International Journal Dental and Medical Sciences Research
Volume 3, Issue 2, Mar-Apr. 2021 pp 733-740 www.ijdmsrjournal.com ISSN: 2582-6018

Cephalometrics for Himachali population using McNamara analysis.

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Submitted: 30-03-2021 Revised: 05-04-2021 Accepted: 08-04-2021

ABSTRACT: Introduction- The standard measurements are utilized to measure the craniofacial dimensions, assessment of facial deformities and to monitor the postoperative results. The variation in the different ethnic group within the same country created a need for cephalometrics for each ethnic group. **Aim** – To formulate the cephalometrics for Himachali population using McNamara analysis. **Method**- The sample consists of lateral cephalogram of 60 subjects with age range from 17 to 25 years. All the cephalometrics were measured using McNamara analysis. **Results**- Himachali population had smaller craniofacial measurement. There was an overall significant decrease in Maxillary length, Mandibular length, Lower anterior facial height and Nasolabial angle and an increase in the Cant of upper lip in males when compared to Caucasian population. However the maxilla-mandibular differences were normal to that of mid-facial length .There was no statistical difference seen between males and females population. The airway was patent and dental parameters were normal in both group. **Conclusion-** Gender and ethnic diversity must be considered during orthodontic diagnosis and treatment planning for an individual.

Keywords:- Cephalometrics, Himachali population, McNamara Analysis.

I. INTRODUCTION

Cephalometry means “head measuring” and cephalometric analysis is the study of dental and skeletal relationships to the head.[6] Since the advent of cephalometric radiography by Broadbent & Hofrath (1931), orthodontists focused on the lateral cephalograms as their primary source of skeletal and dentoalveolar data. [7-10]

Cephalometric analysis is a useful diagnostic tool to determine facial type and its growth pattern, in order to centralize therapeutic measures during treatment and modify facial growth in children and adolescents.[1,3,4,11,12] The standard values of human facial measurements are derived from studies conducted. These standard measurements are utilized to measure the craniofacial dimensions, assessment of facial deformities and to monitor the postoperative results.

Many different systems for analysis have been suggested, which can grossly be classified into two groups. Some evaluate the patient with regard to specific standards, which are also used to set the treatment goal, e.g. the analysis described by Tweed (1954)[13], Steiner (1960)[14] and Ricketts (1961)[15]. Other analyses are performed with the purpose of understanding the malocclusion, whether it is of dentoalveolar or skeletal origin, e.g. those described by Bjork [1947][23], Downs [1948][17], Enlow [1971][18] and McNamara [1984][4,19]. They are based on factors such as age, sex, size and race.[34]

Various studies have stated that the standard measurement of one group should not be considered normal for other racial groups.[21-24] Different racial groups should be treated according to their own characteristics and it is therefore important to develop standards for various population groups.[25-45] Caucasian norms developed are in use for numerous cephalometric analysis, and are thus inadequate for application to other racial groups. The planning of orthodontic treatment often includes comparison of craniofacial structure of a patient to the norm.[20] It is always preferable to compare the cephalometric values of the patient to the norm of their ethnic or racial group. The cephalometric analysis can then be used to accurately identify the deviation found in the patient.[2,3,5,9]

Cephalometrics have been established using various analyses for the Indian population like for the North Indians, & Maharashtrians, Bunts, Gurkhas, Madras city population, Aryo-Dravidians, North Indian preschool children, South Kanara Children, South Indians and Indo-Aryans.[46] McNamara’s analysis is the most suitable for diagnosis, treatment planning and treatment evaluation, not only of conventional orthodontic patients, but also for patients with skeletal discrepancies who require orthognathic surgery.[47] Hence, McNamara’s cephalometric analysis was utilized in this study to establish the new

International Journal Dental and Medical Sciences Research
Volume 3, Issue 2, Mar-Apr. 2021 pp 733-740 www.ijdmsrjournal.com ISSN: 2582-6018

cephalometrics for himachali population since there are no existing one for this population.

