only be prevented using extraoral appliances.

While Kloehn's cervical headgear significantly restricts forward maxillary growth, as shown in multiple studies, it frequently leads to adverse effects such as palatal plane backward rotation, mandibular plane steepening, and extrusion of maxillary molars.

The concept of full coverage MSHPH was introduced by Raymond Thurow.[7] He opined that heavy forces were required to maintain the maxilla in vertical plane while applying a distally directed force to the entire maxilla. A larger base in the splint than the first molars alone can yield a high-pull force distribution. Subsequently, many authors[1,2,8–11] have proposed modifications of the MSHPH and evaluated the impact on the dentoskeletal system. Given the limited number of studies on this appliance, inconsistencies in treatment outcomes across the literature are expected, compounded by modified designs, variations in the clinical management, and applied force. Hence, we aimed to check the effectiveness of MSHPH on skeletal, dental and soft tissues among children with class II malocclusion. Based on the results of our study, the null hypothesis was rejected as substantial cephalometric measurements had significant differences between treated and control group.

Effects on Skeletal Structures

Effect on Maxilla in Sagittal and Vertical Dimensions

The restrictive effect of headgears on the maxillary growth had been proved time and again by almost every author who attempts to study the effects of headgears. This study also confirms the efficacy of MSHPH on downward and forward growth restriction of the maxilla with relative sagittal repositioning of maxilla, significant reduction in the SNA and N perpendicular to point A stands testimonial for this orthopaedic effect. The high pull headgears bring about reduction in class II primarily by restricting the maxillary growth allowing the mandible to grow to its potential which substantially increases SNB angle and reduces the ANB. This aligns with the results observed by Thurow,[7] Orton[9] et al and Uner and Yucel-Eroglu.[11] However, few authors reported only slight sagittal repositioning of the maxilla.[8,12]

The point A in control group had moved forward with increase in midfacial convexity because of increased horizontal growth at A with increase in ANB, which was in accordance with the study by Rothstein.[13] Thus, it is desirable to restrain downward and forward growth of the vertically growing maxilla and allow the mandible to grow normally.

Consistent with the appliance's design, the maxilla exhibits the majority of skeletal changes, leading to restricted vertical development similar to previous reports.[7,9,11] However, few studies[2,8] have noticed only vertical reduction of maxillary development with more of dentoalveolar changes than the skeleton itself. Though these changes represented an orthopaedic response of not more than one to two degrees/millimetres in treated group, nevertheless when compared with control group the results could be considered clinically and statistically significant. This was confirmed with the cephalometric findings which measure vertical parameters Pt A vertical (MD –2.36), ANS Vertical (MD - 1.66 mm), PNS vertical (MD - 1.88 mm) indicating the amount of restriction of vertical development of maxilla which was significantly higher in treatment than control group.

Effect on Mandible

The effect of MSHPH on the mandible was minimal and different from other functional appliances. Anterior movement of the mandible was higher in treated group than control group. This could be because of restriction of the maxilla in vertical dimension which facilitated forward rotation of the mandible and anterior positioning of the pogonion.

The treatment group demonstrated significant decrease in the "ANB angle", driven primarily by posterior movement of "point A" and anterior movement of "pogonion", similar to earlier studies.[1,2,7,9,11]

Effect on the Palatal Plane

Merifield and Cross[14] demonstrated that force vectors positioned posterior to the maxilla's centre of resistance lead to downward tipping of the "anterior nasal spine". Teuscher[15] similarly noted that avoiding this rotation requires positioning the force vector anterior to the centre of resistance. In this study, the MSHPH force was directed through the maxilla's centre of resistance, preserving palatal plane angulation - a result consistent with Fotis et al,[8] Caldwell et al,[2] and Orton et al[9] though reported by Watson,[16] Firoz et al[17] and Uner and Yucel-Eroglu[11] highlighting how force direction relative to the centre of resistance explains outcome variations.

Effect on Dental Structures

In Sagittal and Vertical Dimensions

As anticipated, statistical evaluations confirm that the most substantial changes occur in the maxillary dentoalveolar region, with consensus supporting this treatment's efficacy in reducing incisor proclination and overjet while achieving distal molar movement and Class II to Class I correction.

The headgear has always been the most efficient method to distalize the maxillary molars. In this study, we can appreciate the amount of distal movement of the molar that has taken place. The main reason for bodily distalization of the molar is that the line of force passing through the centre of resistance of the maxillary dentition. Any deviation in the line of force can lead to undesirable distal tipping of the root of the molar with mesial tipping of the crown which is undesirable.

The most desired outcome of MSHPH was overjet correction. In the treated group, the upper incisor was intruded in relation to palatal plane to a great extent. The intrusion of upper incisors in treatment group was significant along with significant reduction in the overbite. The incisor display had significantly reduced as compared to control group. The effective bite opening could be partly due to intrusion of upper anterior with force passing through the centre of resistance of dentition and extrusion of lower posterior teeth while the lower anteriors were in contact with the splint levelling the Spee. In the control group, a clinically significant increase in the vertical height of the incisors was observed.

The control group displayed vertical elongation of maxillary molars, while treated patients exhibited a non-significant decrease or intrusion, suggesting total suppression of vertical growth in both molars and incisors.

Effect on the Soft Tissue

Anticipating soft tissue changes is challenging due to numerous factors like tissue thickness, growth spurts, and individual biological differences, which contribute to varied facial profiles. However, alterations in incisor positioning directly affect overlying soft tissues, leading to measurable profile improvements.

In class II division 1 malocclusion most commonly, we see lip trap and proclination of the upper incisors with hyperactive mentalis. All these are eliminated when we use a splint with high pull headgear which facilitates spontaneous improvement in the soft tissue profile due to retraction of upper incisors, which in turn enhances upper lip fall and reduction of overjet.[18]

In this study, the upper and lower lips showed retrusion, with upper lip retraction being more than the lower.[19]

Limitations

Retrospective design, limited sample size, variable follow-up rates, lack of randomization are some of the limitations in this study. However, to overcome few of these limitations, we had included participants with complete data, matched treated and control group with respect to age, sex and skeletal maturity and enumerated all the patients to increase the power of the study.

Conclusion

The MSHPH was effective in achieving vertical and antero-posterior correction of maxillomandibular malrelationship during the growth period. This was due to effective restriction of maxillary development, for which the mandible continues to develop without rotating backward. The changes that were observed were in the maxilla and maxillary teeth which include distal movement of the maxilla, distal tipping of maxillary molars, palatal tipping of incisors, inhibition of vertical maxillary growth, and incisor intrusion, while the mandibular plane angle shows minimal reduction or remains stable.

Correction of the posterior dental relationships was the significant effect of MSHPH. Overbite and especially overjet decreased substantially and rapidly with proper cooperation from the patient. Whereas in control group there was no restriction on the development of maxilla and the class II discrepancy worsened with further eruption and mesialisation of molars. The overjet and overbite remained same or increased. Consequently, this appliance demonstrates substantial corrective potential, primarily influencing the maxilla and maxillary dentoalveolar structures by regulating both vertical and horizontal growth dimensions. Overall, it serves as an effective orthopaedic phase to achieve foundational treatment objectives before proceeding to fixed appliances.

Abbreviations

MSHPH, Maxillary splint with high pull headgear.

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Disclosure

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