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Long-term effect of the chincap on hard and soft tissues

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SUMMARY The short- and long-term effects of the chincap used in combination with a removable appliance to procline upper incisors were analysed cephalometrically in 23 patients with Class III malocclusions. The overall changes were compared with growth changes in a closely matched control sample of untreated Class III patients. There was no evidence that the chincap retarded growth of the mandible. During treatment, there was an increase in mandibular length and facial height. The lower incisors retroclined and the upper incisors proclined. The incisor relationship was corrected. Soft tissue changes included an increase in nasolabial angle and improvement in soft-tissue profile, including the nose. Skeletal post-treatment changes included further mandibular growth associated with an increase in angle SNB and Wits measurement. Facial height also increased significantly. The Class I overjet was maintained, although slightly diminished. The soft tissue nose, upper and lower lip, and chin moved anteriorly, and the nasal tip and chin moved inferiorly.

At the end of the study period there were no significant skeletal or soft tissue differences between the treated and control groups. The only significant contrasts were in the overjet and the overbite.

Chincap therapy combined with an upper removable appliance to procline the upper incisors is effective in producing long-term correction of the incisor relationship by retroclination of lower incisors, proclination of upper incisors, and redirection of mandibular growth in a downward direction. The direction of growth at the chin is maintained subsequent to treatment, as are the changes in incisor inclination, although in diminished form. There are corresponding improvements in the soft tissue profile.

Introduction

The chincup or chincap, with cervical or occipital traction, has been used since the nineteenth century to control mandibular growth in patients with large and/or anteriorly positioned mandibles. Through the years, Westcott (1844) and Allen (1879) have advocated its use. On the other hand, Angle (1907) regarded the chincap as an unreliable appliance.

The effects of chincap force on dentofacial growth have been investigated using cephalometric analyses and animal experiments. Cephalometric studies have revealed redirection and inhibition of mandibular growth, backward repositioning of the mandible, and remodelling of the mandibular shape (Suzuki, 1972; Irie and Nakamura, 1975; Graber, 1977; Sakamoto, 1981; Wendell *et al.,* 1985; Sugawara *et al.,* 1990). Experimental animal studies showed retardation of ramal growth, closure of the gonial angle, and a decrease in the prechondroblastic layer of the condyle (Janzen and Bluher, 1965; Joho, 1973; Asano, 1986).

Allen *et al*. (1993) studied the short-term effect of the chincap in 23 patients with Class III relationships of the incisor teeth with the chincap supplemented by an upper removable appliance, where proclination of upper incisors was appropriate. They found that the effect of the chincap could be attributed to retroclination of the lower incisors and downward movement of the mandible.

Sugawara *et al.* (1990) studied the long-term effect of chincap therapy in a sample of 63 Japanese girls with Class III malocclusion. They concluded that the skeletal profile was greatly improved during the initial stages of chincap therapy, but often deteriorated thereafter.

Üner *et al.* (1995) investigated the effects of 1 year of chincap treatment and the skeletal changes during the 4 years following the end of chincap therapy in 27 patients with anterior crossbite. Of these, 15 had skeletal Class III and 12 had skeletal Class I jaw relationships. The results showed that where a positive overjet was obtained during treatment, the abnormality tended to return to the original condition during the period following chincap removal. The relapse potential was more pronounced in skeletal Class I than in skeletal Class III patients.

The aims of the present study were to confirm the changes brought about by chincap therapy with an upper removable appliance to procline the upper incisors, to investigate the long-term post-treatment changes, and to compare the overall changes with those in an untreated control sample of subjects with Class III malocclusions.

