









The exceptions were variables Co-A, SN.ANSPNS and SNB, since P values were statistically significant (P<0.05). As for Co-A, P value was out of significance range (Table 3).

**Table 3.** Comparison of cephalometric measurements of study (SG) and control (CG) groups in the 10-12 year age group.

Measurement	SG (n=3)										CG (n=3)										P Value
	95% CI										95% CI										
	Mean	Median	SD	Q1	Q3	Inf	Sup	Min	Max	Mean	Median	SD	Q1	Q2	Inf	Sup	Min	Max			
S-N	66.1	67.6	4.6	69.8	61.0	54.8	77.5	60.0	69.8	62.6	64.0	5.4	67.1	56.6	49.2	75.9	56.6	67.1	0.2752		
Go-Gn	68.3	66.3	5.6	74.6	63.9	54.3	81.3	63.9	74.6	65.2	63.7	8.1	73.9	58.0	45.1	85.3	58.0	73.9	0.2752		
Co-Go	48.9	48.8	0.3	49.2	0.3	48.8	49.6	47.6	49.2	45.8	47.5	6.1	50.9	39.1	30.7	61.0	39.1	50.9	0.5127		
Co-Gn	105.7	103.8	3.8	110.1	103.3	96.3	125.2	103.3	110.1	99.1	103.5	11.1	109.4	86.5	71.5	126.8	86.5	107.4	0.5127		
PoOr.NPg	24.4	23.3	5.6	30.5	19.4	10.4	37.4	19.4	30.5	24.8	26.1	2.3	26.1	22.2	19.2	30.4	22.2	26.1	0.8273		
SNB	33.3	31.5	6.4	40.5	28.0	17.3	49.4	29.0	40.5	34.3	33.0	2.8	37.5	32.5	27.5	41.2	32.5	37.5	0.8273		
Co-A	83.3	84.3	3.9	86.5	79.0	73.7	92.7	79.0	86.5	81.0	81.8	5.4	86.0	75.3	67.6	94.4	76.3	86.0	0.5127		
N-ANS	46.7	45.0	4.3	51.5	43.5	36.1	57.2	42.5	51.5	43.5	45.5	9.4	51.0	33.0	21.2	66.8	33.0	51.0	0.8373		
SN.ANSPNS	10.1	10.3	0.4	10.4	9.7	9.3	11.0	9.7	10.4	6.6	7.0	1.1	7.4	5.4	3.9	9.3	5.4	7.4	0.0595		
SNA	79.5	79.1	2.3	82.0	77.4	72.8	85.2	77.4	82.0	83.5	82.5	3.5	86.3	80.5	74.7	92.2	81.5	88.3	0.1267		

SN.Gn	SN.GoGn	PoOr.GoMe	ANSPNS.GoMe	ANS-Me	ANB	S-Ba	Ba-N
1.6	89.4	77.3	27.7	62.5	77.9	39.8	100.0
6.2	91.0	79.8	26.0	58.5	79.3	38.8	103.5
5.3	3.3	4.9	6.2	7.4	4.5	3.3	7.1
6.2	91.7	80.5	34.5	71.0	81.6	43.5	104.7
14.8	85.7	66.1	34.0	58.0	72.9	37.2	91.8
_4.3	81.3	71.7	22.5	44.2	66.7	31.6	82.3
_11.7	96.6	80.5	12.3 31.5 27.5	80.8	89.2	48.0	118.7
14.8	85.7	71.7	43.0 27.5	58.0	72.9	37.2	91.8
_4.3	91.7	80.5	22.5 27.5	71.0	81.6	43.5	104.7
6.2	89.8	76.8	34.5	60.3	77.9	38.2	93.4
5.6	89.7	77.3	29.8	63.5	79.6	40.8	99.2
2.9	4.3	3.7	30.5	6.4	3.6	5.2	10.6
7.8	94.2	80.2	31.5	64.5	80.3	41.6	99.9
2.3	85.5	72.9	27.5	53.0	73.7	32.2	81.2
_1.7	79.0	67.7	24.7	44.5	69.0	25.3	67.0
12.9	100.6	85.9	35.0	76.2	86.8	51.1	119.9
2.3	85.5	72.9	27.5	53.0	74.7	32.2	81.2
7.8	94.2	80.2	31.5	64.5	80.3	40.6	99.9
0.8273	0.5027	0.8273	0.5127	0.8273	0.2652	0.8273	0.2752

SG: HIV1 patients; CG: Normoreactive patients; Q1: First quartile; Q3: Third quartile; Inf: Inferior; Sup: Superior; Min: Minimum; Max: Maximum

The cephalometric measurements of study and control groups were compared according to various age groups, as mentioned in **Table 4**.

