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Archform of Various Popualtions

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Abstract: ***The way the teeth are aligned on the basal bone determines the archform of an individual. Archform varies between two groups and two individuals of the same group. Differences in the archform are seen between males and females. Mismatch of archform leads to expansion or contraction of archforms and hence a relapse of the corrected malocclusion due to functional instability or structural imbalance is a possibility. Evaluating the archform of an individual plays a key role for an Orthodontist in treatment planning and attaining a greater post treatment stability. Therefore, customizing the archwire according to the local ethnic population's archform is important as it helps in achieving long term post treatment stability. There are studies done by various authors in evaluating and determining the archform for various populations. The archform derived for populations of Turkey, Iran, Japan, Korea, North American whites, Saudi Arabia, Yemen, Egypt, Israel, Bhutan, Malaysia, Caucasian, Italy and India simulate either; the MBT standard archwire forms with slight to moderate variations in the dimensions at canine, premolar or the molar depths or the pentamorphic archforms suggested by Roth. Even the archfroms analysis done on various populations in India viz. Maratha, Aurangabad, Moradabad, Gujarat and South Indian population showed similarities with the MBT standard archforms with slight to moderate variations. The most commonly used archwires today are standardized for Caucasian population. Total of 34 archwire forms are commercially available marketed by 12 companies. This poster describes the various archform studies and provides a comparative assessment of the variations.***

Keywords: archforms, mbt archforms, ovoid, ideal

1. Introduction

Dental arch form is the arch, formed by the buccal and facial surfaces of the teeth when viewed from their occlusal surfaces[24]. In the early stage of developing edgewise appliances, the importance of modifying the archwire form for each patient's individual dental archform was recognized. However, during the 1970s, after the straight-wire appliance was developed by Andrews, Roth designed an archform that was based mainly on his clinical experience; this subsequently became the standard archform for the new system[20]. Because introduction of the Roth archform occurred before publication of articles referencing nickel-titanium (NiTi) archwires, adjustment of each preformed stainless steel archwire to fit the individual patient's dental archform originally adhered to a general procedure called "blanks"[20].

There are variations seen in the archform of individuals compared within the same group or among groups. Hence, evaluating the archform of an individual plays a key role for an Orthodontist in treatment planning and attaining a greater stability. Mismatch of archform leads to excessive expansion or contraction of archforms and hence a relapse of the corrected malocclusion due to functional instability or structural imbalance is a possibility and may lead to an unnatural smile.

The archform evaluation of populations of North American whites and blacks, Caucasian, Japan, Korea, Turkey, Egypt, Iran, Japan, Saudi Arabia, Yemen, Israel, Bhutan, Malaysia, Italy, China, Nepal and India simulate either of the MBT standard archwire forms with slight variations in the dimensions at canine, premolar or the molar depths. Even the archfroms analysis done on various populations of India like Maratha, Aurangabad, Moradabad, Gujarat and Southern Indian population showed similarities with the MBT standard archforms with slight variations.

Therefore deriving an archform for every ethnic population will be beneficial for an Orthodontist in attaining greater post treatment stability.

The most commonly used archwires are according to the archform of Caucasian population. Total of 34 archwire forms are commercially available marketed by 12 companies.

2. Review of Literature

Benjamin G. Burris[1] et.al., (2000) stated that the *American blacks* have larger teeth than *whites*, but they less frequently exhibit crowding apparently because of larger arch dimensions. Blacks, with a more square palate and significantly larger palatal index, were distinguished from whites primarily by greater intercanine and interpremolar widths. Kunihiko Nojima[2]et.al., (2001) clarified the morphological differences between Caucasian and Japanese mandibular clinical archforms in Class I, II, and III malocclusions. The *Caucasian* population had a statistically significant decreased arch width and increased arch depth compared with the *Japanese* population. Yoon-Ah Kook[3]et.al., (2004) evaluated the morphologic differences in the mandibular arches of *Korean* and *North American white* subjects. The subjects were grouped according to archform (tapered, ovoid, and square) to compare the frequency distribution of the 3 archforms between the ethnic groups in each Angle classification. Arch width was statistically significantly smaller in the white group than in the Korean group, but arch depth did not differ. In the Korean group, the most frequent archform was square, whereas in the white group the tapered archform predominated. Souichiro Oda[4] et.al., (2010) compared commercially available preformed archwire forms with normal dental archforms. Canine and first-molar widths were measured on the dental casts with a 3-dimensional laser scanning system. The preformed archwires were significantly narrower than the normal dental arches at both the canine and molar levels. Therefore, preformed archwires that are approximately 1 to 3 mm wider at the canine level and 2 to 5 mm wider at the first-molar level might be required for today's orthodontic needs. Sultan Olmez[5] et.al., (2011) conducted a study to determine the distribution of morphological differences in the clinical mandibular archforms seen in Angle Class I, II and III malocclusions in *Turkish* population. Their results showed

that the most frequent archform encountered among all the groups was the tapered one (62.5%) followed by the ovoid (27.3%) and the square one (10.2%). Gender difference influences on morphological structure was apparent.