Material and methods

The material for the study comprised lateral cephalometric radiographs of 23 patients (14 males, nine females) with a Class III relationship of the incisor teeth treated with the chincap. The reverse overjet averaged 2.93 ± 3.37 mm. Chincap forces between 200 and 450 g with low angulation were used in an attempt to restrain the growth of the mandible. An upper removable appliance for proclination of the upper incisors was added when the incisors were retroclined at presentation. Treatment continued until the overjet was positive. The records consisted of three cephalometric radiographs: the first before treatment (T1), at an average age of 8.11 ± 0.96 years; the second at the end of active treatment (T2), 3.01 ± 1.61 years later than T1; and the third at least 1 year post-treatment (T3), on average 3.34 ± 1.80 years after T2. Before treatment, all subjects were in dental stage 1 (eruption of first molars and incisors). Each treated (chincap) patient was matched before treatment with a Class III (control) subject for the Wits measurement of skeletal discrepancy to within 0.1 mm, sex and dental stage. Control subjects received no treatment during the period of the investigation. The control subjects had two records: one matched with the chincap patient at the commencement of treatment (T1) and the second 4.12 ± 1.86 years after the initial radiograph (T3). The points, planes and lines shown in Figure 1 were traced from the cephalometric radiographs. The definitions of most points were conventional, with the addition of arbitrary points SH and SV on sella horizontal and sella vertical to facilitate the digitization program. In this study the Wits measurement of anteroposterior jaw relationship was measured by projection on the maxillary/mandibular planes bisector (Hall-Scott, 1994) to avoid corruption of the Wits measurement by alteration in the angle of the occlusal plane during treatment.

Tracings were digitized using a GTCO digitizer (SSI Microcad, Fordbrook Business Centre, Pewsey, Wiltshire, UK) with a 16-button cursor connected to an IBM compatible computer, using a program written in GeLa (Gordon, 1994). The output file from GeLa was converted into comma delimited form using an 'awk' script and read in Excel where the initial analyses were carried out.

Method error

Ten films from the chincap group were retraced and digitized, and the method errors calculated as recommended by Dahlberg (1940) and Houston (1983). The standard error of a single determination (Dahlberg) varied between 0.35 and 1.61 mm, and from 0.69 to 1.72 degrees. Houston's coefficient of reliability ranged from 0.86 to 1.00 with only two variables below 0.90, which is given by Houston (1983) as the dividing line between satisfactory and unsatisfactory measurements.

Statistical analysis

The mean differences in cephalometric measurements between the treated group at T1, T2, and T3 were examined using the paired *t*-test. In each case the earlier measurement was subtracted from the later measurement, thus positive differences shown in the tables indicate an increase in the measurement.

The mean measurements derived from the first film in the control group and T1 in the chincap

