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COMPARATIVE EVALUATION OF THE NASOPHARYNGEAL SOFT TISSUE CHARACTERISTICS BETWEEN IDEAL OCCLUSION AND CLASS III MALOCCLUSION IN DAKSHINA KANNADA POPULATION

Dental Science

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ABSTRACT

Introduction : Because of the close relationship between the pharynx and the dentofacial structures, a mutual interaction is expected to occur between the pharyngeal structures and the dentofacial pattern. The aim of this study was to assess and compare the nasopharyngeal characteristics in adults with Ideal occlusion and Class III malocclusion in Dakshina Kannada population. **Materials and Methods:** The study sample consisted of 64 patients with Class III malocclusion and 96 subjects with Ideal Class I molar relation randomly selected from the patients visiting the department of orthodontics of various dental colleges in Dakshina Kannada district. Lateral cephalograms were manually traced, linear and area measurements were determined to define the airway characteristics. Independent means t tests and Pearson correlation analysis were used to evaluate sexual dimorphism and the correlations among the variables. **Results:** Nasal fossa length, lower pharyngeal dimension, and upper adenoid width were greater in the Class III malocclusion group. The cranial base showed significant correlation with nasal fossa length in the Class III malocclusion group. Lower pharyngeal dimension was increased in Class III malocclusion group compared to Ideal Class I occlusion. Sexual dimorphism was also found within Ideal Class I occlusion and Class III Malocclusion groups. **Conclusions :** From analysing the data it was found that the nasopharynx in Class III malocclusion patients in Dakshina Kannada was characterised by an increased lower pharyngeal dimension, upper adenoid width, nasal fossa dimension and also smaller cranial base length.

KEYWORDS

Nasopharynx , Class III malocclusion , Ideal occlusion.

INTRODUCTION

The influence of the soft tissues on craniofacial growth has been discussed in the orthodontic literature for many years. Since 1873 authors have studied airway obstruction and its effects on malocclusion development (Martin O *et al* 2011). Because of the close relationship between the pharynx and the dentofacial structures, a mutual interaction is expected to occur between pharyngeal structures and the dentofacial pattern, and therefore justifies orthodontic interest. In many studies carried out on this subject, it has been demonstrated that there are statistically significant relationships between the pharyngeal structures and both dentofacial and craniofacial structures at varying degrees (Allhaija ESA *et al* 2005).

It has been also suggested that skeletal Class III with maxillary hypoplasia is a cause of upper pharynx constriction (Martin O *et al* 2011). The effects of rapid maxillary expansion associated with maxillary protraction on pharyngeal dimensions demonstrated that maxillary protraction improves the nasopharyngeal airway dimensions (Singh GD *et al* 1997, Robertson C 2004)

According to these facts it can be assumed that a skeletal Class III malocclusion is associated with an abnormal airway. The aim of this study was to assess and compare the differences in nasopharyngeal soft tissue characteristics between Class I and Class III malocclusion in the ethnic population of Dakshina Kannada .

MATERIALS AND METHODS

160 Lateral Cephalograms of patients native to Dakshina Kannada visiting various dental colleges in Dakshina Kannada were collected, of which Group I consisted of 96 subjects with Class I, Ideal occlusion and Group II consisted of 64 subjects with Class III malocclusion in accordance with the inclusion criteria.

INCLUSION CRITERIA

involved Patients native to Dakshina Kannada, above the age of 15 years, with no previous orthodontic treatment, No history of sleep disorders, snoring, sleep apnoea, upper airway disease, Adenoidectomy, pathology in the pharynx ,with Sealed lips in a relaxed position and optimal periodontal health. Group I – Class I molar and skeletal relationship with optimal (-2±1mm and 1±1 mm) overjet and overbite , crowding less than 3mm. Group II - Class III molar and skeletal relationship.

EXCLUSION CRITERIA

included patients with History of sleep disorders , snoring ,sleep apnoea, Posterior cross-bite, Craniofacial deformities, Asymmetries.

Study models were used to determine the molar relation of the samples being collected. Lateral cephalograms were traced manually. Thirteen cephalometric measurements were recorded.