**Table 4.** Comparison of cephalometric measurements of study (SG) and control (CG) groups in the 13-15 year age group.

Co-Go	SG (n=10)										CG (n=10)									
	95% CI										95% CI									
	Co-Go	Co-Gn	PoOr.NPg	SNB	Co-A	N-ANS	SN.ANSPNS	SNA	Measurement	P Value	Co-Go	Co-Gn	PoOr.NPg	SNB	Co-A	N-ANS	SN.ANSPNS	SNA	Measurement	P Value
55.2	114.1	25.2	33.0	85.7	52.1	9.6	81.6	Mean		55.2	114.1	25.2	33.0	85.7	52.1	9.6	81.6	Mean		
53.6	112.8	26.8	31.5	89.3	53.0	9.4	81.2	Median		53.6	112.8	26.8	31.5	89.3	53.0	9.4	81.2	Median		
6.9	5.3	2.4	3.0	15.8	4.7	2.1	3.8	SD		6.9	5.3	2.4	3.0	15.8	4.7	2.1	3.8	SD		
57.9	118.0	26.8	35.0	94.0	54.5	11.9	83.6	Q1		57.9	118.0	26.8	35.0	94.0	54.5	11.9	83.6	Q1		
50.5	111.3	23.5	31.0	86.0	47.0	8.9	77.1	Q3		50.5	111.3	23.5	31.0	86.0	47.0	8.9	77.1	Q3		
50.2	110.3	22.5	30.8	75.4	47.7	8.1	77.9	Inf		50.2	110.3	22.5	30.8	75.4	47.7	8.1	77.9	Inf		
60.1	118.0	26.9	35.2	97.0	55.5	11.1	83.3	Sup		60.1	118.0	26.9	35.2	97.0	55.5	11.1	83.3	Sup		
48.7	104.0	20.7	29.0	42.7	43.0	6.5	72.0	Min		48.7	104.0	20.7	29.0	42.7	43.0	6.5	72.0	Min		
71.9	121.3	29.3	38.0	98.4	58.0	12.4	84.8	Max		71.9	121.3	29.3	38.0	98.4	58.0	12.4	84.8	Max		
50.4	112.9	25.1	32.1	88.5	51.9	9.0	82.0	Mean		50.4	112.9	25.1	32.1	88.5	51.9	9.0	82.0	Mean		
51.5	113.1	24.2	30.5	86.5	52.3	8.3	80.9	Median		51.5	113.1	24.2	30.5	86.5	52.3	8.3	80.9	Median		
4.0	6.3	5.7	6.5	6.7	5.6	3.4	4.2	SD		4.0	6.3	5.7	6.5	6.7	5.6	3.4	4.2	SD		
53.4	114.5	27.9	36.0	93.2	53.5	12.8	84.2	Q1		53.4	114.5	27.9	36.0	93.2	53.5	12.8	84.2	Q1		
46.8	110.4	22.8	26.5	85.2	48.5	6.7	79.6	Q2		46.8	110.4	22.8	26.5	85.2	48.5	6.7	79.6	Q2		
47.5	108.4	21.0	27.4	83.7	47.8	6.5	79.0	Inf		47.5	108.4	21.0	27.4	83.7	47.8	6.5	79.0	Inf		
53.3	117.5	29.3	36.8	93.3	55.9	11.4	85.0	Sup		53.3	117.5	29.3	36.8	93.3	55.9	11.4	85.0	Sup		
42.8	98.8	17.1	25.5	77.6	43.5	4.2	76.9	Min		42.8	98.8	17.1	25.5	77.6	43.5	4.2	76.9	Min		
55.2	122.1	36.2	43.5	102.0	60.0	14.3	90.9	Max		55.2	122.1	36.2	43.5	102.0	60.0	14.3	90.9	Max		
55.2	122.1	36.2	43.5	102.0	60.0	14.3	90.9	P Value		55.2	122.1	36.2	43.5	102.0	60.0	14.3	90.9	P Value		

