ORIGINAL RESEARCH

Prevalence and Correlation of Lip Shapes and Arch Forms in Primary Dentition of Children between 3–6 Years of Age: A Cross-sectional Study

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Abstract

Aims and background: The study of the morphology of soft tissues as well as hard tissues of the orofacial region holds prime importance. A very less information is known about the lips (soft tissues) and maxillo-mandibular arches (hard tissue structures) in primary dentition. Henceforth, there is a need to classify, find the prevalence and correlation of various lip shapes, and arch forms in primary dentition.

Materials and methods: A total of 135 children aged 3–6 years were assessed over a period of 6 months. Lip shapes were classified into three major types: type I (arched upper lip), type II (flat upper lip), and type III (atypical cases). The arch forms were classified into ovoid, square-shaped, and tapered. The data was analyzed using Chi-squared test.

Results: The prevalence of lip shapes includes: type Ib (43.70%), type IIb (34.07%), type IIa (14.07%), type Ia (7.41%), and type III (0.74%). Arch form prevalence for maxilla, ovoid (79.26%), tapered (16.30%), and square (4.44%) shaped arch form while for mandible, ovoid (57.04%), square (36.30%), and tapered (6.67%) arch form.

Conclusion: The most prevalent lip shapes were type Ib followed by type IIb and the most common arch form was ovoid followed by tapered for maxilla and square for mandible. There was no significant correlation found between lip shapes and arch forms in primary dentition.

Clinical significance: The knowledge of lip shapes in primary dentition would aid in rehabilitation of the abnormalities like cleft lip, electrical burns, etc., while the information on arch forms will support the fabrication of prefabricated appliances, correction of alveolar defects, etc.

Keywords: Arch forms, Facial esthetics, Lip shapes, Primary dentition.

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Introduction

The lips play a crucial role in facial esthetics, serving as a key feature of the lower face and acting as an expressive medium for various emotions, such as joy, sadness, and anger. They are fundamental to maintaining facial symmetry and enhancing overall facial esthetics. Lip shapes keep changing gradually from infancy through adolescence and vary in ethnicity, gender, race, etc.[1]

In Young Caucasians, the optimal vertical proportion between the upper and lower lips is in the ratio of 1:1.6. Certain ethnic groups, particularly individuals of African descent, tend to have genetically larger lip volume, which provides a natural defense against solar elastosis.[2] Male lips are flatter and thinner when compared to females in whom fuller lips are commonly seen. Lips being dynamic organs, very few studies have been conducted in relation to the evaluation of lip shapes. There is no widely accepted classification of lip shapes, some authors have classified them according to the mouth corners, lip fullness, upper to lower lip ratio, etc. It is important to know the normality of lip shapes in primary dentition to differentiate, predict, and rehabilitate abnormalities like cleft lip, electrical burns, etc., accurately. This may also prove to be of forensic importance.

The dental arch form refers to the curved shape formed by the configuration of the alveolar ridge.[3] The size and shape of the dental arch undergo various changes during the growth of the supporting bones and posteruptive tooth movements. Additionally, the configuration of the dental arch is influenced by the surrounding muscles and functional forces within the oral cavity. While individual variations arise from factors such as facial biotype, gender, ethnicity, eruption patterns, posteruptive tooth movements, bone growth, environmental influences (including habits like digit sucking, mouth breathing, atypical swallowing, and lip biting), personal growth, and genetics primarily dictates the shape and dimensions of the dental arches. Several methods have been developed to describe dental arch morphology, ranging from straightforward classifications of arch shapes to complex mathematical equations. However, there has been limited focus on the dental arch form during the primary dentition stage.

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Numerous efforts have been undertaken to define an "ideal" form of the arch acknowledging that the dental arch is inherently symmetrical. According to De Castro et al., most common upper arch form was rounded followed by triangular, while for lower arch U shaped was most common in primary dentition of children between 3 and 39 months.[4] According to Owais et al., the most prevalent arch forms observed in the maxilla and mandible were medium-sized oval and square shapes, respectively.[3] Braun et al. in their study found that the primary dental arch typically takes on an oval shape, while the permanent dental arch is characterized by an elliptical form.[5] It has been proposed that there is currently no specific form that accurately defines dental arch forms, and customization appears to be a requirement in various circumstances to ensure optimal stability over the long term.

