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ORIGINAL RESEARCH

Orthopedic Effect of Chin Cup during Mixed Dentition Stage

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ABSTRACT

Introduction: Chin cup (CC) therapy has been used as the traditional appliance for treating class III malocclusion during mixed dentition period. The aim of this study was to investigate the effect of CC on the improvement of skeletal and dentoalveolar skeletal changes in class III patients during mixed dentition stage.

Materials and methods: A total of 30 patients (7–9 years old) with skeletal class III malocclusion were selected based on clinical and cephalometric examination. Out of 30 patients, 20 underwent CC therapy. All orthodontic records and measurements were taken before and after treatment. Similar records were collected from the control group. The lateral cephalometric films were traced before and after treatment and analyzed.

Results: There was a significant improvement in maxillary and the mandibular skeletal measurements after CC therapy. Improvement of ANB angle and an increase in Wits appraisal have been detected in the treated group according to intermaxillary skeletal variables.

Conclusion: The study concluded that the CC therapy is effective for correcting skeletal class III malocclusion along with positive changes in the dentoskeletal variables during the mixed dentition stage.

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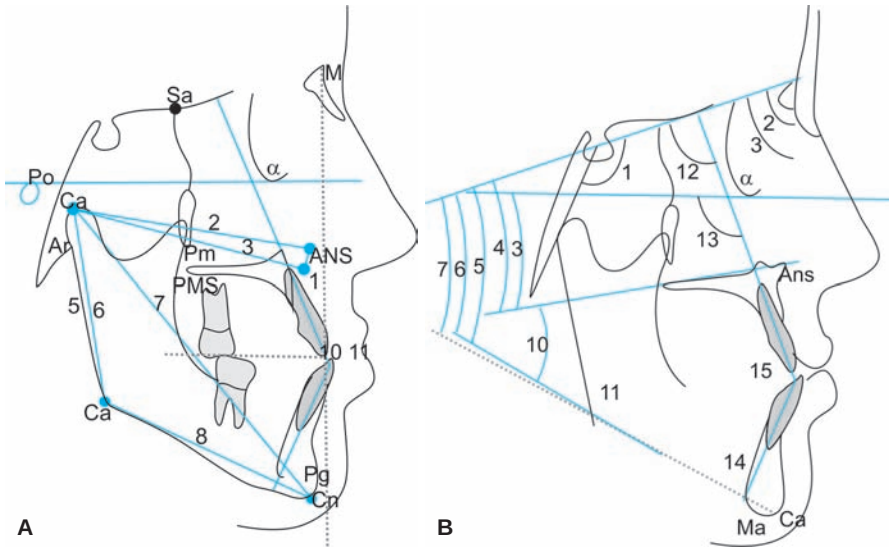
INTRODUCTION

Chin cup (CC) therapy has been widely used as the traditional appliance for treating class III malocclusion. Chin cup is the preferred appliance for growing children with mandibular prognathism.[1-3] Chin cup is designed to suppress and/or redirect the mandibular growth, close the gonial angle, and remodel the mandibular and temporomandibular joint. The CC appliances can be divided into two subcategories: The vertical pull CC and the occipital pull CC. The vertical pull CC is an orthopedic extraoral appliance designed and used to address problems associated with lower face height and/or open bite, which can accompany class III or class I malocclusions.[4] Unlike other extraoral appliances, vertical pull CC should be worn during or shortly after the pubertal period, treatment lasts for 1 or 2 years depending on the severity of the case with this type of appliances.[5]

The other type of CC appliance is occipital pull CC and is used in anteroposterior problems and, specifically, class III malocclusion. Contrary to vertical CC, occipital pull CC is used for moderate orthopedic class III problems for the age group between 4 and 9 years.[6] It can also be worn during the retention period following face mask treatment.[7] Factors, such as age and sex of the patient have to be given important consideration during the CC therapy. The duration of wearing the device could range from 8 to 10 hours a day.[3]

Despite the advantages of the CC appliance, clinical results of using CC proved to be a matter of debate.[8,9] The



