

Dental arch length and arch symmetry analysis of Nepalese permanent dentition

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Abstract

Objective: To study the dental arch lengths at canines and first molars of permanent dentitions of Nepalese adults using Lavelle's method.

Materials and methods: Dental stone models of one hundred subjects with normal occlusion and dentofacial proportion were studied using standard Boley gauze. The study compared gender differences among the Nepalese adults as well as between the Nepalese and Caucasian samples.

Results: Arch lengths of the Nepalese males were significantly greater than those of the females at all parameters studied except at mandibular canine. The arch lengths of the Nepalese adults were significantly greater than those of the Caucasians except at mandibular canine.

Conclusion: Significant variation between left and right sides of the dental arch lengths at mandibular canine region suggest asymmetry of dental arch among Nepalese adults.

Key words: Arch length, Arch Symmetry, Lavelle's method

Introduction

Lavelle¹ in 1971 defined dental arch length as the oblique dimension measured between the most mesial aspect of anterior teeth and the most distal aspects of posterior teeth. The dental arch length denotes the sagittal dimension of the dental arch from most anterior reference point to the posterior surface. Various researchers have measured the dental arch length differently; and many consider arch length and arch depth synonymously. Other researchers including Burris², DeKock³, and Barrett⁴ measured arch length at mid-palatal line. Sanin⁵ estimated dental arch length using fourth degree polynomial formula.

Anthropologists believe that different racial types have differently shaped dental arches. Williams⁶ in 1917 stated that arches vary slightly to harmonize with different racial types, and the variability within a racial type is extremely less. Laine⁷ showed that, arch length did not differ from one Caucasoid population group to another of same age range. Buris², Merz⁸ found that the Black subject's arches were longer compared to Whites. Confirming the general observation, most of the researchers including Barrett⁴, Bishara⁹, and Huang¹⁰ found greater dimension of arch length in males compared to females.

The study on dental arch symmetry is of interest to orthodontists from functional as well as esthetic point of view. Historically Gruenberg¹¹ in 1912 devised "symmetroscope" to measure the symmetry of the dental arch; later Friel¹² modified it as a transparent celluloid sheet with ruled squares. Lu¹³ in 1964 studied the symmetry of dental arch using orthogonal polynomial analysis. BeGole¹⁴ suggested cubic spline curve as an ideal means to represent the asymmetry of the dental arch. Comparing left and right sides of the dental arch has been the most common method to describe the arch asymmetry. Lavelle & Plant¹⁵ compared right and left sides of the dental arch with normal occlusion to analyze arch symmetry using traveling microscope.

The racial, sexual and symmetrical variations in dental arch lengths are thus deemed important to be analyzed for permanent dentition of the Nepalese adults. The study is believed to be useful for orthodontic, odontometric and anthropometric purposes.

Materials and methods

The sample consisted of dental stone cast of one hundred Nepalese adults aged 17 to 32 years; with

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equal female to male ratio. The sampling was based on inclusion criteria established for the research. The samples possessed all permanent teeth (with or without third molars), Angle's Class I molar and canine relationships, normal overjet and overbite, orthognathic skeletal and facial profile. The subjects were selected among the patients who visited to the Dental Center of Kathmandu Model Hospital and among the participants of dental camp organized by the same center.

The measurement of dental arch length followed the method described by Lavelle et al¹. The dimensions were measured between the mesial line angles of the central incisors to the distal contact point of the canine and to the distal contact point of first molar in oblique direction on both right and left sides (Fig 1). The measurements were performed directly on maxillary and mandibular casts using standard Boley gauge (Dentaurum Munchner model) of 0.1 mm accuracy.

The samples were analyzed for the statistical difference between female and male sexes, and between the Nepalese and Caucasian (British) samples. The mean arch lengths were compared between right and left sides to analyze the symmetry of the dental arch. The data were also compared with Cucasians, Australian aboriginies, Negroid and Mongoloid races as reported by Lavelle¹. The statistical analysis was performed using Student's t-test at the level of significance of 0.05.

Result

A descriptive statistics of the mean arch lengths of Nepalese female, male, and combined female and male subjects are presented in Table 1, Table 2, and Table 3 respectively. The data also show the average of the right and left dimensions.

When comparing the arch lengths between Nepalese females and males, all mean values of the males were significantly greater than those of the females at all dimensions except for the mandibular arch length at canine on the left side (Table 4 and Table 5).

When comparing the difference between Nepalese females and males for the average of right and left arch lengths, all dimensions were greater in males except for arch length at mandibular canine (Table 6).