In pediatric dentistry, a thorough evaluation of the transition from deciduous dentition to permanent dentition is essential for preventing and addressing malocclusion at an early stage. In-depth knowledge on growth and development of dental arch is therefore clinically essential. The shape of the dental arches significantly influences diagnosis and treatment planning, prosthetic stability, and esthetics.

It is a well-known fact that the perioral soft tissues through the various muscular forces determine the shape and growth of the skeletal components. Thus, finding the existence of correlation between lip shapes and arch forms would further aid in establishing stability and esthetics while planning for rehabilitation of patients indicated for prosthesis including those with ectodermal dysplasia, cleft lip/palate, etc.

Materials and Methods

Study Design

Observational, cross-sectional, and institution-based study.

Setting

The study was carried out in the department of pediatric and preventive dentistry over a period of 3 months. Ethical approval was granted by the Institutional Ethics Committee. Data for the study was collected by taking extraoral and intraoral pictures using Sony IMX 890, focal length: 24 mm, and aperture: f/1.8. Written informed consent was acquired from the parents or guardians of the patients prior to participation in the study.

A total of 135 children between 3 and 6 years of age with primary dentition were selected from the outpatient department of pediatric and preventive dentistry. The data was recorded over a duration of 3 months.

Participants

The samples were collected according to the inclusion and exclusion criteria. Inclusion criteria: children with primary dentition, competent lips, and between 3 and 6 years of age were included in this study. Exclusion criteria: children with bony pathologies involving upper or lower jaws like tori, etc., cleft lip/palate, presence of deleterious oral habits (which affects the arch shape and lip shape eventually), and special healthcare needs were excluded from the study.

The anteroposterior view of facial photograph was taken from a fixed distance of 80 cm to assess the lip shapes. Patients were directed to maintain lips in a relaxed posture and keep body straight upright against the wall, have a straight gaze, and photographed from the camera (focal length: 24 mm, aperture: f/1.8) at the same place in the room. The obtained photographs were subsequently evaluated for lip shapes and classified as type I if the stomion was positioned above an imaginary line drawn between the oral commissures on both sides, and type II if it was located on or below that line. Subtype "a" was designated if the lower margin of the upper lip was upturned at approximately a quarter point laterally; while subtype "b" was assigned if the lip was flat or downturned as shown in Figures 1A to D. The lip shapes not falling into these criteria were classified as atypical.

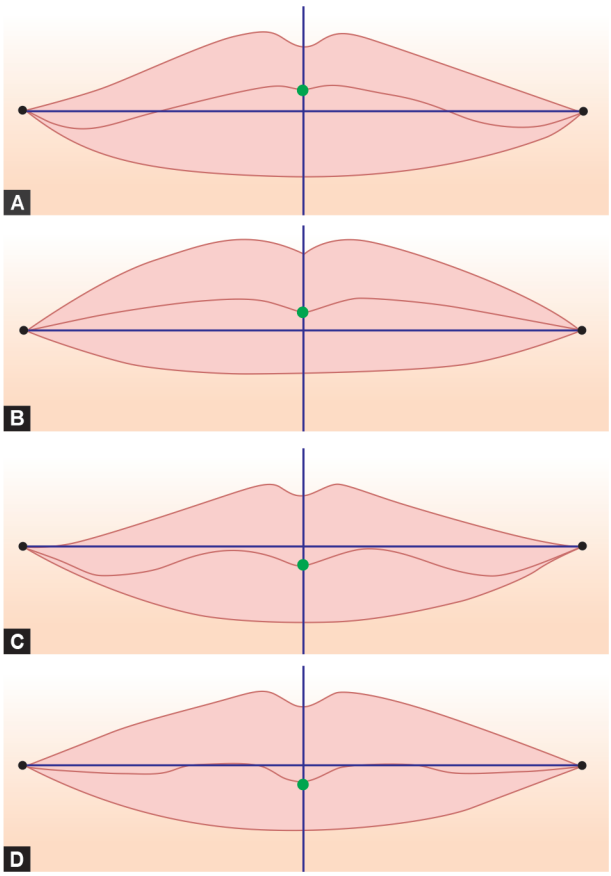
Intraoral occlusal photographs using smartphone (inbuilt sensor: Sony IMX 890, focal length: 24 mm, and aperture: f/1.8) were taken using intraoral mirrors for assessment of the arch forms, which were classified as ovoid, square-shaped, and tapered as shown in Figure 2A to C.