Mohamed Bayome[6] et. al., (2011) aimed at evaluating the morphologic differences in the mandibular arches of *Egyptian* and *North Americanwhite* subjects. Their results showed that there was an even frequency distribution of the 3 archforms in the Egyptian group and on the other hand, the most frequent archform was ovoid followed by tapered and square in the white group. Yossi Gafni[7] et.al., (2011) aimed at identifying the archforms of *Israeli* subjects with dental normocclusion and malocclusions and to clarify the morphologic differences between Israeli and North American white subjects with various malocclusions. Their results showed that the most frequent mandibular archform of the Israeli group was found to be ovoid as opposed to tapered in the North American white group. Fabiane LOULY[8]et.al., (2011) evaluated dental arch dimensional changes of Brazilian children. Dental casts were taken from 66 children (29 males; 37 females) with normal occlusion selected among 1, 687 students aged 9, 10, 11 and 12 years. Their results showed that only the maxillary anterior segment length showed a significant increase from 10-12 years. They concluded that males had larger maxillary depth than females and the predominant archform was elliptical. Asma Shafique[9] et.al., (2011) determined and compared the frequency distribution and results of two methods establishing morphology of the dental archform. It was conducted on 250 patients visiting Lahore Medical and Dental College, *Lahore*. The casts were measured and photocopied, then superimposed on Orthoform templates to determine the archforms. The dental arches were classified into square, ovoid, and tapered forms to determine and compare the frequency distributions between the two methods. According to Noroozi's mathematical model, frequency distribution of ovoid, square and tapering archforms was found to be 82%, 64%and 11.2% respectively while according to orthoform templates those were 53.2%, 9.2% and 37.6% respectively. The ovoid archform was most common archform according to both methods. Siti Adibah Othman[10] et.al., (2012) determined and compared the frequency distribution of various arch shapes in ethnic *Malays and Malaysian Aborigines* in Peninsular Malaysia and investigated the morphological differences of archform between these two ethnic groups. They examined 120 ethnic Malay study models and 129 Malaysian Aboriginal study models. They marked 18 buccal tips and incisor line angles on each model, and digitized them using 2-dimensional coordinate system. Dental arches were classified as square, ovoid, or tapered by printing the scanned images and superimposing Orthoform arch templates on them. Their results showed that the most common maxillary arch shape in both ethnic groups was ovoid, as was the most common mandibular arch shape among ethnic Malay females. The rarest arch shape was square.

Vishnu Jagdishbhai Patel[11]et.al., (2012) determined the maxillary and mandibular archform of Gujarati (Indian) adults with normal occlusions. Fifty seven study models of untreated individuals were examined. According to their study, moving from anterior to posterior, both the arches diverge proportionally, except in second molar area where slight convergence toward midline was noted. Females had proportionally narrower arch dimensions than those for males. Five archforms were determined according to relative deviations of various ratio combinations. Jeevan Maniklal Khatri[12] et.al., (2012) evaluated the nature of archform among patients seeking orthodontic treatment at CSMSS Dental College, Aurangabad, India and morphological differences in archform among different classes of Angle's malocclusion classification. They randomly selected 200 patients with age range from 12 to 30 years. Their results showed that commonest archform found was ovoid (50%), followed by tapered (32.5%) and square (17.5%). When male and female archforms were compared, it was found that next to ovoid, square archforms were more common in males and tapered were more common in females. No correlation was found between Angle's classification of malocclusion and particular archform. Dr Rabindra Man Shrestha[13] (2013) analysed the dental archforms of *Nepalese* adults and classified them into morphological types. Predetermined transverse and sagittal dimensions on dental stone models of one hundred Nepalese adults aged 17-32 years with normal occlusion and dentofacial proportion were measured. The study compared the gender difference among the Nepalese samples. Their results showed the distribution of the Nepalese archform types as; 26% flat arch, 24% wide arch, 19% pointed arch, 18% narrow arch and 13% mid arch. Dr Nabil M. Al-Zubair[14] (2013) assessed the dental archforms of *Yemeni* adult sample. A total of 398 study models were constructed and evaluated to do measurements for both arches using a modified sliding caliper gauge. Their results showed that Narrow form is the most prevalent archform (30.9%) followed by wide form (23.9%), their prominence appear more in females and the least prevalent archform was the mid form (9.3%), while flat and pointed forms were in between 18.3% and 17.6% respectively. They concluded that five archforms: narrow, wide, mid, pointed and flat were distinguished as unique forms for the dental arches, with the predominance of the narrow archform were found among Yemeni adults. Meenakshi Bisht[15]et.al., evaluated the archform among Indian population at Moradabad, India. Archform of these models was determined with using 3M Unite template. Their results showed that the most prevalent archform was ovoid (62.2%) followed by the tapered (26.0%) and square (4.8%) archform. It was found that there was significant correlation between the face form and archform among the study subjects.