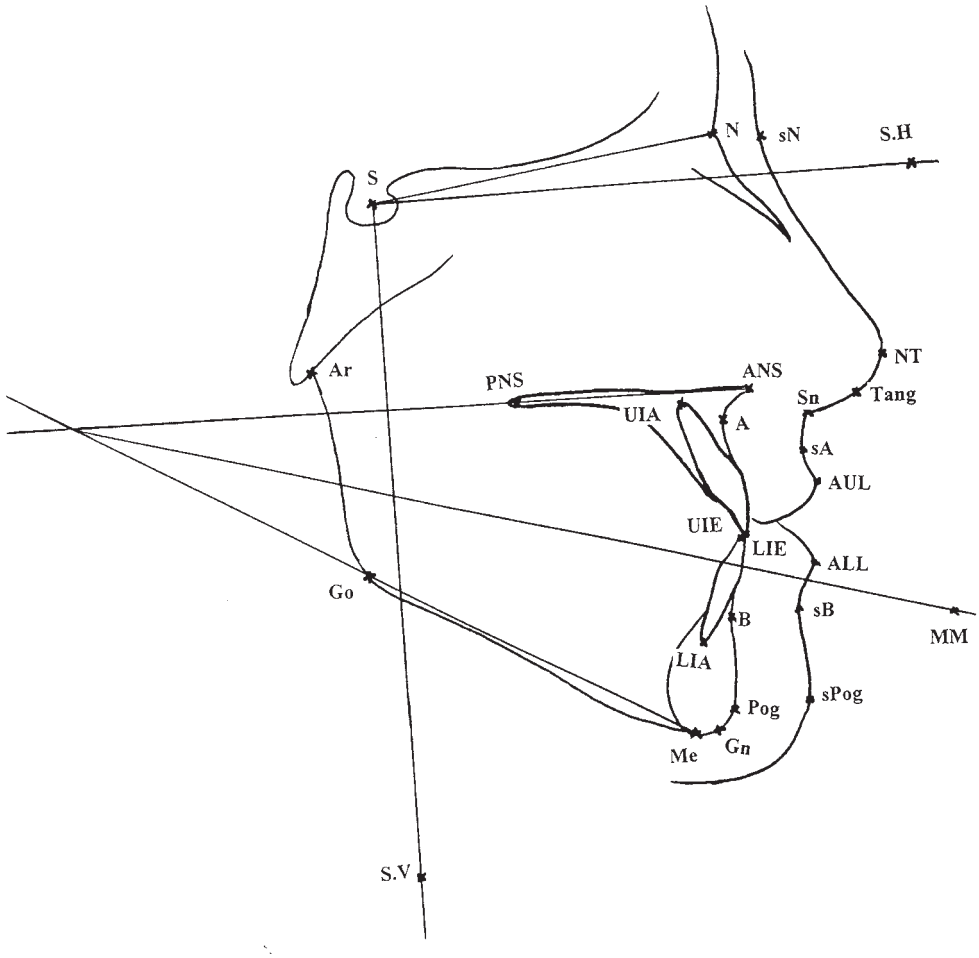

Figure 1 Hard and soft tissue reference points and reference planes. Sella (S), nasion (N), articulare (Ar), anterior nasal spine (ANS), posterior nasal spine (PNS), point A, point B, pogonion (Pog), menton (Me), gnathion (Gn), gonion (Go). SH: a point located on the sella horizontal line. SV: a point located on the sella vertical line. UIE: midpoint of upper central incisor edge. UIA: apex of the upper central incisor. LIE: midpoint of lower central incisor edge. LIA: apex of lower central incisor. MM: a point located on the maxillary-mandibular plane bisector. Maxillary plane (ANS–PNS), mandibular plane (Go–Me), sella horizontal: horizontal line through sella, 7 degrees below sella–nasion line. Sella vertical: vertical line through sella, perpendicular to sella horizontal. sN: soft tissue nasion. NT: most prominent or anterior point of the nose tip. Tang: the most anterior point on the columella of the nose. Sn: the point at which the nasal septum merges with the upper cutaneous lip in the mid-sagittal plane. sA: soft tissue point A. AUL: the most anterior point of the upper lip. ALL: the most anterior point of the lower lip. sB: soft tissue point B. sPog: soft tissue pogonion.

Hard tissue measurements: the conventional measurements were used except for Wits, where the Max/Mand bisector was used instead of the occlusal plane.

Soft tissue measurements: nasolabial angle AUL–Sn–Tang (AUST). Soft tissue profile including the nose sN–NT–sPog (NNP). Soft tissue profile excluding the nose sN–sA–sPog (NAP). NV: the perpendicular distance from nose tip to sella vertical. sAV: the perpendicular distance from soft tissue point A to sella vertical. AUV: the perpendicular distance from anterior upper lip to sella vertical. ALV: the perpendicular distance from anterior lower lip to sella vertical. sBV: the perpendicular distance from soft tissue point B to sella vertical. sPV: the perpendicular distance from soft tissue pogonion to sella vertical. sPH: the perpendicular distance from soft tissue pogonion to sella horizontal. NH: the perpendicular distance of nose tip to sella horizontal.

Table 1 Means for the skeletal measurements and mean differences at the three stages in the chincap group.

Variable	T1		T2		T3		Mean differences		
	Mean	SD	Mean	SD	Mean	SD	T2 – T1	T3 – T2	T3 – T1
SNA°	78.98	3.52	78.96	4.05	79.74	4.18	–0.02 NS	0.78 NS	0.76 NS
Ar–Gn (mm)	100.83	4.00	107.07	5.84	116.37	7.83	6.24***	9.30***	15.54***
Ar–Go (mm)	40.76	3.08	43.43	3.25	48.35	4.65	2.67***	4.91***	7.59 ***
Go–Me (mm)	65.54	3.46	70.96	4.98	76.59	5.98	5.41***	5.63***	11.04***
N–Me (mm)	107.00	4.26	115.17	7.42	122.80	7.88	8.17***	7.63***	15.80***
SNB°	80.91	4.24	80.46	4.21	81.78	4.35	–0.46 NS	1.33***	0.87 NS
ANB°	–2.02	2.48	–1.52	2.48	–2.06	2.83	0.50 NS	–0.54 NS	–0.04 NS
Wits (mm)	–9.74	2.85	–9.72	3.44	–11.26	3.84	0.02 NS	–1.54***	–1.52*
Max/Mand°	29.46	5.63	29.43	5.38	27.91	4.59	–0.02 NS	–1.52**	–1.54*
LFH (mm)	60.26	4.59	65.09	5.66	69.22	6.72	4.83***	4.13***	8.96***
ANS–Me/N–Me (%)	56	0.03	56	0.02	56	0.03	0.00 NS	0.00 NS	0.00 NS