Figs 1A and B: (A) Cephalometric linear measurements: (1) A to N perpendicular, (2) Co-ANS, (3) Co-A, (4) Pg to N perpendicular, (5) Co-Go, (6) Ar-Go, (7) Co-Gn, (8) Go-Gn, (9) Wits appraisal, (10) Overjet, (11) Overbite; and (B) cephalometric angular measurements: (1) NSBa, (2) SNA, (3) SNB, (4) ANB, (5) SN-PP, (6) SN-GoMe, (7) SN-GoGn, (8) FH-palatal plane (PP), (9) FH-mandibular plane (MP), (10) PP-MP, (11) gonial angle, (12) U1-SN, (13) U1-FH, (14) incisor mandibular plane angle (IMPA), (15) interincisal angle

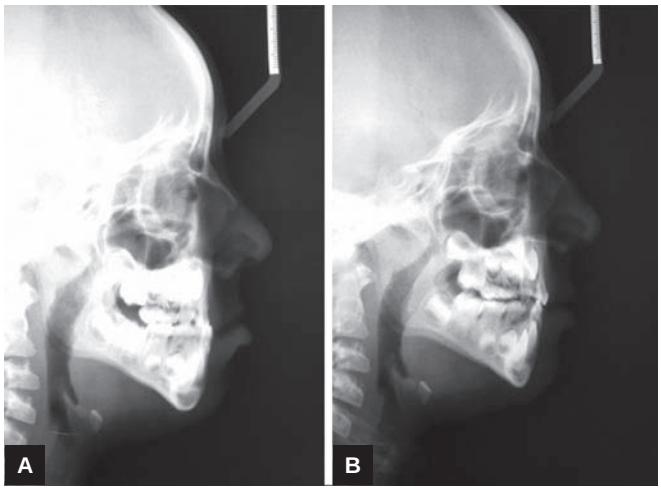
usage of CC reveals contradictions regarding their use and clinical effectiveness. Several cephalometric variables are found to be affected by the CC use, such as reduction of the SNB (sella, nasion, B point) and the gonial angle, increase in the anterior facial height, increase of the overjet (OJ), and slight reduction of the overbite (OB).[10,11] It is also used to open the bite along with an intraoral appliance or a bite-plate.[12,13] The reduction of SNB angle leads to restriction on the mandibular growth, significant rotation of the mandible, and significant increase of the OJ.[2,14] On the contrary, other studies revealed that using CC in class III malocclusion results in increased OB and negative OJ.[15] The objective of the study was to evaluate the skeletal and dentoalveolar changes in class III malocclusion treated with CC therapy.

MATERIALS AND METHODS

The study was conducted on 30 patients with skeletal class III malocclusion. Patients selected ranged from 7 to 9 years of age and were followed up for 10 months. The study was approved by the institutional review board. Patients were selected from the Orthodontic Department of the Faculty of Dental Medicine in Al-Azhar University, Egypt. Out of 30 patients, 20 had undergone CC therapy with maxillary bite block. The remaining 10 subjects who did not undergo the treatment were included as control group.

Selection of patients in both groups was made according to the following criteria: (1) Skeletal class III relationship with normal maxilla and prognathic mandible, (2) all patients had no transverse discrepancy between dental arches, (3) no craniofacial anomaly, (4) no history of previous orthodontic treatment, (5) all patients had class III malocclusion in the mixed dentition stage, and (6) patients and parents are cooperative with the dentist.

The orthodontic records were taken for all patients. Lateral cephalometric films were taken to analyze the pre- and posttreatment changes resulted from using CC, and appliances were worn for 12 to 14 hours a day with force magnitude 600 gm per side. At the beginning of the treatment (T1) and the end (T2), lateral cephalograms were taken. The analysis used for all cephalograms in this study contained measurements from several analyses. In addition, the researcher used lateral cephalometric films to determine linear and angular measurements as in Figures 1A, B, 2A and B. Furthermore, for establishing



Figs 2A and B: (A) Lateral cephalometric pretreatment; and (B) lateral cephalometric posttreatment

Figs 3A and B: (A) Preoperative view; and (B) Postoperative view

the patients' skeletal age, hand and wrist radiographs were used and analyzed.

