

Morphological and Dimensional Characteristics of Dental Arch among Tribal and Non-tribal Population of Central India: A Comparative Study

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Abstract:

Background: Differences in the dental arch among Bhil Aborigines were investigated and compared with non-tribal individuals residing in a tribal zone of Central India. Plaster models (120) were made with the help of alginate impression of tribal adults as well as non-tribal adults residing in the same area. The supposition as aborigines being primitive due to dietary practices maxillary arch size and mandibular arch size is distended in comparison to the non-tribal population as adaptation of soft refined diet has disrupted the growth of the jaws. Hence, an attempt was made to evaluate the arch widths of tribal population and to associate it with non-tribe population in the same area of Central India.

Materials and Methods: Difference in morphology and dimension of the maxillary and mandibular arches was aimed at Bhil tribes as well as non-tribal residents of tribe rich zone of Central India. The study was steered amid 120 individuals both tribal and non-tribe equally around 60 each through a well-organized out-reach program intermittently. Study models were made of dental arches of all participants. All measurements of the arch dimension were patent on the study casts using an electronic digital sliding caliper. Pair *t*-test was applied by using SPSS software version-19.0.

Results: In the maxillary arch, on appraisal the non-tribal and Bhil tribe's subjects, it showed a statistically significant difference in inter-incisor width (2.95 mm), inter-canine width (2.60 mm), arch depth (3.25 mm). While inter premolar width (0.20 mm) and inter molar width (0.80 mm) anterior arch length (0.60 mm), and

posterior arch length (0.10 mm) showed statistically not significant difference between non-tribal population and Bhil tribe subjects.

In the mandibular arch, it showed a statistically significant difference in inter-canine width (1.00 mm). Although, inter-incisor width (0.72 mm), inter-molar width (0.80 mm), arch depth (0.90 mm), anterior arch length (0.30 mm), posterior arch length (0.35 mm), and curve of Spee (0.13 mm) showed statistically not significant difference between general population and Bhil tribe subjects.

Conclusion: When associated non-tribal population to Bhil tribes subjects, for the morphological and dimensional characteristics of dental arches Bhil tribe subjects exhibited: A narrower and shorter maxilla; reduced mandible size; smaller incisor widths for the maxillary and mandibular arches.

Key Words: Arch depth, bhil tribe, dental arch

Introduction

Appraisal of dental arches is of pronounced significance for decisive diagnosis and optimal craniofacial treatment modalities. The values of the dimensions of the arch include: Width, depth and circumference, inter-canine and inter-molar distances, over-jet and over-bite, which change during growth in different ways (the width of the teeth remains the same, whereas the lengths of the mandibular and maxillary bones increase).¹

The circumference or perimeter is the furthermost imperative dimension of the dental arch and varies bestowing to age and gender. The intensifications in the arch are more allied to the proceedings underlying tooth development and somewhat less to skeletal growth.

India is home to many tribes who have very interesting history of origin, customs and social practices. So much so that even today they are far distinct from the "civilized" society around them. Tribal in Central India constitute a sizeable population.²

Owing to the diverse etymological, ethnic and geographical environment, and its uncharacteristic impediments, the diverse tribal world of Central India has not only been largely cut-off from the mainstream of development. Central India holds among the top in terms of schedule tribe population and 12th rank in respect of the proportion of schedule tribe population to total population.³

Very little is known regarding the origin of these tribes. There is no recorded history of Bhils and data on health status, almost no light is thrown on the oral health status and treatment needs.

Cast measurements used in this study were based on the previous studies done by Little,⁴ Sinclair and Little,⁵ Bishara *et al.*,⁶ Al-Wahadni *et al.*,⁷ and Chopra *et al.*⁸ They measured upper and lower inter-incisor width, inter canine width, inter premolar width, inter molar width, arch depth, anterior and posterior arch length and curve of Spee.