Mandava Prasad[16] et.al., (2013) investigated if dental arch widths correlated with vertical facial types and if there are any differences in arch widths between untreated male and female adults in South Indian population. Lateral cephalogram and dental casts were obtained from 180 untreated South Indian adults above 18 year old with no cross bite, minimal crowding and spacing. The angle between the anterior cranial base and the mandibular plane was measured on lateral cephalogram of each patient. Dental casts were used to obtain comprehensive dental measurements including maxillary and mandibular inter canine, inter premolar and inter molar widths, as well as amount of crowding or spacing. Their results showed that male arch widths were significantly larger than those of

females and there was a significant decrease in inter arch width as the MP‑SN angle increased in untreated adult South Indian population. Nitin Dungarwal[17]et.al., (2013) conducted a study to ascertain whether or not Pont's index can be used reliably on Maratha individuals. 60 patients between ages 18 and 25 years were obtained belonging to Maharashtra. Their results showed that the arches were symmetrical. The arch dimensions showed variations in males and females. They concluded that significant correlation was found between the sum of maxillary incisors and interpremolar width but not with the intermolar width while sum of mandibular incisors showed significant correlation with the interpremolar and intermolar arch width. There is no single archform unique to any of the ethnic groups. Males showed larger inter-canine width and inter second molar arch width than females. Jasmeet Singh Sodhi[18]et.al., (2015) study was to evaluate the archform and dimension in a local population in *southern India*. A sample of 60 normal subjects from the local population was used for the study equally divided into male and female groups. The arch dimensions showed that males had significantly larger maxillary arch as compared to that of females, with no significant differences in the mandibular arches. Nivedita Sahoo[19] et.al., (2016) compared and classified *Indian* and *Bhutane se*arch forms of 60 untreated Indian and 60 untreated Bhutanese adults between the ages of 11 to 26 years. The most important finding of their study is that the Bhutanese subjects have highest prevalence of wider archforms as compared to the Indian subjects who significantly have narrow archforms. Naomi Saze[20] et.al., (2016) evaluated the variation in form of nickel-titanium (NiTi) archwires by comparing them with the dental archform of normal Japanese subjects before and after placing them in the first molar tubes. They collected the mandibular dental casts of 30 normal subjects, scanned, and the dental arch depths and widths from the canine to the first molar were measured. Standardized images of 34 types of 0.016-inch preformed NiTi archwires were also taken, and the widths were measured and then classified by cluster analysis. Images of these archwires placed in a custom jig with brackets attached at the mean locations of the normal mandibular central incisors and first molar were additionally taken. The widths of the pooled and classified archwires were then compared with the normal dental arch widths before and after placement in the jig and among the groups. The archwires were classified into three groups: small, medium, and large. After placement in the jig, the pooled archwire widths were found to be significantly narrower and wider at the canine and second premolar respectively, than at the dental arch, but not in the individual comparisons between groups. Mohammad Hossein Toodehzaeim[21]et.al., (2016) aimed at verifying the prevalence of three different morphologies of the mandibular and maxillary dental arch in natural normal occlusions and that may help guiding orthodontists customizing shape of orthodontic archwires. They examined 132 study models including 66 maxillary and 66 mandibular arches. Three square, ovoid, and tapered templates were overlaid on arches using special software. Samples were categorized according to the adaptability of templates on images. Inter canine and inter molar widths were also measured on casts and recorded. Ovoid was the most frequent form (54%) in *Iranian* population. Tapered (36%) and square (10%) forms were on second and third steps, respectively. R. Ferro[22] et.al., (2017) evaluated the maxillary and mandibular archforms in an *Italian* adolescents sample with normocclusion. The dental casts of 106 adolescents were taken. Twelve clinical bracket points were measured for each cast and six parameters were evaluated: intercanine and intermolar width, canine and molar depth, canine and molar ratio. Moreover, each cast was classified into tapered, ovoid, or square form. A similar ovoid (43.4%) and tapered (46.2%) archform was found, while the square form was the rarest (10.4%). Males exhibit higher dental arch values in comparison to females. They concluded that the individualisation of orthodontic therapy leads to more effective treatment by working within the subject's natural dental arch shape. Haidi Omar[23] et.al., (2018) determine the dental arch dimensions and archforms in a sample of *Saudi* orthodontic patients. This study is a biometric analysis of dental casts of 149 young adults recruited from different orthodontic centers in Jeddah, Saudi Arabia. Dental arch measurements, including intercanine and inter-molar distance, were found to be significantly greater in males than females. The most prevalent dental archforms were narrow tapered (50.3%) and narrow ovoid (34.2%) respectively, referring to the Ricketts pentamorphicarchform templates, narrow ovoid, ovoid, narrow tapered, tapered, and normal forms.