II. AIMS and OBJECTIVES

1. To formulate the cephalometrics for Himachali population using McNamara analysis.
2. To compare the Himachali population norms with caucasian population.
3. To check sexual dimorphism.

III. MATERIALS AND METHOD

60 Pre treatment lateral cephalograms were included in the study. All the cephalograms were traced manually by the same operator. All the landmarks were identified and marked and measurements were recorded (Table :- 1).

Statistical Analysis

The standard deviation, mean and range were calculated for all the values. The levene's Test for equality of variance. Independent -t – test for Gender difference and the equality of means was done. In all these tests, $p > 0.05$ indicated no statistical difference while $p \leq 0.05$ indicated statistically significant difference between the measurement of males and female for that respective parameter.

TABLE:- 1 Landmarks and References lines for McNamara Analysis

Maxilla to cranial base		
1	NA-P perpendicular	A vertical line is constructed perpendicular to the Frankfort horizontal and extended inferiorly from the nasion. The perpendicular distance is measured from point A to the nasion perpendicular
2	SNA	The angle between the SN and NA lines
Mandible to Maxilla		
3	Co – Gn (Effective mandibular length)	A line is measured from the condylion to the anatomic gnathion
4	Co – A (Effective midface length)	A line is measured from the condylion to point A
5	Mx MD – DF (Maxillomandibular differences)	Effective mandibular length minus effective midface length
6	ANS – Me (Lower anterior face height)	A line measured from the anterior nasal spine to the menton
7	MD – P (Mandibular plane angle)	The angle between the anatomic Frankfort plane and the mandibular plane, gonion – menton
8	FA – A (Facial axis angle)	A line is conducted from the basion to the nasion (NBa). A second line (the facial axis) is constructed gnathion (the intersection of the facial plane and the mandibular plane). The facial axis angle is the angle between the NBa and the facial axis.
Mandible to Cranial base		
9	Pg – N	The perpendicular distance is measured from the pogonion to the nasion perpendicular.
Dentition		
10	Ui – A (Upper incisor to point A)	A point A perpendicular is constructed parallel to the nasion perpendicular through point A. The perpendicular distance is measured from the most anterior surface of the upper incisor to the point A perpendicular.
11	Li – A Pg (Lower incisor to A – Po line)	The distance is measured from the facial surface of the lower incisor to the A

		pogonion line.
Airway Analysis		
12	Upper airway	Measured from a point on the posterior outline of the soft palate to the closest point on pharyngeal wall
13	Lower airway	Measured from the point of intersection of the posterior border of the tongue and the inferior border of the mandible to the closest point on the posterior pharyngeal wall

IV. RESULTS

The study consisted of 60 subjects amongst which 30 were males and 30 were females. The age was 17-25 years so the mean of all the parameter measured in study on 60 subjects is shown by Table 2.

Table 2. Descriptive statistics for overall subjects.

Parameter	**Mean(60)**
1. **Nasolabial angle**	96.038^0
2. Cant of upper lip	12.450^0
3. Point A to N Perpendicular	1.338mm
4. Cd to Point A	83.310mm
5. Cd to GN	88.268mm
6. Maxilla-Mandible Difference	20.498mm
7. ANS to Me	61.427mm
8. Facial axis angle	86.175^0
9. Mandibular plane angle	25.347^0
10. Pog to N Perpendicular	3.573mm
11. Maxillary incisor position	2.910mm
12. Mandibular incisor position	1.850mm
13. Upper Pharynx	13.692mm
14. Lower Pharynx	9.002mm

These are the group statistics with mean, standard deviation and standard error mean for male and female row 1 is showing values for all 30 males and row 2 is showing the values for 30 females (Table 3).