The tribal population in Khargone district, which has reasonably meager ethnic diversity, can present different characteristics. The ethnic diverse tribe is expected to have difference in dietary habits as well as the lifestyles. Most studies indicate that normal measurements for one group may not be considered normal for other race or ethnic groups. Different racial groups must be treated according to their own characteristics.¹ However, there is no published study addressing the morphologic characteristics of the dental arches for ethnic groups. They live in isolated locations and preserve their own traditions. Their craniofacial constitution differs from the settlers of non-ethnic residents. There is only very trivial anthropological relating oral health world-wide. No published literature on oral health or morphological determinants of ethnic minorities.

Estimation of dental arches is of great importance for definitive diagnosis and optimal craniofacial treatment and hence racial groups must be treated according to the categorization in dental arches. So, this is a humble attempt to evaluate the arch size difference among tribal population non-tribal residents of a particular geographic area. For recommending the concern authority the oral health services for comprehensive treatment planning.

Materials and Methods

A sample of 60 adults were selected from tribal as well as simulated from non-tribal adults residing in the same tribal rich zone of Central India. In view to assemble the sample for the purpose of morphological cast preparation, consecutive four camps were organized in the Tehsil area of Badalpur and Piplai villages of Khargone District, in the month of September 2013 to November 2013. The camp was organized in collaboration of People's Dental Academy Bhopal, Departments of Public Health Dentistry, Department of Prosthodontics and friends association a non-governmental organization dynamic in the area. Campaign for the free oral health check-up followed by treatment in consecutive days was organized to create awareness in the particular area constantly for a week before the commencement of the camp. Over-all 546 individuals visited the camp site. Tribal individuals 132 and non-tribal residents 414 attended the oral health camp. Amid tribal attending the oral health camp 41 children and adults with edentulous arches (6) and partial dentulous arches (11) were excluded from the statistical frame. Sample frame of 74 adults inclusive of the study were explained about the study and verbal consent and consent form with thumb impressions on a preformed consent were documented. Few dropouts due to

fear of unknown, few due to lack of understanding and some due to failure in impression making or individuals encountered incompatible reactions with impression material. At a final point 60 tribal individuals were included in the frame and the study models were made effectively. Similar impressions and the cast for study models were made for 60 non-tribal residents visiting the camp residing in the same area.

Individually non-tribal population subjects and Bhil tribes were excluded from this research if they had only of the following:

1. Clinically evident inter proximal dental carries
2. An alternation in the number or shape of the teeth that might affect the diameter of the dental arch (e.g. congenitally missing teeth of turner's tooth)
3. Any oral habit that might influence the dental arches
4. Any hereditary or acquired dental of facial deformity
5. Appearance of orthodontic treatment prior to the starting of the examination.

A comparative study was conducted among 120 subjects and 60 Bhil tribe and non-tribal subjects to evaluate maxillary and mandibular arch dimensions. Khargon is in the middle of the Narmada River valley with the Vindhya mountain range situated in the north and Satpura in the south. The River Narmada flows along a path of 50 km (31 mi) inside the district. Veda and Kunda are the other two main rivers in the district.

Before preliminary study ethical clearance was obtained from the Institutional Ethics Committee of People's Dental Academy Bhopal. Written consent was obtained from tribal center.

Alginate impression was fabricated of both maxillary and mandibular dental arches of all participants. In order to standardize the dental models as much as possible, all impressions were cast in hard stone on same day as the impressions was taken.

All measurements of arch dimensions were made on the casts using an electronic digital sliding caliper. Paired *t*-test was applied using SPSS software version-14 (IBM, USA).

The following measurements were made by one examiner. Intra examiner variability was checked by kappa statistics which was 96.2%.

- Inter-incisor width was measured from the distal contact point of the permanent lateral incisor on one side to the distal contact point of the contra lateral permanent lateral incisor.
- Inter- canine width was measured from the cusp tip of the permanent canine on one side to the cusp lip of the contra lateral permanent canine.
- Inter premolar width was measured from the cusp tip of the second premolar on one side to the cusp tip of the contra lateral second premolar.
- Inter-molar width was measured from the mesio-buccal

cusps tip of the first permanent molar on one side to the contra lateral first permanent molars.