NS, not significant; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Table 2 Means for the dental measurements and mean differences at the three stages in the chincap group.

Variable	T1		T2		T3		Mean differences		
	Mean	SD	Mean	SD	Mean	SD	T2 – T1	T3 – T2	T3 – T1
Li/Mand°	84.67	6.11	78.39	7.63	79.3	36.72	–6.28***	0.94 NS	–5.35***
Ui/Max°	107.91	6.00	114.91	9.37	114.52	6.71	7.00**	–0.39 NS	6.61***
Li/A–Pog (mm)	4.63	2.92	2.57	2.92	2.85	3.03	–2.07***	0.28 NS	–1.78***
Overjet (mm)	–2.93	3.37	2.20	1.86	1.39	2.40	5.13***	–0.80*	4.33***
Overbite (mm)	1.76	3.40	2.35	1.81	2.72	1.93	0.59 NS	0.37 NS	0.96 NS

NS, not significant; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

group were compared, and tested for significance using the independent samples *t*-test. Similarly, the last film values for the controls were compared with the T3 values for the chincap. The overall mean changes in the two groups were compared using the independent samples *t*-test.

Results

The changes due to chincap therapy (T2 – T1), the post-treatment changes (T3 – T2), and the overall effects (T3 – T1) are shown in Tables 1–3. During treatment there was an increase in total (Ar–Gn), ramal (Ar–Go), and body (Go–Me) mandibular length, and in total and lower facial heights (N–Me, LFH). Dentally, the lower incisors retroclined (Li/Mand) and the upper incisors proclined (Ui/Max), while the lower incisal edges became more posteriorly related to the A–Pog line (Li/A–Pog). These changes in incisor inclination and position resulted in significant correction of the initially reversed overjet. Soft tissue changes revealed an increase in nasolabial angle (AUST) and improvement in soft tissue profile, including the nose (NNP). The upper lip moved forward (AUV, sAV), and the soft tissue nose and chin grew anteriorly and inferiorly (NV, sPV, NH, and sPH).

Skeletal post-treatment changes (T3 – T2) included further mandibular growth in terms of the total length (Ar–Gn), ramal length (Ar–Go), and body length (Go–Me). This was reflected

Table 3 Means for the soft tissue measurements and mean differences at the three stages in the chincap group.

Variable	T1		T2		T3		Mean differences		
	Mean	SD	Mean	SD	Mean	SD	T2 – T1	T3 – T2	T3 – T1
AUST°	101.83	13.46	108.20	9.55	105.17	12.22	6.37*	–3.02 NS	3.35 NS
NNP°	138.15	4.44	135.87	4.04	135.39	4.95	–2.28***	–0.48 NS	–2.76***
NAP°	171.17	5.53	170.85	6.41	171.30	5.14	–0.33 NS	0.46 NS	0.13 NS
NV (mm)	89.65	3.94	94.80	4.21	101.65	4.98	5.15***	6.85***	12.00***
AUV (mm)	79.61	5.57	82.15	5.56	87.93	5.87	2.54*	5.78***	8.33***
ALV (mm)	79.35	7.07	80.50	7.04	86.93	7.55	1.15 NS	6.44***	7.59***
sBV (mm)	72.44	7.07	74.39	7.38	80.52	7.58	1.96 NS	6.13***	8.09***
sAV (mm)	76.43	4.59	79.52	4.75	84.70	4.99	3.09**	5.17***	8.26***
sPV (mm)	72.96	8.23	75.85	8.56	82.98	9.15	2.89*	7.13***	10.02***
NH (mm)	33.52	3.59	36.15	4.14	38.78	4.54	2.63***	2.63***	5.26***
sPH (mm)	93.04	4.05	98.65	6.83	105.63	6.80	5.61***	6.98***	12.59***

NS, not significant; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Table 4 Means for the skeletal measurements and differences between means in the control and chincap groups.