Table 3.- Descriptive statistics for males and females

	Gender	**Mean**	**Std. Deviation**	**Std. Error Mean**
1. Nasolabial angle	M(30)	96.290	12.5805	2.2969
	F(30)	95.787	9.1404	1.6688
2. Cant of upper lip	M(30)	12.433	2.7784	.5073
	F(30)	12.467	2.7635	.5045
3.Point A to N Perpendicular	M(30)	1.297	1.1981	.2187
	F(30)	1.380	1.3464	.2458
4. Cd to PointA	M(30)	83.227	16.9714	3.0985
	F(30)	83.393	14.9970	2.7381
5. Cd to GN	M(30)	86.977	9.4889	1.7324
	F(30)	89.560	10.5055	1.9180

6.Maxilla-Mandible Difference	M(30)	19.950	3.9298	.7175
	F(30)	21.047	4.2742	.7804
7. ANS to Me	M(30)	60.990	4.3840	.8004
	F(30)	61.863	5.2910	.9660
8. Facial axis angle	M(30)	86.183	3.7243	.6800
	F(30)	86.167	4.5245	.8261
9. Mandibular plane angle	M(30)	25.793	4.4717	.8164
	F(30)	24.900	4.8632	.8879
10.Pog to N Perpendicular	M(30)	4.023	2.3828	.4350
	F(30)	3.123	1.4505	.2648
11.Maxillary incisor position	M(30)	2.723	1.3130	.2397
	F(30)	3.097	1.1868	.2167
12.Mandibular incisor position	M(30)	1.947	.8955	.1635
	F(30)	1.753	1.0471	.1912
13. Upper Pharynx	M(30)	13.477	3.1055	.5670
	F(30)	13.907	3.2615	.5955
14. Lower Pharynx	M(30)	8.940	2.3032	.4205
	F(30)	9.063	2.6133	.4771

Table.4 -Independent sample test, Levene's test for the equality of variances and t-test for equality of means.

Independent Samples Test							
		Levene's Test for Equality of Variances		**t-test for Equality of Means**			
		F	**Sig.**	**T**	**Df**	**Sig. (2-tailed)**	**Mean Difference**
1. Nasolabial angle	Equal variances assumed	2.213	.142	.177	58	.860	.5033
	Equal variances not assumed			.177	52.94	.860	.5033
2. Cant of upper lip	Equal variances assumed	.003	.954	-.047	58	.963	-.0333
	Equal variances not assumed			-.047	57.99	.963	-.0333
3. Point A to N Perpendicular	Equal variances assumed	.394	.533	-.253	58	.801	-.0833
	Equal variances not assumed			-.253	57.22	.801	-.0833
4. Cd to Point A	Equal variances assumed	.584	.448	-.040	58	.968	-.1667
	Equal variances not assumed			-.040	57.13	.968	-.1667
5. Cd to GN	Equal variances assumed	1.096	.299	-1.00	58	.322	-2.5833
	Equal variances not assumed			-1.00	57.40	.322	-2.5833
6. Maxilla-Mandible Difference	Equal variances assumed	.732	.396	-1.03	58	.305	-1.0967
	Equal variances not assumed			-1.03	57.59	.305	-1.0967

7. ANS to Me	Equal variances assumed	2.330	.132	-.696	58	.489	-.8733
	Equal variances not assumed			-.696	56.06	.489	-.8733
8. Facial axis angle	Equal variances assumed	2.292	.136	.016	58	.988	.0167
	Equal variances not assumed			.016	55.93	.988	.0167
9. Mandibular plane angle	Equal variances assumed	.033	.857	.741	58	.462	.8933
	Equal variances not assumed			.741	57.59	.462	.8933
10. Pog to N Perpendicular	Equal variances assumed	9.683	.003	1.767	58	.082	.9000
	Equal variances not assumed			1.767	47.89	.084	.9000
11. Maxillary incisor position	Equal variances assumed	.882	.351	-1.15	58	.253	-.3733
	Equal variances not assumed			-1.15	57.41	.253	-.3733
12. Mandibular incisor position	Equal variances assumed	1.707	.197	.769	58	.445	.1933
	Equal variances not assumed			.769	56.63	.445	.1933
13. Upper Pharynx	Equal variances assumed	.127	.722	-.523	58	.603	-.4300
	Equal variances not assumed			-.523	57.86	.603	-.4300
14. Lower Pharynx	Equal variances assumed	.570	.453	-.194	58	.847	-.1233
	Equal variances not assumed			-.194	57.09	.847	-.1233