- Arch depth was measured as the shortest distance connecting the distal surface of the first permanent molars to the labial surface of the most anterior tooth in the arch.
- Anterior arch length was measured between the mesial contact point of the permanent central incisor and the point between the permanent canine and the first premolars.
- Posterior Arch length was measured between the mesial contact point of the permanent canine and the distance contact point of the second premolars.
- The curve of Spee was measured as the perpendicular line from the cusps tip of the second premolars to a line connecting the distant cusps tip of the first permanent molar and the incisal edge of the most anterior tooth.
- A period of training was completed by the evaluator to ensure compliance with the measurement criteria and improve reproducibility. The reproducibility was evaluated by analyzing the difference between 10 double measurements taken at different times for all variables investigated. The error of measurement or mean square error was assessed by Dahlberg's formula:⁸

$$SE^2 = \sum d^2 / 2n$$

Results

Table 1 reveals the finding of this study for maxillary arch measurements in non-tribal subjects and Bhil tribe subjects.

It shows that inter-incisor width was greater for non-tribal subjects in comparison to Bhil tribe subjects. It was 30.45 (±1.28 mm) for non-tribal subjects and 27.50 mm (±1.00 mm) for Bhil tribes subjects. There was statistically noteworthy difference for inter-incisor width (P = 0.000).

Inter-canine width was greater for non-tribal subjects when comparison to Bhil tribes subjects. It was 38.35 (±2.58 mm) for non-tribal subjects and 35.75 mm (±2.24 mm) for Bhil tribes subjects. It also shows statistically significant difference between non-tribe subjects and Bhil tribe subjects (P = 0.002).

It also shows that inter molar width was 57.35 mm (±3.41 mm) for non-tribe subjects and 56.55 mm (±3.32 mm) for Bhil tribes

subjects demonstrating a statistically not significant difference of 0.80 mm (P = 0.456).

It also shows that inter premolar width was 49.30 mm (±3.31) in non-tribal subjects and 49.10 mm (±3.73 mm) in Bhil tribes subjects demonstrating a statistically not significant difference of 0.20 mm (P = 0.859).

Maxillary Arch depth was 38.65 mm (±3.05 mm) for non-tribal subjects and 35.40 mm (±2.26 mm) for Bhil tribe's subjects. A statistically significant difference of 3.25 mm was found between non-tribal subjects and Bhil tribe's subjects (P = 0.000).

Table 2 reveals the finding of this study for mandibular arch measurements in non-tribe subjects and Bhil tribe subjects.

It shows that inter-incisor width was greater for non-tribe subjects in comparison to Bhil tribe's subjects. It was 21.20 mm (±1.61 mm) for non-tribe subjects and 20.50 mm (±1.19 mm) for Bhil tribe subjects.

Inter-canine width was greater for Bhil tribe subjects in comparison to non-tribe subjects. It was 25.45 (±1.32 mm) for non-tribe subjects and 26.45 mm (±1.67 mm) in Bhil tribes subjects. It also shows significant difference of 1.00 mm between non-tribe subjects and Bhil tribes subjects (P = 0.042).

It also shows that inter premolar width was 38.00 mm (±2.64 mm) in non-tribe subjects and 38.00 mm (±1.52 mm) in Bhil tribes subjects. There was no difference between non-tribe subjects and Bhil tribes subjects.

It also shows that inter molar width was 45.00 mm (±3.11 mm) in non-tribe subjects and 45.80 mm (±2.76 mm) in Bhil tribes demonstrating a statistically not significant difference of 0.80 mm (P = 0.395).

Mandibular Arch depth was 33.10 mm (±1.65) in non-tribe subjects and 32.20 mm (±1.54 mm) in Bhil tribe's subjects. A statistically not significant difference of 0.90 mm was found for arch depth (P = 0.083).

Table 1: Mean, SD and mean difference of maxillary arch measurements in Bhil tribes.