Variable	Control group (T1) $n = 23$		Chincap group (T1) $n = 23$		Mean group difference	Control group (T3) $n = 23$		Chincap group (T3) $n = 23$		Mean group difference
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
SNA°	77.28	4.27	78.98	3.52	1.70 NS	78.29	4.64	79.74	4.18	–1.45 NS
Ar–Gn (mm)	105.04	8.67	100.83	4.00	–4.22*	115.60	9.18	116.37	7.83	–0.77 NS
Ar–G° (mm)	42.43	4.83	40.76	3.08	–1.67 NS	48.55	5.62	48.35	4.65	0.21 NS
G°–Me (mm)	69.61	5.76	65.54	3.46	–4.07**	75.75	5.74	76.59	5.98	–0.84 NS
N–Me (mm)	114.78	9.08	107.00	4.26	–7.78***	124.03	10.47	122.80	7.88	1.23 NS
SNB°	79.07	4.13	80.91	4.24	1.85 NS	81.04	4.64	81.78	4.35	–0.74 NS
ANB°	–1.86	1.55	–2.02	2.48	–0.16 NS	–2.96	2.26	–2.07	2.83	–0.89 NS
Wits (mm)	–9.82	2.66	–9.74	2.85	–0.09 NS	–12.66	3.83	–11.26	3.84	–1.40 NS
Max/Mand°	30.09	4.92	29.46	5.63	–0.63 NS	27.76	5.22	27.91	4.59	–0.15 NS
LFH (mm)	64.25	5.63	60.26	4.59	–3.99*	69.09	7.42	69.22	6.72	–0.13 NS
ANS–Me/N–Me (%)	56	0.01	56	0.03	0.00 NS	56	0.02	56	0.02	0.00 NS

NS, not significant; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

in an increased SNB angle and larger negative Wits measurements. Facial height also increased significantly (N–Me, LFH) and the maxillary/mandibular planes angle reduced (Max/Mand). The Class I overjet was maintained, although slightly diminished. The soft tissue nose, upper lip, lower lip, and chin moved anteriorly (NV, AUV, ALV, sBV, sAV, sPV), and the nasal tip and chin moved inferiorly (NH, sPH).

Comparison of the means of chincap subjects at T1 and the controls at the beginning of the study is shown in Tables 4–6. The chincap sample, on average, had a shorter mandible in terms of total and body length (Ar–Gn, Go–Me), and diminished total and lower anterior face height (N-Me, LFH), less proclined upper incisors (Ui/Max), a smaller nasolabial angle (AUST), and the nasal tip and chin were at a higher level (NH, sPH).

Comparison between the means relating to the chincap group at T3 and controls on the last radiograph (Tables 4–6) revealed no significant

Table 5 Means for the dental measurements and differences between means in the control and chincap groups.

Variable	Control group (T1) $n = 23$		Chincap group (T1) $n = 23$		Mean group difference	Control group (T3) $n = 23$		Chincap group (T3) $n = 23$		Mean group difference
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Li/Mand°	85.28	7.05	84.67	6.11	–0.61 NS	83.49	8.29	79.33	6.72	4.16 NS
Ui/Max°	112.48	7.22	107.91	6.00	–4.57*	114.70	5.09	114.52	6.71	0.17 NS
Li/A–Pog (mm)	3.89	3.10	4.63	2.92	0.74 NS	4.50	3.76	2.85	3.03	1.65 NS
Overjet (mm)	–1.60	1.07	–2.93	3.37	–1.34 NS	–2.62	1.76	1.39	2.40	–4.01***
Overbite (mm)	0.62	1.83	1.76	3.40	1.14 NS	0.57	2.40	2.72	1.93	–2.15**

NS, not significant; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Table 6 Means for the soft tissue measurements and differences between means in the control and chincap groups.