1. PNS-AD1: Lower aerial width, the distance between PNS and the adenoid tissue measured through the PNS-Ba line (Ad1).
2. AD1-Ba: Lower adenoid width, defined as the soft tissue thickness at the posterior nasopharynx wall through the PNS-Ba line.
3. PNS-Ba: Lower airway width, the distance between PNS and Ba – the sum of variables 1 and 2.
4. PNS-AD2: Upper aerial width, the distance between PNS and the nearest adenoid tissue measured through a perpendicular line to S-Ba from PNS (Ad2).
5. AD2-H: Upper adenoid width, defined as the soft tissue thickness at the posterior nasopharynx wall through the PNS-H line.
6. Hormion (H): The cephalometric point located near the adenoidal tissue at the cranial base, localized where a perpendicular to S-Ba line crosses the sphenoid bone. The variations of this point are minimal because it is located far from growing sites.
7. PNS-H: Upper airway width .the distance between PNS and H – the sum of variables 1 and 2.
8. N-H: Nasal fossa length, the distance between N and H.
9. S-N: Anterior cranial base.
10. McNamara's upper pharynx dimension: The minimum distance between the upper soft palate and the nearest point on the posterior pharynx wall.

McNamara's lower pharynx dimension: The minimum distance between the point where the posterior tongue contour crosses the mandible and the nearest point on the posterior pharynx wall.

11. Total area,
12. Aerial area,
13. Adenoidal area – was measured using the method of Handelman and Osborne. This method takes as reference the Ba-N plane, the bispinal plane, and 2 perpendicular lines to the bispinal plane ; one crosses the more anterior point at the atlas vertebrae , and other

crosses the PNS . The resulting trapezoid is divided into 2 spaces (aerial and adenoid).The total area is the sum of the adenoidal and aerial areas. The individual areas are calculated using Autocad Software. Differences in variables between patients with Class III and Class I molar relation were compared.

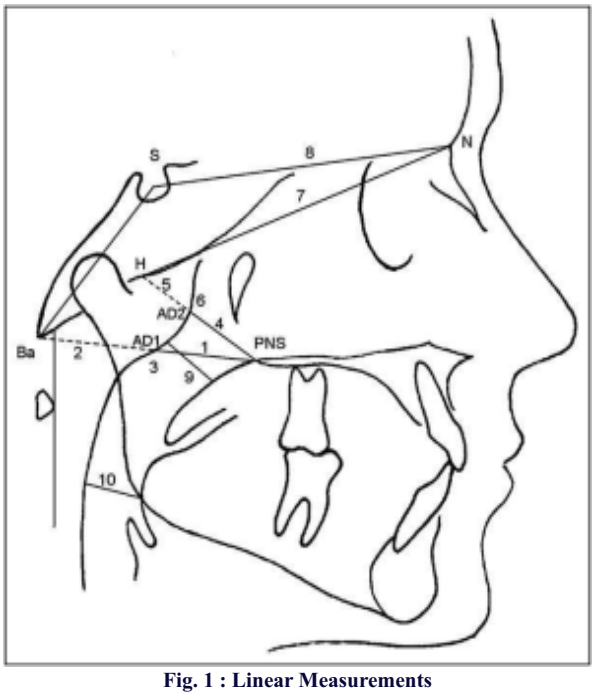

Fig. 1 : Linear Measurements

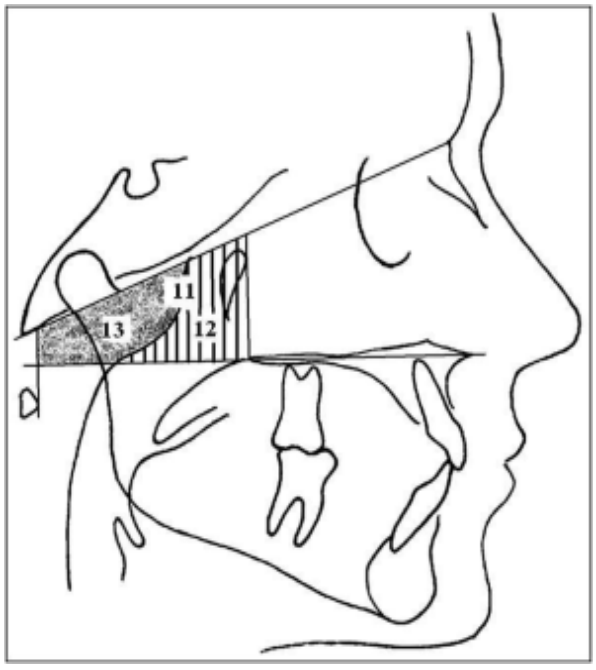

Fig. 2 Surface variables: 11- Total area (12+13);12- aerial area; 13- adenoidal area

STATISTICALANALYSIS

Descriptive statistics was done by measuring Mean, standard deviation, proportions, with 95% confidence interval. Inferential statistics was done by independent t test, Pearsons correlation, paired t test, and ANOVA factor analysis. Error analysis was done by Dahlbergs formula, paired t test and correlation . All calculations were done by SPSS version 19.0.