Variable	Maxilla				Difference between means	P value
	General population		Bhil tribes			
	Mean	SD	Mean	SD		
Inter-incisor width	30.45	1.28	27.50	1.00	2.95	0.000
Inter-canine width	38.35	2.58	35.75	2.24	2.60	0.002
Inter-premolar width	49.30	3.31	49.10	3.73	0.20	0.859
Inter-molar width	57.35	3.41	56.55	3.32	0.80	0.456
Arch depth	38.65	3.05	35.40	2.26	3.25	0.000
Anterior arch length	22.60	1.67	23.20	2.48	-0.60	0.375
Posterior arch length	14.30	0.92	14.20	0.95	0.10	0.738

SD: Standard deviation

Table 2: Mean, SD and mean difference of mandibular arch measurements in Bhil tribes.

Variable	Mandible				Difference between means	P value
	Non-tribe population		Bhil tribes			
	Mean	SD	Mean	SD		
Inter-incisor width	21.20	1.61	20.50	1.19	0.72	0.126
Inter-canine width	25.45	1.32	26.45	1.67	-1.00	0.042
Inter-premolar width	38.00	2.64	38.00	1.52	0.00	1.000
Inter-molar width	45.00	3.11	45.80	2.76	-0.80	0.395
Arch depth	33.10	1.65	32.20	1.54	0.90	0.083
Anterior arch length	16.00	1.30	15.70	0.92	0.30	0.405
Posterior arch length	13.50	0.83	13.15	0.72	0.35	0.168
Curve of Spee	2.35	0.49	2.23	0.47	0.13	0.416

SD: Standard deviation

It also shows that curve of Spee was 2.35 mm (± 0.49 mm) in non-tribe subjects and 2.23 mm (± 0.47 mm) in Bhil tribes subjects demonstrating a statistically not substantial difference of 0.13 mm between non-tribe subjects and Bhil tribes subjects ($P = 0.416$).

Discussion

Bhil tribe which has quite deprived ethnic diversity can present different characteristics. So aim of our study was to evaluate maxillary and mandibular measurements in non-tribe subjects and Bhil tribe subjects residing in a common tribal rich zone of Central India.

Inter-incisor width

In the maxillary arch inter-incisor width shows significant difference between non-tribe subjects and Bhil tribes subjects ($P = 0.000$). The mean difference between non-tribe subjects and Bhil tribes subjects was 2.95 mm. It was higher in non-tribe subjects (30.45 mm) as compared with Bhil tribes subjects (27.50 mm).

In the mandibular arch the mean difference between non-tribe subjects and Bhil tribe subjects was 0.70 mm. It was higher in non-tribe subjects (21.20 mm) as compared with Bhil tribe subjects (20.50 mm).

While a study conducted by Al-Wahadni *et al.*⁶ showed that maxillary inter-incisor width was 27.37 mm and mandibular inter-incisor width was 21.18 mm among Jordanian children and young adults.

Inter canine width

In the maxillary arch inter-canine width show significant difference between non-tribe subjects and Bhil tribe subjects ($P = 0.002$). The mean difference between non-tribe subjects and Bhil tribes subjects was 2.60 mm. It was higher in non-tribe subjects (38.35 mm) in comparison with Bhil tribe subjects (35.75 mm). In the mandibular arch the mean difference between non-tribe subjects and Bhil tribes' subjects was 1.00 mm. It was higher in Bhil tribe subjects (26.45 mm) in comparison with non-tribe subjects (25.45 mm). Other

studies⁹⁻¹¹ while examining the modifications in the inter-canine widths during dentition maturation, observed constancy for these values. However, Sinclair and Little⁵ have stated that there were significant deviations in this factor because they reported a 0.75 mm decrease in the inter-canine distance especially for women from 13 to 20 years.

Bishara *et al.*¹² verified a reduction of 0.4 and 0.6 mm in the upper and lower inter canine width respectively, for female individuals and 0.4 mm in the lower inter canine distance for male individual but only after 25 years.