Table 7 shows that the mandibular arch length at canine on left side is significantly greater than that on the right side of the combined Nepalese females and males.

The study shows that all arch length measurements except at the mandibular canine length were greater in Nepalese compared to the Caucasian samples (Table 8). Table 9 illustrates the comparative arch lengths of Nepalese adults with other racial groups as reported by Lavelle.

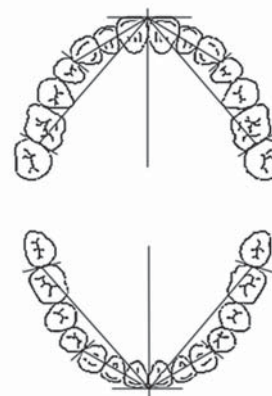


Fig 1: Dental arch length reference points

Table 1: Descriptive statistics for the arch lengths of Nepalese females (in mm)

		Right			Left			Average		
		Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Mx	I ₁ – C	22.17	1.02	4..80	22.10	1.07	5.30	22.14	1.04	5.05
	I ₁ – M ₁	43.23	1.54	6.80	43.33	1.71	8.30	43.28	1.60	7.55
Md	I ₁ – C	16.96	0.77	3.50	17.09	0.75	3.40	17.03	0.74	3.40
	I ₁ – M ₁	39.00	1.52	7.80	39.11	1.47	7.30	39.05	1.47	7.55

Table 2: Descriptive statistics for the arch lengths of Nepalese males (in mm)

		Right			Left			Average		
		Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Mx	I ₁ – C	22.68	1.14	4.60	22.67	1.08	4.30	22.68	1.09	4.45
	I ₁ – M ₁	44.41	1.98	8.80	44.33	1.92	8.30	44.37	1.93	8.50
Md	I ₁ – C	17.31	0.92	3.60	17.40	0.91	4.00	17.36	0.90	3.70
	I ₁ – M ₁	40.01	1.67	7.00	40.12	1.91	8.10	40.06	1.77	7.30

Table 3: Descriptive statistics for the arch lengths of combined Nepalese females and males (in mm)

		Right			Left			Average		
		Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Mx	I ₁ - C	22.43	1.11	5.70	22.39	1.11	5.50	22.41	1.09	5.60
	I ₁ - M ₁	43.82	1.86	8.80	43.83	1.88	9.20	43.83	1.85	8.75
Md	I ₁ - C	17.13	0.86	3.80	17.25	0.85	4.00	17.19	0.84	3.85
	I ₁ - M ₁	39.50	1.67	7.80	39.61	1.77	9.00	39.56	1.70	8.05

Table 4: t-Test of significance for the difference between the mean arch lengths of Nepalese females and males on right side

		Female		Male		p-value	Significance
		Mean	S.D.	Mean	S.D.		
Mx	I ₁ - C	22.17	1.02	22.68	1.14	0.021	*
	I ₁ - M ₁	43.23	1.54	44.41	1.98	0.001	***
Md	I ₁ - C	16.96	0.77	17.31	0.92	0.038	*
	I ₁ - M ₁	39.00	1.52	40.01	1.67	0.002	**

(* P ≤ 0.05, ** P ≤ 0.01, *** P ≤ 0.001)

Table 5: t-Test of significance for the difference between the mean arch lengths of Nepalese females and males on left side

		Female		Male		p-value	Significance
		Mean	S.D.	Mean	S.D.		
Mx	I ₁ - C	22.10	1.07	22.67	1.08	0.009	**
	I ₁ - M ₁	43.33	1.71	44.33	1.92	0.007	**
Md	I ₁ - C	17.09	0.75	17.40	0.91	0.066	NS
	I ₁ - M ₁	39.11	1.47	40.12	1.91	0.004	**

(NS = not significant, ** P ≤ 0.01)

Table 6: t-Test of significance for the difference between the sexes for the average of right and left arch lengths

		Female		Male		p-value	Significance
		Mean	S.D.	Mean	S.D.		
Mx	I ₁ - C	22.14	1.04	22.68	1.09	0.012	*
	I ₁ - M ₁	43.28	1.60	44.37	1.93	0.003	**
Md	I ₁ - C	17.03	0.74	17.36	0.90	0.051	NS
	I ₁ - M ₁	39.05	1.47	40.06	1.77	0.003	**

(NS = not significant, * P ≤ 0.05, ** P ≤ 0.01)

Table 7: t-Test of significance for the difference between right and left arch lengths of combined Nepalese females and males