SN.Gn	SN.GoGn	PoOr.GoMe	ANSPNS.GoMe	ANS-Me	ANB	S-Ba	Ba-N	S-N	Go-Gn
2.3	89.1	77.4	25.9	66.5	77.8	42.6	105.8	70.6	74.6
1.6	88.4	77.2	26.8	67.3	78.5	41.9	106.4	70.5	76.1
2.6	2.9	3.7	5.1	4.9	4.0	3.9	7.2	3.6	3.6
4.6	91.6	81.3	31.5	70.0	82.0	46.2	109.6	73.0	77.0
0.7	87.1	73.4	22.5	62.0	74.8	39.7	100.8	67.4	72.3
0.5	87.0	74.8	23.3	63.0	74.9	39.8	100.7	68.1	72.0
4.2	91.2	80.1	30.5	70.0	80.7	45.3	111.0	73.2	77.1
_1.3	83.0	72.8	20.0	57.5	71.4	36.7	95.3	66.0	67.1
6.3	92.3	82.7	35.0	73.0	82.5	49.6	117.6	76.6	78.6
2.5	89.0	79.4	25.7	65.4	79.6	42.8	104.0	69.9	75.0
2.5	89.2	79.7	25.5	65.8	79.4	42.2	103.3	68.3	73.8
2.6	2.1	3.8	6.2	7.8	3.3	4.2	6.8	4.5	5.4
4.7	90.2	82.6	30.5	70.0	82.6	46.9	107.2	74.0	79.8
0.0	88.3	76.3	21.5	60.0	76.8	40.0	98.5	66.3	73.2
0.6	87.5	76.7	22.2	59.8	77.3	39.7	99.3	66.6	71.2
4.3	90.5	82.1	31.1	71.0	82.0	45.8	108.8	73.1	78.9
-1.5	84.7	74.2	17.5	53.0	75.5	36.7	96.7	64.1	64.3
6.4	92.7	84.3	36.5	80.0	85.6	49.8	114.2	76.2	83.9
6.4	92.7	84.3	36.5	80.0	85.6	49.8	114.2	76.2	83.9

SG: HIV1 patients; CG: Normoreactive patients; Q1: First quartile; Q3: Third quartile; Inf: Inferior; Sup: Superior; Min: Minimum; Max: Maximum



In 10-12 year age group, when considering mean values, positions of maxilla and mandible in study group were retruded in relation to base of the skull when compared with control group. Growth pattern in study group was more horizontal and effective size of bone bases was increased than in control group. However, the differences were not statistically significant, except for palatal plane inclination (Table 3).

Table 4 shows comparison of cephalometric means with regard to mean values in the 13-15 year age group, the maxilla was retruded slightly, and mandible was protruded in the study group in relation to the base of the skull compared with control group. Also, the former had a decreased effective maxillary size and an increased effective mandibular size than the latter. In this age group, growth patterns were almost similar in both groups. None of the

values related to maxillary and mandibular positions in antero-posterior direction, growth pattern and effective linear measurements in this particular age group showed statistically significant differences between study and control groups (Table 4).

With regards to the mean values in 16-18 year age group, the position of maxilla in the study group was slightly decreased, and the mandible was protruded in relation to base of the skull when compared with the control group. Although the former had an effective maxillary size smaller than that of latter, effective mandibular size was similar between 2 groups. The growth pattern was more horizontal in the study group than in the control group. The only statistically significant difference was position of the maxilla in anteroposterior direction (SNA) (Table 5).

Table 5. Comparison of cephalometric measurements of study (SG) and control (CG) groups in the 16-18 years age group.