Similarly, Carter and McNamara¹³ found a decrease of 0.65 and 0.58 mm, in the upper and lower canine widths respectively, When they evaluated adult individuals.

Inter premolar width

In the maxillary arch, the inter-premolar width shows statistically not significant difference between non-tribe subjects and Bhil tribe's subjects. The mean difference between non-tribe subjects and Bhil tribe subjects was 0.20 mm. It was higher in general population subjects (49.30 mm) in comparison with Bhil tribe subjects (49.10 mm). In the mandibular arch, there was no difference in inter-premolar width.

While a study conducted by Al-Wahadni *et al.*⁷ showed that maxillary inter-premolar width was 44.75 mm and mandibular inter premolar width was 38.88 mm among Jordanian children and young adults.

Inter molar width

In the maxillary arch the inter-molar width shows significant difference between non-tribe subjects and Bhil tribe subjects. The mean difference between non-tribe subjects and Bhil tribe subjects was 0.80 mm. It was higher in non-tribe subjects (57.35 mm) in comparison with Bhil tribe's subjects (56.55 mm).

In the mandibular arch the mean difference between non-tribe subjects and Bhil tribe's subjects was 0.80 mm. It was higher in

Bhil tribe's subjects (45.80 mm) in comparison with non-tribe subjects (45.00 mm).

While a study conducted by Tibana *et al.*¹⁴ showed that no significant change was observed for the upper inter-molar width, whereas the lower arch showed a reduction of 0.25 mm with a 0.58 mm standard deviation.

Bishara *et al.*⁶ demonstrated a mean increase of 0.2 mm in upper inter molar width, but they were observing individuals between 25 and 45 years which could be a reflection of the predisposition for this age group.

Arch depth

In the maxillary arch, the arch depth shows significant difference between non-tribe subjects and Bhil tribe subjects. The mean difference between non-tribe subjects and Bhil tribe subjects was 3.25 mm. It was higher in non-tribe subjects (38.65 mm) in comparison with Bhil tribe subjects (35.40 mm).

In the mandibular arch, the mean difference between non-tribe subjects and Bhil tribe subjects was 0.90 mm. It was higher in non-tribe subjects (33.10 mm) in comparison with Bhil tribe subjects (32.20 mm).

Sinclair and Little⁵ also reported significant reduction in the upper and lower arch length with the time. On the other hand Moorrees and Chadha¹⁵ showed constant values for dental arch length in individual more than 14 years old. The upper length showed a mean reduction of 0.67 mm, and the lower arch length showed a mean reduction of 0.71 mm. However, several studies have indicated a reduction in arch length through time.^{5,16,17}

Anterior arch length

In the maxillary arch, the anterior arch length shows significant difference between non-tribe subjects and Bhil tribe subjects. The mean difference between non-tribe subjects and Bhil tribe's subjects was 0.60 mm. It was higher in Bhil tribe subjects (22.60 mm) in comparison with non-tribe subjects (23.20 mm).

In the mandibular arch the mean difference between non-tribe subjects and Bhil tribe subjects was 0.30 mm. It was higher in general population subjects (16.00 mm) in comparison with Bhil tribe's subjects (15.70 mm).

While a study conducted by Al-Wahadni *et al.*⁷ showed that maxillary anterior arch length was 21.57 mm and mandibular anterior arch length was 16.38 mm among Jordanian children and young adults.

Posterior arch length

In the maxillary arch, the posterior arch length shows statistically significant difference between non-tribe subjects

and Bhil tribe subjects. The mean difference between non-tribe subjects and Bhil tribe subjects was 0.10 mm. It was higher in non-tribe subjects (14.30 mm) in comparison with Bhil tribe subjects (14.20 mm).

In the mandibular arch, the mean difference between general population subjects and Bhil tribe subjects was 0.35 mm. It was higher in non-tribe subjects (13.50 mm) in comparison with Bhil tribe subjects (13.15 mm).