RESULTS

Significant sexual dimorphism was found within Ideal occlusion group (Group I) in the lower adenoid width, nasal fossa length and cranial base length which were greater in males of Ideal occlusion group. The upper pharyngeal dimension was found to be wider in females compared to males.

In the Class III malocclusion group (Group II) significant sexual dimorphism was seen in men having greater Nasal fossa length and cranial base length than women.

The Pearson correlation test was done for correlating the cranial base to the other nasopharyngeal variables in both groups and the results indicate that within Ideal occlusion group variables with p value less than 0.05 are AD1Ba, PNS-Ba and NH as shown in Table I.

Table I - Correlation between cranial base and other nasopharyngeal variables in Ideal occlusion group
***R – Correlation Coefficient**

		PNS - AD1	AD1 Ba	PN Sba	PNS- AD2	AD 2-H	PN SH	NH	Upper pharynx dim	Lower pharynx dim	Adenoid Space	Aerial Space	Total Space
SN	*R	.072	.265	.232	-.012	.125	.125	.564	-.171	.072	.179	.013	.127
	**P	.488	**.009**	**.023**	.910	.226	.237	**.0001**	.095	.485	.081	.900	.219
	%	0.005	0.070	0.054	0.000	0.016	0.015	0.318	0.029	0.005	0.032	0.000	0.016

Table II - Correlation between cranial base and other nasopharyngeal variables in Class III malocclusion group.

Table – II shows the variables PNS-AD1,AD1-Ba, PNS-Ba, PNS-AD2, PNS-H, NH, Aerial space and total space with NH indicated maximum correlation with the anterior cranial base Within the Class III malocclusion group.

		PNS - AD1	Ad1 Ba	PN Sba	PNS- AD2	AD 2-H	PN SH	NH	Upper pharynx dim	Lower pharynx dim	Adenoid Space	Aerial Space	Total Space
SN	R	.251	.275	.58 6	.292	.03 9	.47 3	.62 8	.130	.157	.185	.346	.373
	P	**.047**	**.029**	**.0001**	**.020**	**.75**	**.0001**	**.0001**	.310	.219	.146	**.005**	**.003**
	%	0.063	0.075	0.344	0.085	0.002	0.224	0.395	0.017	0.025	0.034	0.120	0.139

Table III - Comparison between Ideal occlusion group and Class III malocclusion group.

In Table –III , on correlating the Ideal occlusion group with Class III malocclusion group the following variables; AD2-H, N-H, SN, Lower pharyngeal dimension showed statistically significant differences. The upper adenoid width , nasal fossa length were increased in Class III malocclusion group, anterior cranial base length was reduced in Class III malocclusion group, lower pharyngeal dimension was increased in Class III malocclusion group.

Table IV - Comparison between Prognathic Mandible and Retrognathic Maxilla within the Class III malocclusion group.

Table IV shows the correlation of variables done between Prognathic mandible and Retrognathic maxilla within the Class III malocclusion group , only upper pharyngeal dimension was found to be statistically significant and lower in subjects with a retrognathic maxilla .

Parameters	Ideal occlusion group (96)		Class III malocclusion group (64)			Percentage of variance	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean difference		
PNS-AD 1 (mm)	26.83	3.98	25.80	4.72	1.03125	.138	NS
AD1-Ba (mm)	18.98	4.02	24.13	27.48	-5.14583	.072	NS

PNS-Ba (mm)	46.29	4.70	46.95	5.45	-0.66146	.415	NS
PNS-AD2 (mm)	22.97	3.95	21.97	5.23	1.00521	.169	NS
AD2-H (mm)	**10.14**	**4.31**	**11.59**	**4.52**	**-1.45052**	**.043**	**Sig**
PNS-H (mm)	32.76	4.53	33.86	4.30	-1.09896	.127	NS
N-H (mm)	**81.78**	**5.43**	**84.81**	**5.50**	**-3.03646**	**.001**	**HS**
SN (mm)	**69.65**	**3.78**	**71.41**	**4.20**	**-1.76687**	**.008**	**Sig**
Upper pharynx (mm)	14.69	3.25	13.88	3.19	-0.80729	.123	NS
Lower pharynx (mm)	**10.24**	**3.42**	**13.06**	**5.67**	**-2.81771**	**.0001**	**HS**
Adenoidal area (mm2)	143.18	86.31	165.76	90.15	-22.57992	.113	NS
Aerial area (mm2)	418.22	99.09	396.41	116.44	21.80768	.207	NS
Total area (mm2)	562.64	130.03	562.17	152.63	0.46599	.984	NS

Table V shows statistically significant differences (P\0.05) among Ideal occlusion group, retrognathic maxilla group and prognathic mandible group. Significant differences were found in the nasal fossa length and lower pharyngeal dimension. Nasal fossa length was increased in the retrognathic maxilla group and prognathic mandible group. Lower pharyngeal dimension was increased in the retrognathic maxilla group and prognathic mandible group.