Measurement	SG (n=8)										CG (n=8)										P Value
	95% CI										95% CI										
	Mean	Median	SD	Q1	Q3	Inf	Sup	Min	Max	Mean	Median	SD	Q1	Q2	Inf	Sup	Min	Max			
PoOr.NPg	26.0	26.9	5.0	28.5	22.3	21.8	30.2	18.4	32.3	23.3	20.9	7.2	29.8	18.4	17.2	29.4	13.2	34.0	0.9164		
SNB	33.4	31.5	6.1	38.0	29.3	28.3	38.5	25.0	43.5	30.4	27.5	5.8	36.3	25.3	25.5	35.2	24.5	38.5	0.8336		
Co-A	90.0	94.1	9.6	96.7	84.6	82.0	98.0	71.3	97.7	92.4	98.5	18.5	103.7	88.8	77.0	107.9	50.2	107.2	0.2698		
N-ANS	54.1	54.0	5.6	57.5	49.5	49.4	58.8	47.0	63.5	57.4	57.3	6.8	62.3	52.5	51.7	63.1	47.5	67.5	0.2261		
SN.ANSPNS	7.4	8.7	2.2	9.1	5.6	5.6	9.3	3.5	9.3	8.1	6.8	2.2	10.4	6.6	6.3	9.9	5.9	11.3	0.4623		
SNA	81.2	82.8	3.2	84.1	82.1	79.5	84.9	75.4	86.0	85.7	85.2	2.7	86.6	84.3	82.5	87.0	77.6	87.2	0.0460		

SN.Gn	SN.GoGn	PoOr.GoMe	ANSPNS.GoMe	ANS-Me	ANB	S-Ba	Ba-N	S-N	Go-Gn	Co-Go	Co-Gn
3.8	88.9	78.0	28.3	75.8	78.6	44.1	107.6	73.1	77.9	59.8	120.5
3.8	88.1	77.2	26.8	77.5	79.0	45.8	110.9	76.1	80.6	61.7	126.6
2.3	4.6	3.1	4.9	10.1	2.4	5.0	10.1	7.8	9.8	7.5	12.3
5.3	92.0	80.7	32.5	83.5	80.6	47.9	114.6	78.0	84.8	64.1	128.6
2.2	87.2	75.4	24.0	65.5	76.4	41.0	99.4	68.7	71.2	54.6	109.3
1.9	85.2	75.4	24.2	67.3	76.5	39.9	99.1	66.6	69.7	53.5	110.2
5.7	92.7	80.6	32.4	84.3	80.6	48.3	116.1	79.7	86.0	66.0	130.8
0.6	80.9	73.4	24.0	63.5	75.2	35.3	91.7	59.8	60.2	47.6	101.3
7.4	96.0	81.7	36.0	90.0	81.3	49.8	117.4	79.7	89.8	69.7	133.5
5.2	89.5	78.9	26.5	74.1	79.0	45.7	110.6	75.9	82.5	59.8	123.8
5.6	89.7	77.3	29.8	63.5	79.6	40.8	99.2	64.0	63.7	47.5	123.0
2.0	3.7	4.5	6.3	6.8	2.9	3.3	7.3	5.1	7.1	7.8	9.4
6.7	92.2	83.2	32.3	80.5	81.1	47.0	114.8	78.2	85.8	64.1	126.9
4.1	86.1	76.9	21.8	68.3	77.7	43.7	108.4	72.8	76.3	56.7	120.9
3.6	86.5	75.1	21.3	68.4	76.5	41.9	104.5	70.6	76.6	53.3	115.9
6.9	92.6	82.6	31.7	79.8	81.4	47.4	116.7	79.1	88.5	66.3	131.6
1.7	85.0	70.1	19.5	64.5	73.9	37.4	93.7	64.3	74.0	44.8	107.4
7.9	95.0	84.2	36.5	84.0	83.1	47.5	115.2	78.8	96.4	70.9	141.3
0.4008	0.247	0.5286	0.3994	0.7128	0.1722	0.9164	0.8336	0.6744	0.4623	0.635	0.9164

SG: HIV1 patients; CG: Normoreactive patients; Q1: First quartile; Q3: Third quartile; Inf: Inferior; Sup: Superior; Min: Minimum; Max: Maximum