While a study conducted by Al-Wahadni *et al.*⁷ showed that maxillary posterior arch length was 14.04 mm and mandibular posterior arch length was 13.42 mm among Jordanian children and young adults.

Curve of spee

In the mandibular arch, the curve of spee shows statistically significant difference between non-tribe subjects and Bhil tribe subjects. The mean difference between non-tribe subjects and Bhil tribe subjects was 0.13 mm. It was higher in non-tribe subjects (2.35 mm) in comparison with Bhil tribe subjects (2.23 mm). While a study conducted by Al-Wahadni *et al.*⁷ showed that curve of Spee was 1.06 mm among Jordanian children and young.

Conclusion

When equated morphological and dimensional differences in the arch width among non-tribe and Bhil tribe's subjects, Bhil tribe subjects exhibited: A narrower maxilla; a shorter maxilla and mandible; and smaller incisor widths for the maxillary and mandibular arches.

References

1. Carrillo EL, Gonzalez-Perez JC, Kubodera-I to T. Dental arch morphology of Mazahua and Mestizo teenagers from Central Mexico. *Braz J Oral Sci* 2009; 8(2):92-6.
2. Scheduled Castes & Scheduled Tribe Welfare Department, Government of Madhya Pradesh. <http://www.tribal.mp.gov.in/>.
3. "Madhya Pradesh: DATA HIGHLIGHTS: THE SCHEDULED TRIBES, Census of India 2001". Govt. of Madhya Pradesh. Retrieved 2010-04-09.
4. Little RM. The irregularity index: A quantitative score of mandibular anterior alignment. *Am J Orthod* 1975;68(5):554-63.
5. Sinclair PM, Little RM. Maturation of untreated normal occlusions. *Am J Orthod* 1983;83(2):114-23.
6. Bishara SE, Treder JE, Jakobsen JR. Facial and dental changes in adulthood. *Am J Orthod Dentofacial Orthop* 1994;106(2):175-86.
7. Al-Wahadni A, Qudeimat MA, Al-Omari M. Dental arch morphological and dimensional characteristics in Jordanian children and young adults with beta-thalassaemia major. *Int J Paediatr Dent* 2005;15(2):98-104.
8. Chopra A, Rao NC, Gupta N. Palatal rugae and arch

- length: A tool in gender determination. *Universal Research Journal of Dentistry* 2013;3(2)54-59.
9. Knott VB. Longitudinal study of dental arch widths at four stages of dentition. *Angle Orthod* 1972;42(4):387-94.
 10. Sillman JH. Dimensional changes of the dental arches: longitudinal study from birth to 25 years. *American Journal of Orthodontics*. 1964; 50:824-842.
 11. Blake M, Bibby K. Retention and stability: A review of the literature. *Am J Orthod Dentofacial Orthop* 1998;114(3):299-306.
 12. Bishara SE, Treder JE, Damon P, Olsen M. Changes in the dental arches and dentition between 25 and 45 years of age. *Angle Orthod* 1996;66(6):417-22.
 13. Carter GA, McNamara JA Jr. Longitudinal dental arch changes in adults. *Am J Orthod Dentofacial Orthop* 1998;114:88-99.
 14. Tibana RH, Palagi LM, Miguel JA. Changes in dental arch measurements of young adults with normal occlusion – A longitudinal study. *Angle Orthod* 2004;74:618-23.
 15. Moorrees CFA, Chadha MJ. Available space to the incisors during dental development. *Angle Orthodontics* 1965; 35:12–22.
 16. Bishara SE, Jakobsen JR, Hession TJ, Treder JE. Soft tissue profile changes from 5 to 45 years of age. *American Journal of Orthodontics & Dentofacial Orthopedics* 1998;114:698-706.
 17. Bishara SE, Jakobsen JR, Treder JE, Stasi MJ. Changes in maxillary and mandibular tooth size-arch length relationship from early adolescence to early adulthood. *American Journal of Orthodontics & Dentofacial Orthopaedics* 1989; 95:46-59.