The P value for all the perimeters are more than 0.05 indicating no statistical difference (Table. 4) and there is no statistical difference between male and female. So from this we can say that-

- Adult Himachali population were found to have smaller craniofacial measurement.
- There were overall significant decrease in Maxillary length, Mandibular length, Lower anterior facial height and Nasolabial angle and an increase in the Cant of upper lip in males when compared to Caucasian population.
- Adult Himachali population were found to have smaller craniofacial measurement.
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V. DISCUSSION

Clinical orthodontics have seen the advent of numerous preventive as well as interceptive procedures, which allow three dimensional repositioning of almost every bony structure in the facial region and of functional appliance therapy which presents new possibilities in the treatment of skeletal discrepancies.[3,5,9,48-50] Cephalometric analysis is the most commonly used method to assess the dentofacial morphology, which is important in orthodontic treatment planning and evaluation of treatment changes.[50] The shape and size of the craniofacial complex changes with age,

so does the values of cephalometric measurements. Hence, cephalometric standards should be available for different age groups.[51] Most of the cephalometric analyses which are used today in India have originated in White North American adults. Most importantly, in a country like India where the intracountry variation in population is found to a great extent morphogenetically as well as linguistically, developing a specific normative standard for the entire population can be erroneous in nature. Therefore, existence of norms based on individual population groups becomes an absolute necessity to produce acceptable results.[29,32,38,48,51]

Numerous studies have shown intrapopulation gender based differences for various linear and angular cephalometric measurements between males and females.[30-32,51,53,54] For McNamara analysis, there was a statistically significant difference between males and females in about half of variables.[50-55] Therefore, cephalometric standards should be available for different gender groups to be used for orthodontic and other diagnosis, and treatment planning.[53] In accordance with these findings, the measurements of male and female subjects were analyzed for statistically significant differences. The norms are usually derived from samples demonstrating ideal dental occlusions of the class I variety.[20] Various population norms have been obtained from a random sample of subjects with Class I occlusion including those with minor malocclusions.[50] Hence, the subjects having Angle's class I occlusion with normal overjet and overbite were selected for the study. Ethnic homogeneity was achieved by selecting the subjects having both parents from a Himachal background.

McNamara suggested that a need has arisen for a method of cephalometric analysis that is sensitive not only to the position of the teeth within a given bone but also to the relationship of the jaw elements and cranial base structures one to another. He devised his method of analysis with an effort to relate teeth to teeth, teeth to jaws, each jaw to the other, and the jaws to the cranial base.[56] This approach makes the actual analysis most suitable for diagnosis, treatment planning, and treatment evaluation.[35] Further, this analysis uses linear measurements so that the treatment planning and diagnosis can be made easier.[57] Also, no norms based on McNamara's analysis are available for the Himachali population. Hence, this analysis was adopted for the current study.

Gender Differences

According to the present study, the gender wise differences in the measurements of the parameters of McNamara's analysis were statistically non-significant although Adult Himachali population were found to have smaller craniofacial measurement. There were overall significant decrease in Maxillary length, Mandibular length, Lower anterior facial height and Nasolabial angle and an increase in the Cant of upper lip only in males this finding was in accordance with the findings of sample of McNamara (1984) for Caucasian subjects. However the maxilla-mandibular differences were normal to that of mid-facial length. There was no statistical difference seen between males and females population. The airway was patent and dental parameters were normal in both group.

VI. CONCLUSION

1) A total of 60 adults (30 males and 30 females) between the age group of 17 – 25 years from Solan district were included in the study.
2) This study introduces cephalometric values for the permanent dentition period using McNamara Analysis for Himachali adults residing in solan districts of Himachal which are non-existent till date; and hence, can be utilized for better and accurate orthodontic treatments for this population group.
3) Gender and ethnic diversity must be considered during orthodontic diagnosis and treatment planning for an individual.
4) There were overall significant decrease in maxillary length, mandibular length, lower anterior facial height and Nasolabial angle and an increased in the cant of upper lip specifically in males when compared to females.
5) The gender related differences of the cephalometric parameters were insignificant for all males and femalesin this study.

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