		Right		Left		p-value	Significance
		Mean	S.D.	Mean	S.D.		
Mx	I ₁ - C	22.43	1.11	22.39	1.11	0.361	NS
	I ₁ - M ₁	43.82	1.86	43.83	1.88	0.879	NS
Md	I ₁ - C	17.13	0.86	17.25	0.85	0.001	***
	I ₁ - M ₁	39.50	1.67	39.61	1.77	0.062	NS

(NS = not significant, *** P ≤ 0.001)

Table 8: t-Test of significance for the difference between the arch lengths of Nepalese and Caucasian subjects

		Caucasian (Lavelle, 1971)		Nepalese (Shrestha, 2009)		p-value	Significance
		Mean	S.D.	Mean	S.D.		
Mx	I ₁ - C	17.7	1.16	22.41	1.09	0.000000	***
	I ₁ - M ₁	36.9	0.82	43.83	1.85	0.000000	***
Md	I ₁ - C	17.5	1.18	17.19	0.84	0.082809	NS
	I ₁ - M ₁	38.5	0.29	39.56	1.70	0.000141	***

(NS = not significant, *** $P \leq 0.001$)

Table 9: Comparative arch lengths of Nepalese and other racial groups

		Caucasian (Lavelle, 1971)		Australian Aborigine (Lavelle, 1971)		Negroid (Lavelle, 1971)		Mongoloid (Lavelle, 1971)		Nepalese (Shrestha, 2009)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Mx	I ₁ - C	17.7	1.16	18.6	1.12	22.7	0.58	18.2	0.56	22.4	1.09
	I ₁ - M ₁	36.9	0.82	47.7	0.53	38.9	0.53	36.0	0.53	43.8	1.85
Md	I ₁ - C	17.5	1.18	18.1	1.11	17.8	0.63	18.8	0.49	17.2	0.84
	I ₁ - M ₁	38.5	0.29	38.8	0.57	38.4	1.13	39.0	0.47	39.6	1.70

Discussion

The odontometric or anthropometric study of dental arch is best performed among adults. Proffit¹⁶ noted a definitive sequence of jaw growth in three planes of space. The growth of the dental arch width is completed first, followed by arch length, and finally growth in arch height takes place. DeKock,³ Sinclair,¹⁷ Bishara,¹⁸ and Harris¹⁹ reported decrease in dimension of arch length with the attainment of adulthood, then after the dental arch attains the stable dimension.

The present study is in agreement with the findings of Barrett⁴, Bishara⁹, and Huang¹⁰ confirming that arch lengths of the males were greater than those of the females. The present study is also consistent with the contemporary studies on arch width²⁰ and arch circumference²¹ of the Nepalese adults; which reported that arch dimensions of the Nepalese males were significantly greater as compared to females.

The racial variation in arch length is also evident from the present study. The arch lengths of the Nepalese adults were significantly greater than those of the Caucasians suggesting the longer dental arch sagittally. This finding is consistent with the cephalometric study²² on Nepalese adults which reported that both maxilla and mandible in relation to cranial base were positioned more anteriorly with greater SNA and SNB angles.

Most theories consider dental arch forms to be symmetrical. White²³ however observed a great deal of asymmetry in the dental arches. Lavelle & Plant¹⁵

observed the dimensions of the teeth and arch lengths on right side were greater than those on the left, but the differences were insignificant. Bishara, Jacobsen et al.¹⁸ however found no significant differences between right and left sides in arch length measurement. The present analysis showed that the mandibular arch length at canine region was significantly greater on left side. The apparent bilateral differences on arch dimensions show that the Nepalese dental arch with normal occlusion is dimensionally asymmetrical.

Kanazawa²⁴ observed significant correlation between the size of the teeth and length of the dental arch. However present study is not consistent with such finding. The present study found greater dimensions of arch length on left side contrarily another study²⁵ on mesio-distal tooth diameter of Nepalese adults show most of the tooth dimensions significantly wider on right side. Thus these facts imply that the arch lengths are not dependent on mesio-distal crown diameters.

Conclusion

- Dental arch lengths of Nepalese males are significantly greater than those of the females for both maxillary and mandibular canine and first molar dimensions except at mandibular canine on left side.
- Average of the left and right arch lengths of the Nepalese males are significantly greater than those of the females for all dimensions except at mandibular canine.

- Mandibular arch length at canine on left side is significantly greater than that on the right side of the combined Nepalese adults suggesting asymmetry of the dental arch at the region of mandibular canine.
- All arch length measurements of the Nepalese adults were significantly greater than those of the Caucasians except at the mandibular canine.

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