Variable	Control group (T1) $n = 23$		Chincap group (T1) $n = 23$		Mean group difference	Control group (T3) $n = 23$		Chincap group (T3) $n = 23$		Mean group difference
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
AUST°	111.04	11.35	101.83	13.46	–9.21*	111.04	12.09	105.17	12.22	5.87 NS
NNP°	136.57	4.62	138.15	4.44	1.59 NS	135.60	5.05	135.39	4.95	0.21 NS
NAP°	172.26	4.73	171.17	5.53	–1.09 NS	173.28	4.31	171.30	5.14	1.98 NS
NV (mm)	93.32	9.29	89.65	3.94	3.66 NS	100.63	8.99	101.65	4.98	1.02 NS
AUV (mm)	79.33	9.86	79.61	5.57	–0.28 NS	84.67	9.71	87.93	5.87	–3.26 NS
ALV (mm)	77.62	10.86	79.35	7.07	–1.73 NS	84.78	10.87	86.93	7.55	–2.15 NS
sBV (mm)	71.51	10.88	72.43	7.07	–0.92 NS	77.93	11.69	80.52	7.58	–2.59 NS
sAV (mm)	77.09	8.95	76.43	4.59	0.65 NS	82.21	8.90	84.70	4.99	–2.49 NS
sPV (mm)	72.18	11.84	72.96	8.23	–0.77 NS	80.67	12.63	82.98	9.15	–2.30 NS
NH (mm)	37.58	3.64	33.52	3.59	–4.05***	40.78	3.80	38.78	4.54	2.00 NS
sPH (mm)	100.22	8.54	93.04	4.05	–7.17***	106.38	8.79	105.63	6.80	0.75 NS

NS, not significant; *$P < 0.05$; ***$P < 0.01$.

differences between them in either skeletal or soft tissue measurements. The only significant differences between the two groups was in the overjet and overbite.

Overall changes in the chincap and control groups (T3 – T1) are compared in Table 7.

The chincap group showed significantly greater growth in anterior face height (N–Me, LFH) and mandibular length (Ar–Gn, Go–Me), which resulted in anterior movement of point B.

In the chincap group, the lower incisors showed greater retroclination and the upper incisors greater proclination (Li/Mand, Ui/Max). The overjet showed a highly significant improvement when compared with the controls. The soft tissues followed the skeletal and dental changes, where the upper lip and nasal tip grew more anteriorly (NV, AUV, sAV), and the nasal tip and chin grew more inferiorly in the chincap group (NH, sPH).

Discussion

The chincap, combined with an upper removable appliance, was effective in correcting the incisor relationship. The mandible continued to grow while the chincap was worn, and there was

Table 7 Mean overall changes in control and chincap groups for the total observation period (T3 – T1).