Sample Size Calculation

The sample size was determined using G*Power 3.1.9.7. It has been assumed that, in this study, lip shapes will be classified into three types and arch forms will be classified into three types. The required sample size was calculated using Chi-squared test. Thus, minimum required sample size is 133.

Statistical Analysis

The data were input into an Excel spreadsheet and analyzed using SPSS (Statistical Package for the Social Sciences) version 25.0 from



Figs 1A to D: (A) Type Ia; (B) Type Ib; (C) Type IIa, and (D) Type IIb. Green dot: stomion; black dot: cheilion. From "classification of mouth corners in Asian women," by TK Jeong, 2020, Plast Reconstr Surg Glob Open, 8, 1 (10.1097/GOX.0000000000002608). 2020 by TK Jeong

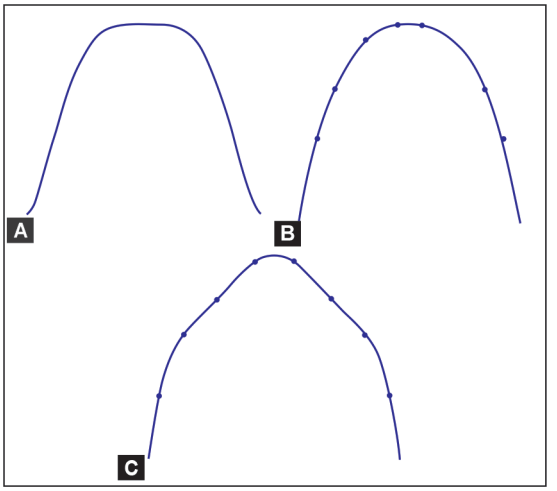
IBM, Chicago. The Shapiro–Wilk test was employed to assess the probability distribution of the data, which indicated that it was not normally distributed. Descriptive statistics were performed. Data was described as median (interquartile range), number, and percentages. The groups were compared using Chi-squared test. The association between two variables was evaluated using Chi-squared test, with a *p*-value of <0.05 considered statistically significant.

Results

The study included 135 children aged 3–6 years.

Arch Shape (Maxillary Arch)

The maxillary arch of most of the children was ovoid [107 (79.3%)], followed by tapered [22 (16.3%)] and square [6 (4.4%)]. The most prevalent arch shape for both males and females was ovoid (85.3 and 73.1%, respectively). The shape of the maxillary arch was not found to differ significantly between males and females (*p*-value > 0.05) as shown in Figure 3A.



Figs 2A to C: (A) Graphic representation of the square arch form, (B) Oval arch form, and (C) tapered arch form. From "maxillary and mandibular arch forms in the primary dentition stage," by Al Owais, 2014, Oral Health Dent Manag, 13(2), 331

Arch Shape (Mandibular Arch)

The mandibular arch of most of the children was ovoid [77 (57.0%)], followed by square [49 (36.3%)] and tapered [9 (6.7%)]. The most prevalent mandibular arch form for both males and females was ovoid [68.1 and 52.2%, respectively]. The shape of the mandibular arch was not found to differ significantly between males and females (*p*-value > 0.05) as shown in Figure 3B.

Lip Shape

The lip shape of the children in decreasing order of occurrence was as follows: type Ib [59 (43.7%)] > type IIb [46 (34.1%)] > type IIa [19 (14.1%)] > type Ia [10 (7.4%)] > type III [1 (0.7%)] as shown in Figure 4.

Correlation between Lip Shapes and Arch Forms

No significant association was found between lip shape and the arch form (*p*-value > 0.05) as shown in Table 1.

Discussion

Lips are an organ of esthetics. Rehabilitation and reconstruction of malformed lips in children to best resemble normal anatomy is a major concern. Malformations of the craniofacial region frequently include cleft lip alone or associated with syndromes like median facial dysplasia, Van der Woude syndrome, Wolf–