Each cephalogram was traced, and the linear and angular variables were measured. The cephalometric measurements used in the study were as following: Maxillary skeletal, SNA angle, A-N perpendicular (point A to a line drawn perpendicular to the FM from N), Co-ANS, and Co-A; cranial flexure, NSBa angle; mandibular skeletal: SNB angle, Pg-N perpendicular (Pg to a line drawn perpendicular to the FM from N), Co-Go, Ar-Go, Co-Gn, and Go-Gn; vertical skeletal: SN-palatal plane (PP) angle, SN-GoMe angle, SN-GoGn angle, FH-PP angle, FH-mandibular plane (MP) angle, PP–MP angle, and gonial angle (Ar-Go-Me); skeletal differences: ANB angle, wits appraisal (distance between the two points of intersection of the two perpendicular lines from points A and B to the functional occlusal plane), and maxillo-mandibular differential (difference between Co-A and Co-Gn) and dental measurements: Maxillary central incisor (U1)-SN angle, U1-FH angle, incisor MP angle, interincisal angle, OJ, and OB.

Statistical Analysis

All measurements were tabulated and analyzed. The data were analyzed using one-way analysis of variance and Tukey *post hoc* analysis.

RESULTS

The cephalometric measurements of the control and treated groups are shown in Table 1. Significant changes were seen in the treated group at the end of the CC therapy with improvements in the maxillary and the mandibular skeletal measurements in the treated group (Figs 3A and B). Improvement in intermaxillary skeletal variables was observed in the treated group with an average increase of ANB angle and Wits appraisal. The

Table 1: Comparison of the changes from T1 and T2 in the control and treated groups

	Control group			*Treated group*		
	T1	*T2*		*T1*	*T2*	
	Mean ± SD	*Mean ± SD*	*Significant*	*Mean ± SD*	*Mean ± SD*	*Significant*
Cranial flexure						
NSBa	128.1 ± 3.15	128.2 ± 3.01	−0.118 NS	129.9 ± 2.43	127.4 ± 1.8	3.71***
Maxillary skeletal						
SNA	78 ± 1.51	78.2 ± 1.42	−0.37 NS	81 ± 1.31	78.53 ± 1.35	5.26***
A-N⊥ (mm)	−5.06 ± 1.66	−5.13 ± 1.8	0.105 NS	−1.26 ± 1.49	−3.06 ± 1.38	3.41**
CO-ANS (mm)	78.8 ± 1.97	79.8 ± 1.56	−1.53 NS	91.46 ± 1.5	88.4 ± 1.88	7.79***
CO-A (mm)	74.4 ± 2.19	75.26 ± 2.21	−0.39 NS	82.4 ± 1.95	80.9 ± 2.08	2.35*
Mandibular skeletal						
SNB	80.26 ± 1.27	80.33 ± 1.54	−0.129 NS	82.6 ± 1.12	79.2 ± 1.26	7.79***
Pg-N⊥ (mm)	0.33 ± 1.718	0.4 ± 1.8	−0.104 NS	2.36 ± 1.46	0.4 ± 1.73	3.35**
CO-GO (mm)	47.06 ± 2.18	48.13 ± 1.84	−1.19 NS	57.06 ± 1.7	50.2 ± 1.97	10***
Ar-GO (mm)	38.26 ± 1.43	39.26 ± 1.62	−1.78 NS	47 ± 1.92	42.46 ± 1.59	7***
Co-Gn (mm)	102.6 ± 2.76	103.9 ± 3.3	−1.13 NS	126.9 ± 2.98	120 ± 2.18	7.18***
GO-GN (mm)	64.4 ± 1.95	65.5 ± 1.48	−1.42 NS	80 ± 1.69	77.8 ± 1.99	3.77**
Skeletal difference						
ANB	−1.26 ± 0.79	−1.16 ± 0.82	1.12 NS	1.96 ± 0.74	−2.2 ± 1.42	10***
Wits app	−6 ± 1.69	−6.16 ± 1.38	0.11 NS	−2.26 ± 1.03	−12.2 ± 3.12	11***
Vertical						
SN-PP	9.26 ± 1.29	9.54 ± 1.28	−0.58 NS	11.6 ± 1.35	10 ± 1.5	3.55**
SN-GO Me	38.93 ± 1.46	39.03 ± 1.11	−0.21 NS	48 ± 1.24	39.26 ± 1.53	17***
SN-GO GN	38 ± 1.69	38.73 ± 1.84	−0.21 NS	48.6 ± 1.63	39.3 ± 1.49	3.55**
FH-PP	3.46 ± 1.15	4.2 ± 0.95	−1.57 NS			
FH-MP	27.43 ± 2.6	28.8 ± 2.19	−1.57 NS	6.4 ± 1.96	4.7 ± 2.28	17***
PP-MP	29.76 ± 2.53	30 ± 2.93	−1.59 NS	33.2 ± 2.48	31 ± 3.21	16***
Gonial angle	131.4 ± 2.83	133 ± 3.18	−0.23 NS	36.6 ± 1.71	34.13 ± 2.06	2.53*
Dental						
U1-SN	100 ± 3.66	102 ± 3.66	−1.22 NS	105 ± 3.29	101.9 ± 1.57	3.39**
U1-FH	106 ± 5.07	108 ± 5.21	−0.87 NS	116.4 ± 2.89	114 ± 2.07	2.68*
IMPA	89.4 ± 1.96	90.7 ± 2.36	−1.67 NS	89.26 ± 2.43	86.4 ± 2.06	4.01**
Interincisal angle	141.6 ± 3.18	139.5 ± 1.81	−0.78 NS	131.5 ± 2.44	128 ± 2.61	3.6**
Overjet	−2.26 ± 1.03	−2.76 ± 1.25	1.19 NS	–3.06 ± 1.72	2.26 ± 0.96	10.5***
Overbite	2.26 ± 0.92	2.38 ± 0.92	−0.15 NS	5.06 ± 1.47	3.86 ± 1.68	2.40*