Parameters	Prognathic mandible (25)		Retrognathic maxilla (17)		Percentage of variance	
	Mean	Standard Deviation	Mean	Standard Deviation		
PNS-AD 1 (mm)	26.48	5.32	23.82	3.94	.087	NS
AD1-Ba (mm)	21.44	4.49	35.82	51.98	.174	NS
PNS-Ba (mm)	47.92	6.12	47.29	4.84	.726	NS
PNS-AD2 (mm)	22.28	4.59	20.29	3.98	.155	NS
AD2-H (mm)	12.00	3.98	13.03	4.66	.447	NS
PNS-H (mm)	34.28	4.05	33.29	4.66	.471	NS
N-H (mm)	85.72	5.17	86.35	5.84	.714	NS
SN (mm)	71.44	2.96	72.47	4.05	.346	NS
Upper pharynx (mm)	**15.46**	**2.88**	**13.56**	**2.97**	**.045**	**Sig**
Lower pharynx (mm)	13.04	5.12	12.12	2.65	.499	NS
Adenoidal area (mm2)	176.09	91.22	206.97	83.49	.272	NS
Aerial area (mm2)	400.56	131.49	382.58	110.49	.646	NS
Total area (mm2)	576.66	175.15	589.56	139.46	.801	NS

Table V - Comparison between subjects with Prognathic mandible, Retrognathic maxilla and Ideal occlusion.

Measurements	Prognathic mandible (25)		Retrognathic maxilla (17)		Ideal occlusion group (96)		Percentage of Variance	
	Mean	SD	Mean	SD	Mean	SD		
PNS-AD 1 (mm)	26.48	5.32	23.82	3.94	26.83	3.98	0.98	NS
AD1-Ba (mm)	21.44	4.49	35.82	51.98	18.98	4.02	0.71	NS
PNS-Ba (mm)	47.92	6.12	47.29	4.84	46.29	4.70	0.26	NS
PNS-AD2 (mm)	22.28	4.59	20.29	3.98	22.97	3.95	0.89	NS
AD2-H (mm)	12.00	3.98	13.03	4.66	10.14	4.31	0.25	NS
PNS-H (mm)	34.28	4.05	33.29	4.66	32.76	4.53	0.27	NS
N-H (mm)	**85.72**	**5.17**	**86.35**	**5.84**	**81.78**	**5.43**	**0.03**	**Sig**
SN (mm)	71.44	2.96	72.47	4.05	69.65	4.20	0.32	NS
Upper pharynx (mm)	15.46	2.88	13.56	2.97	13.88	3.25	0.06	NS
Lower pharynx (mm)	**13.04**	**5.12**	**12.12**	**2.65**	**10.24**	**3.42**	**0.001**	**Sig**
Adenoidal area (mm2)	176.09	91.22	206.97	83.49	143.18	86.31	0.11	NS
Aerial area (mm2)	400.56	131.49	382.58	110.49	418.22	99.09	0.83	NS
Total area (mm2)	576.66	175.15	589.56	139.46	562.64	130.03	0.37	NS

DISCUSSION

This study was conducted to establish the nasopharyngeal airway characteristics in subjects with Class III malocclusion and to compare them with a control group having Ideal occlusion in the Dakshina Kannada population. Although similar studies have been undertaken in the past in various populations by Kilinic et al (2008), Sayinsu et al (2006) and Alhaija et al (2005) in the Turkish population, Samman et al (2003) in the Hong kong population none has been done in the Dakshina Kannada population.

In the Class III nasopharyngeal morphology, significant sex differences were found in the nasal fossa length and anterior cranial base length. Anterior cranial base length was found to be greater in men compared to women which was statistically highly significant. Previous studies by Martin et al (2011) also showed that men have greater anterior cranial base length.

In contrast, Ideal occlusion group showed differences in 4 variables, which include lower adenoid width, nasal fossa length, cranial base length and upper pharyngeal dimension. The mean values were greater in men except in upper pharyngeal dimension which was found to be larger in females. These results suggest that subjects with Class III malocclusion show less sexual dimorphism similar to previous studies by Martin et al .