## DISCUSSION

Adolescents seropositive for HIV now attend the dental hospitals and demand full treatment for their oral health conditions. Studies evaluating growth and development of face have identified that, up to 5 years of age well-developed craniometric dimensions and especially significant increase in the height and width of the jaw are observed. But the greatest gain in growth occurs only after 6 years of age, with continuous increase in jaw length and facial height, width, and depth, until craniofacial dimensions reach maturity during adolescence, between 13 and 15 years of age [37]. Because of the drawbacks inherent in cross-sectional study, differences that could be found in different age groups in our study which suggest continuous craniofacial growth, with whole face growing vertically and horizontally in both groups.

In these results, we found that 2 measurements had statistically significant differences: the angle between palatal plane and base of skull (SN.ANSPNS) and angle demonstrating position of the maxilla in antero-posterior direction (in relation to the base of skull), represented by SNA. In 10-12 year age range, the SN.ANSPNS values showed the rotation of maxilla (palatal plane) was increased in the HIV1 patients, but these values diminished in subsequent age groups, along with the values of normoreactive patients. No significant changes in completion of growth were observed; this occurred in patients in our study group.

The angle SNA was shown to be significantly decreased in the 13-15 and 16-18 year age group. The reduction in measurement was interpreted as retrusion of maxillary bone [35]. Although the study was not longitudinal, there were 3 interpretations for this craniofacial change. The first was this change could be a consequence of the respiratory pattern of HIV1 adolescents, which is compromised by airway infections during growth period. SNA may be decreased in those with compromised respiratory function of upper airway, as in mouth-breathing patients [31,32].

The HIV infection associated or not with states of immune activation and inflammatory processes, can change osteoclastogenesis by increasing rate of apoptosis of primary osteoblasts, decreasing calcium deposition and alkaline phosphatase activity, diminishing specific bone proteins and compromising differentiation of mesenchymal cells into osteoblasts [33]. The long-term use of HAART may be definitely responsible for systemic alterations that affect growth of these adolescent children [5,7,12,13].

HAART emerged as a solution to deleterious effects caused by the virus by lowering the circulating viral load. The immunologic reconstitution induced by use of antiretroviral agents, expressed by increase in CD41 T lymphocytes, has allowed these patients to be clinically stable, with reductions in opportunist infections that could bring about malnutrition.

Although gains in weight and height among HIV1 patients undergoing HAART are vital, these gains are less than weight and height gains of normoreactive adolescents [36,37]. In this study, other linear and angular values of HIV1 children had no statistically significant differences when compared with the control group. However, it was possible to identify a trend toward decrease in the linear measurements of maxilla, mandible and base of the skull in the study patients between 13-15 and 16-18 years old. In this age group 14 angular and linear measurements in our study patients were lower than those of the controls. This difference was seen only in 5 measurements in the 10-12 year age group and in 7 measurements in the 13-15 year age group. We believe that the findings could be a basis for longitudinal study with these group patients. Nevertheless, this study was a cross-sectional and did not establish cause and effect relationship; this could be a drawback of our study.

Another limitation and confounding factor of study was that only telerradiographs of adolescents who were referred for the orthodontic treatment were included and consequently they had some amount of deviation from normality (in both groups). An ideal study design would include all adolescents, irrespective of their need for orthodontic treatment. But, ethical questions are raised as a result of submitting adolescents to ionizing radiation not only during growth period, but also at various times throughout life, only to see possible changes in their craniofacial growth. It was not possible to mention that either HIV or HAART alone is responsible for possible developmental delay, or to evaluate HIV1 patients with and without use of HAART separately, since in India all HIV1 children who are under medical treatment are also receiving antiretroviral treatment. Although 18 comparisons per group were done, only 2 measurements had statistically significant differences with marginally significant P value. Since no overall differences were found between 2 groups in our study, we hypothesized that beneficial effects of antiretroviral therapy overcame adverse effects.

## CONCLUSION

The majority of measurements in HIV1 children and adolescents were not different from the control group to generate statistically significant difference in craniofacial growth.

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