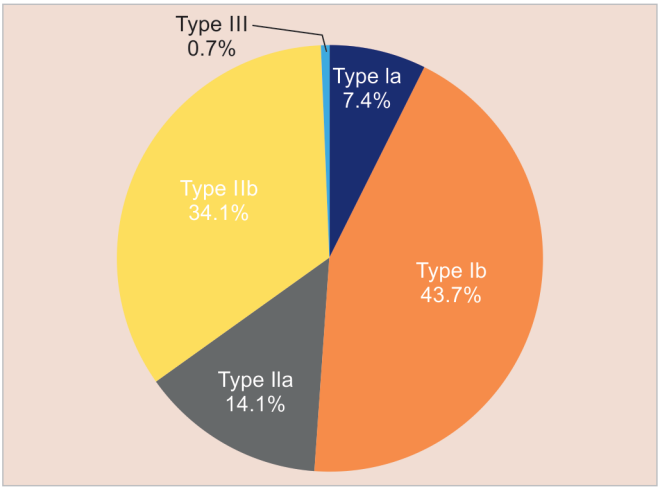
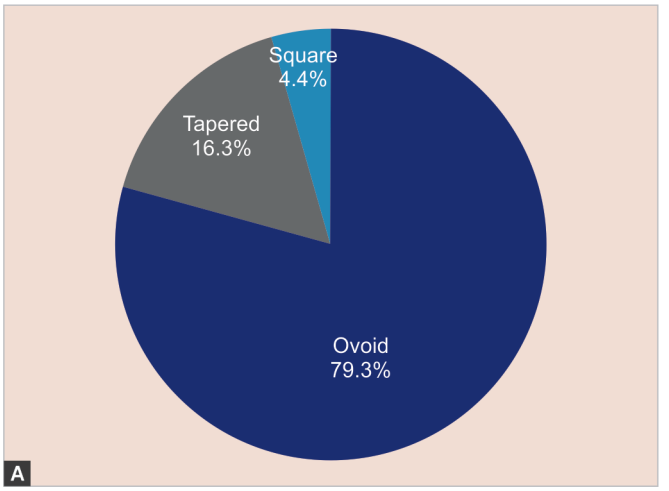
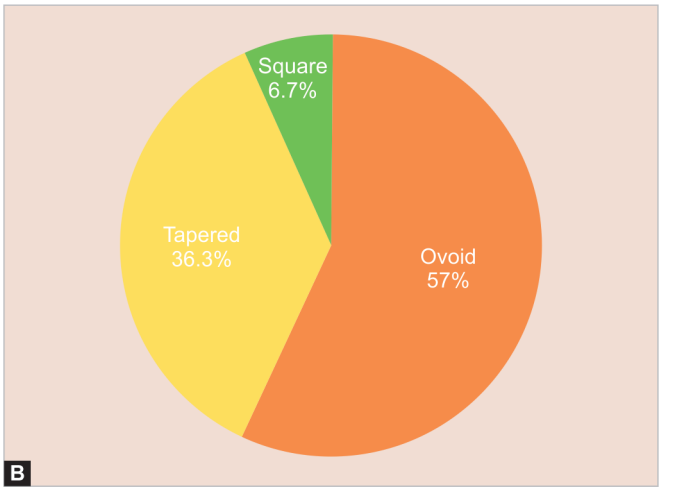


Fig. 4: Distribution of study subjects based on the lip shape





Figs 3A and B: Distribution of study subjects based on (A) maxillary arch forms and (B) mandibular arch forms

Table 1: Association between arch shape and lip shape

		Arch shape						
Lip shape		*Ovoid*	*Tapering*	*Square*	*Total*	*Chi-square value*	*df*	*p-value*
Type Ia	Number	8	2	0	10	3.418	8	0.905
	Percentage	7.5%	9.1%	0.0%	7.4%			
Type Ib	Number	46	10	3	59			
	Percentage	43.0%	45.5%	50.0%	43.7%			
Type IIa	Number	15	2	2	19			
	Percentage	14.0%	9.1%	33.3%	14.1%			
Type IIb	Number	37	8	1	46			
	Percentage	34.6%	36.4%	16.7%	34.1%			
Type III	Number	1	0	0	1			
	Percentage	0.9%	0.0%	0.0%	0.7%			
Total	Number	107	22	6	135			
	Percentage	100.0%	100.0%	100.0%	100.0%			

Hirschhorn syndrome, etc.[6,7] Cheiloplasty (corrective lip surgery) is often performed when a child is 3 months old or weighs 5 kg. It is done in a single session for unilateral clefts and in two sessions for bilateral clefts (at 3 and 6 months of age).[8] Although cleft lip repair reduces asymmetry, video stereophotogrammetry of the corrected cleft lip reveals that a certain degree of asymmetry inevitably remains.[9] Dense correspondence analysis of three-dimensional (3D) facial images before and after surgical lip restoration revealed persistent mediolateral and anteroposterior asymmetries, although residual vertical asymmetry was minimal.[10] Thus, in order to rehabilitate clefts, electrical burns, severe lip bites, etc., there is a need to know the most prevalent lip shape in the pediatric population. Lips are dynamic organs and are very difficult to classify, and very little literature is available in reference to the pediatric lips.