The following variations between subjects with Ideal occlusion and Class III malocclusion were found:

1. The upper adenoid width was found to be larger in Class III Malocclusion group.
2. The nasal fossa length and lower pharyngeal dimension were also larger in Class III Malocclusion group.
3. The cranial base length was found to be decreased in Class III malocclusion group similar to the findings in previous studies by Nobuyuki et al (2002).
4. In males of the Class III malocclusion group there was an increase in the McNamaras upper and lower pharyngeal dimension compared to the males in Ideal occlusion group
5. In females of the Class III malocclusion group lower adenoid width , upper aerial width, nasal fossa length and Mc Namara's upper pharyngeal dimension were found to be increased compared to the females in Ideal occlusion group .
6. The Upper pharyngeal dimension was found to be greater in females with Ideal occlusion when compared to males of the same group.
7. The lower adenoid width , nasal fossa length and cranial base length were found to be greater in males among Ideal occlusion group

Cranial base length is statistically related to several airway variables, out of which significant results were found mainly in nasal fossa length and lower airway thickness in the Class III malocclusion group. Among these two variables nasal fossa length showed maximum correlation with the anterior cranial base in accordance with the study by Martin et al (2011).

Similar to the findings of Steinberg and Fraser (1995), Robertson (2004) a significant relationship was found between the anterior cranial base and nasal fossa length. This relationship is more evident in subjects with Class III malocclusion. This study also agrees with these authors about the lower dimension of the cranial base length in Class III subjects.

Variations in pharyngeal airway space have also been described with some sleep disorders such as Obstructive Sleep Apnoea (OSA). Treatment modalities like orthognathic surgery for mandibular deformity alters skeletal and soft-tissue components, including the Pharyngeal Airway Space (PAS).Various studies have shown a correlation between the skeletal abnormalities of the cranial base, nasopharynx and the onset and severity of Ostructive Sleep Apnoea.

The present study also shows a decreased cranial base length in Class III malocclusion group. We know from the studies of Bacon et al and Tangugsorn et al (1989, 2001) that reduced anterior cranial base can be related to a increased predeliction for Ostructive Sleep Apnoea.

The importance of cranial base length to the contribution of midfacial retrognathia and Class III malocclusion remains unclear due to contradictory results from cephalometric studies. Various investigators like Sanborn (1955), Kerr and Adams (1988), Hopkin et al (1968) have reported that cranial base length is smaller in Class III subjects compared with their Class I counterparts, while other studies like Battagel (2000) , show only minor differences or none at all as confirmed by Anderson and Popovich (1983). Thus it would seem that anterior cranial base length may not play an important role in the etiology of Class III malocclusion, due to the conflicting nature of the data reported in the literature.

Analyzing differences between ideal occlusions and Class III malocclusions, the lower pharyngeal dimension is increased in Class III subjects, due to the advanced position of the hyoid bone found to be consistent with the findings of Trotman et al (1997) and Athanasiou et al (1991).

An increased cranial deflection is a common characteristic of Class III patients. A more angulated cranial base determines a more advanced glenoid fossa position and a more retruded maxilla (1994,1995). It was also observed in this study that the upper airway dimension did not show any statistically significant variation between the Ideal occlusion and Class III subjects.

Within the Class III malocclusion group significant difference were also found in Mc Namara's lower pharyngeal dimension between subjects with prognathic mandible and retrognathic maxilla. The variable showed a increased value in the prognathic mandible group suggesting that subjects with a Class III malocclusion have a larger lower airway, that is due to a forward position of mandible .In a previous study by Muto et al it was reported that pharyngeal airway diameter was largest in the group with mandibular prognathism followed by normal mandible and mandibular retrognathism groups.

Intra group variations were also found between Ideal occlusion and retrognathic maxilla, prognathic mandible. The lower pharyngeal dimension showed increased values in the prognathic mandible group when compared to the Ideal occlusion group which is in accordance with the study by Muto et al.

Hence, the subjects of the Class III Malocclusion group were characterized by a reduced anterior cranial base length and increased lower pharyngeal dimension, upper adenoid width and nasal fossa length.

CONCLUSION

- Sexual dimorphism though found in both the groups, is lesser in Class III malocclusion.
- Cranial base length is related to lower airway thickness and nasal fossa length in Class III malocclusion, similar association is not found in Ideal occlusion.
- Cranial base length is decreased in Class III malocclusion in comparison with the Ideal occlusion.
- Lower pharynx dimension, upper adenoid width and nasal fossa length are increased in Class III malocclusion compared to Ideal occlusion.
- Lower pharynx dimension is greater in subjects with Class III malocclusion with prognathic mandible than those with retrognathic maxilla and Ideal occlusion.

CONFLICT OF INTEREST: NIL
SOURCE OF FUNDING: Self

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