*Statistically significant at ($p < 0.05$) level; **statistically significant at ($p < 0.01$) level; ***statistically significant at ($p < 0.001$) level; SD: Standard deviation; NS: Not significant

OJ has improved significantly (2.26 ± 0.96) at the end of CC therapy. In addition, there was a significant decrease in the axial inclination of the upper and lower incisors (Table 1).

DISCUSSION

This study was conducted to analyze the dentoalveolar changes in 20 patients with class III malocclusion treated with CC therapy. The sagittal maxillary position [SNA-AN⊥], showed significant changes at the end of CC therapy while Co-A and Co-ANS showed nonsignificant changes. This observation is in agreement with the studies reported by Tuncer et al[11] and Altuğ et al.[16] However, other studies failed to show any similar changes.[3,10,17]

This study showed significant reduction of all mandibular skeletal variables (Ar-Go, Co-Go, Co-Gn, and SNB) except Go-Gn and this agrees with earlier studies.[3,10,11,17] This reduction could be explained as the result of the force of CC, which is applied directly to the mandible for trying to restrict its horizontal growth and convert it to some extent into vertical growth.[18] However, a study by Deguchi and McNamara[14] observed no significant changes by CC therapy in class III patients. This study showed a significant increase in ANB and Wits appraisal, which is in agreement with other studies.[3,10,11,17] A significant increase in vertical angular variables (SN-Go Me, SN-Co GN) was also observed. This increase is due to the backward and downward rotation of the mandible.

Significant reduction of gonial angle was also observed in the study group, similar to the observations of the previous reports.[3,10,17] This effect may be due to the applied force passing through the occipital area and the glenoid

fossa via the condyle.[14] Similar findings were reported in earlier studies.[2,4] In contrast to the earlier reports,[3,17] our study showed significant reduction of Co-Go.

The study showed positive OJ in all patients at end of CC therapy. There was also a significant decrease in axial inclination of maxillary anterior teeth and interincisal angle at the end of CC therapy. However, mandibular anterior teeth and OB showed no significant changes at the end of treatment, which is in agreement with earlier studies.[3,17] A significant increase in OB was reported by Barrett et al[17] and this may be due to the use of Quad-helix with the CC in the treatment of class III malocclusion cases.

CONCLUSION

From the observations, it can be concluded that the CC therapy is effective for correcting skeletal class III malocclusion. It can significantly improve the dentoskeletal variables during the mixed dentition stage. Further longitudinal long-term studies are required to fully ascertain the skeletal and dental changes of CC therapy.

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