The assessment of lip shapes includes direct observation, two-dimensional (2D), and 3D methods. Honda et al. used a 2D method-video imaging to estimate the lip shapes.[11] Lucero and Munhall developed a finite-element model (FEM) of the face and lips that estimated lip positions in three dimensions. Eskes et al. reported that features derived from facial surface electromyography (sEMG) can accurately estimate lip shapes in three dimensions.[12]

In this study, type Ib is the most common type of lip shape in children, followed by type IIb, type IIa, type Ia, and type III. The same sequence is followed by both males and females. According to a study conducted on Asian women by Jeong et al. using similar classification, most common type of lip shape was found to be type IIb.[13]

According to a study conducted by de Lima and Gubert, in 100 patients of Brazil, vermillion lips came in five different shapes: standard, voluminous, thin, oval, and heart-shaped. Standard and thin lips were the most common among female lips in the study population while there was no gender predilection seen in the classification used in this study.[14]

The recognition of dental arch shapes during the primary dentition stage has sparked the interest of numerous pediatric dentists, as this knowledge could assist their clinical practice.[3] The knowledge of common arch forms in pediatric patients could aid in the prefabrication of various orthodontic appliances including preorthodontic trainer, myobrace, prefabricated cross-arch space maintainers, rehabilitation in ectodermal dysplasia patients, etc. Basic information about children's arch shapes appears to be scarce in the literature and there is a need to contribute to the available information.

In this study the most prevalent maxillary arch shape came out to be ovoid (79.3%), followed by tapered (16.3%), and square (4.4%); while for mandible it was ovoid (57.0%) followed by square (36.3%), and tapered (6.7%) arch forms. The result for the most prevalent maxillary arch form was consistent with those of the study conducted by De Castro et al. where the most prevalent arch form was ovoid (58.39%), but the second most common arch form in his study was square rather than tapered, while the outcomes for mandibular arch form were quite different.[4]

The results of the study for maxillary arch form correlate with that of a study conducted on 435 preschool children by Owais et al., while for mandibular arch form square-shaped arch form is slightly more prevalent than the ovoid and tapered is the least prevalent mandibular arch form similar to this study. Additionally, the results of this study align partially with those of Pinkham et al., who suggested that the maxillary arch can be U- or V-shaped, while the mandibular arch is typically U-shaped, with square shapes not being documented.[15] Aljayousi et al. identified at least five arch forms that characterize dental arches in untreated young Jordanian adults with normal occlusion.[16]

The shapes of the maxillary as well as mandibular arch were not found to differ significantly between males and females which is in agreement with the studies conducted by De Castro et al. as well as Pinkham et al., while gender differences were detected in study conducted by Owais et al.

No significant association was found between lip shape and the arch form as the *p*-value was 0.905 (i.e., >0.05) as shown in Table 1. This may be attributed to the muscular forces other than labial muscles including the buccinator and tongue which contribute toward the shape of dental arches.

The lips are a muscular organ and advanced techniques of lip assessment like sEMG can yield a more dynamic evaluation of the influence of lip shapes on the arch form.

Conclusion

The lip shape of highest prevalence is type Ib in children between 3 and 6 years of age. This may lead to improved reconstruction of the malformed lips in Indian population. The most prevalent maxillary

and mandibular dental arch form during the primary dentition period is ovoid, which may facilitate the fabrication of prefabricated appliances and the rehabilitation of alveolar defects. There exists no significant correlation between lip shapes and arch forms.

Clinical Significance

The knowledge of the anatomy of lip and arch shape aids in rehabilitating various malformations as seen in cleft lip and palate. The most common lip shape is type Ib, which would help with improved repair of deformed lips in this population. The most frequent dental arch shape is ovoid, which serves as a framework for the repair of alveolar abnormalities.

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