Variable	Control	Chincap	Mean difference	Standard error	*P*
SNA°	1.01 ± 1.37	0.76 ± 2.12	–0.25	0.53	NS
Ar–Gn (mm)	10.55 ± 4.96	15.54 ± 5.56	4.99	1.55	**
Ar–G° (mm)	6.12 ± 2.96	7.59 ± 3.90	1.47	1.02	NS
G°–Me (mm)	6.14 ± 3.61	11.04 ± 3.83	4.90	1.10	***
N–Me (mm)	9.25 ± 5.28	15.80 ± 5.37	6.55	1.57	***
SNB°	1.98 ± 1.44	0.87 ± 2.07	–1.11	0.53	*
ANB°	–1.09 ± 1.28	–0.04 ± 2.44	1.05	0.58	NS
Wits (mm)	–2.84 ± 2.08	–1.52 ± 2.99	1.32	0.76	NS
Max/Mand°	–2.33 ± 2.00	–1.54 ± 2.87	0.79	0.73	NS
LFH (mm)	4.84 ± 3.24	8.96 ± 4.62	4.12	1.18	***
FP%	0.00 ± 0.01	0.00 ± 0.02	0.00	0.01	NS
Li/Mand°	–1.79 ± 4.39	–5.35 ± 5.73	–3.56	1.51	*
Ui/Max°	2.22 ± 5.56	6.61 ± 7.65	4.39	1.97	*
Li/A–Pog (mm)	0.61 ± 1.50	–1.78 ± 2.04	–2.39	0.53	***
Overjet (mm)	–1.02 ± 1.98	4.33 ± 2.97	5.35	0.74	***
Overbite (mm)	–0.05 ± 2.21	0.96 ± 3.37	1.01	0.84	NS
AUST°	0.00 ± 6.80	3.35 ± 8.58	3.35	2.28	NS
NNP°	–0.97 ± 2.56	–2.76 ± 3.22	–1.79	0.86	*
NAP°	1.02 ± 4.23	0.13 ± 3.94	–0.89	1.21	NS
NV(mm)	7.32 ± 3.87	12.00 ± 4.38	4.68	1.22	***
AUV(mm)	5.35 ± 3.74	8.33 ± 4.62	2.98	1.24	*
ALV(mm)	7.16 ± 4.21	7.59 ± 5.14	0.43	1.39	NS
sBV(mm)	6.42 ± 3.95	8.09 ± 4.88	1.67	1.31	NS
sAV(mm)	5.12 ± 3.79	8.26 ± 3.98	3.14	1.15	**
sPV(mm)	8.49 ± 4.31	10.02 ± 5.86	1.53	1.52	NS
NH(mm)	3.21 ± 2.38	5.26 ± 2.97	2.05	0.79	*
sPH(mm)	6.16 ± 4.47	12.59 ± 5.98	6.43	1.56	***

NS, not significant; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

no improvement in mandibular protrusion as measured by SNB degrees or the jaw relationship as measured by Wits and ANB degrees.

There was no evidence that the chincap retarded growth of the mandible, which conflicts with Janzen and Bluher (1965), Joho (1973) and Asano (1986), but the total and lower facial height increased, which might be interpreted as a redirection of mandibular growth in a downward direction as found by Graber (1977). The chincap retroclined the lower incisors and the removable appliance proclined the upper incisors. The lengthening of the face improved the soft tissue profile and seemed to be more effective in increasing the nasolabial angle than proclination of upper incisors in reducing it. These findings confirm Allen *et al.* (1993).

The post-treatment phase saw substantial growth of the mandible, an increase in mandibular protrusion and deterioration in the horizontal intermaxillary discrepancy (Wits), thus confirming Sugawara *et al.* (1990) and Üner *et al.* (1995). The vertical growth of the face post-treatment was almost as great as the changes during treatment. There was an increase in ramus height, which exceeded the increase in lower anterior face height resulting in reduction of the maxillary/mandibular planes angle and forward rotation of the mandible. Dentally, the overjet diminished, but remained positive. Stability in the improved soft tissue profile was evident, although the upper lip, lower lip, and chin continued to grow forward following the skeletal pattern.

Although the control group was closely matched with the chincap group in respect of sex, Wits measurement, and stage of dental development, the chincap subjects initially had a shorter mandible (body and ramus), reduced lower face

height and slightly more retroclined upper incisors compared with the control sample. In view of the low prevalence of Class III malocclusions, the control group was as comparable with the chincap group as could be achieved. While the overall growth of the mandible was greater in the treated group, the overjet remained positive due to a downward, rather than forward direction of mandibular growth and greater proclination of upper incisors and retroclination of lower incisors as compared with the controls. At the end of the study period, there were no statistically significant skeletal or soft tissue differences between the groups. The only differences were the increased overjet and overbite in the chincap subjects, which maintained the incisors in a corrected relationship.

Conclusions

Chincap therapy combined with an upper removable appliance to procline the upper incisors is effective in producing long-term correction of the incisor relationship by retroclination of the lower incisors, proclination of the upper incisors, and a redirection of mandibular growth in a downward direction. The direction of growth at the chin is maintained subsequent to treatment as are the changes in incisor inclination, although in a diminished form. There are corresponding improvements in the soft tissue profile.

The ideal case for the chincap, combined with an upper removable appliance to procline upper incisors, is a patient with diminished facial height, where a substantial overbite can be achieved, and where the antero-posterior skeletal discrepancy can be compensated or camouflaged by moderate proclination of the upper incisors and retroclination of the lower incisors.

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