3. Discussion

There are studies conducted by various authors in evaluating and comparing the archforms of individuals with the commercially available archwire forms. Some populations simulated the available archwire forms and some simulated with mild to moderate variations in the dimensions at canine or premolar or molar depths.

The following are the studies done by authors comparing the archform of populations with the available standard archforms. Studies done by Yoon-Ah Kook[3] et.al., and Sultan Olmez[5] et.al., on evaluating the Korean and North American whites archforms and Turkish population archforms respectively, resulted that the Korean population has Squared archforms while North American whites has Tapered archfroms and Turkish population has Tapered archform (62.5%).

Mohamed Bayome[6]et.al., and Yossi Gafni[7] et.al., evaluated the archforms between populations of Egypt and North American Whites and Israeli and North American white respectively. Egyptians show equal frequency of all three archform types whereas North American Whites showed more of Ovoid archform followed by Tapered and Squared according to Mohamed Bayome and Israeli population show Ovoid archform and North American whites show Tapered archform according to Yossi Gafni's study.

Siti Adibah Othman[10]et.al., compared the archforms of Malays and Malaysian Aborigines and said that the commonest archform was Ovoid.

Jeevan Maniklal Khatri[12]et.al., and Meenakshi Bisht[15]et.al., evaluated the archforms of people of Aurangabad and Moradabad, India and said that Ovoid was the common archform with 50% prevalence followed by Tapered and

Squared archforms in Aurangabad and Ovoid was the common archform form with 62.2% prevalence followed by Tapered and Squared in Moradabad population.

Mohammad Hossein Toodehzaeim[21]et.al., conducted a study on Iranian population and R. Ferro[22]et.al., on Italian population, compared the archforms of the population with the Orthoform template and said that Ovoid archform was more common with 54% of prevalence in Iranian population and Ovoid (43.4%) and Tapered (46.2%) archform was found, while the Square form was the rarest (10.4%) in Italian population.

Haidi Omar[23]et.al., determined the archfroms in Saudi Orthodontic patients and compared with the Ricketts pentamorphicarchform template and concluded that narrow tapered is the most prevalent archfrom with 50% followed by narrow Ovoid with 34%.

The following are the studies where the archforms were evaluated and derived for the populations.

Benjamin G. Burris[1]et.al., stated that the American blacks have larger teeth than whites. Blacks, with a more square palate and significantly larger palatal index, were distinguished from whites primarily by greater intercanine and interpremolar widths.

Kunihiko Nojima[2]et.al., compared the archforms of Caucasian and Japanese population and said that the Caucasian population had a statistically significant decreased arch width and increased arch depth compared with the Japanese population.

Fabiane LOULY[8]et.al., evaluated dental arch dimensional changes of Brazilian children. Their results showed that only the maxillary anterior segment length showed a significant increase from 10-12 years. Males had larger maxillary depth than females at the age range evaluated. The predominant dental archform found was elliptical.

Vishnu Jagdishbhai Patel[11]et.al., determined the maxillary and mandibular archform of Gujarati (Indian) adults with normal occlusions. Their results showed, both the arches diverge proportionally, except in second molar area where slight convergence toward midline was noted. Five archforms were determined according to relative deviations of various ratio combinations.

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Dr Nabil M. Al-Zubair[14] assessed the dental archforms of Yemeni adults. Their results showed Narrow form is the most prevalent archform (30.9%) followed by wide form (23.9%), their prominence appear more in females and the least prevalent archform was the mid form (9.3%).

Mandava Prasad[16]et.al., investigated if dental arch widths correlated with vertical facial types and if there are any differences in arch widths between untreated male and female adults in South Indian population. He concluded that dental arch width is associated with gender, vertical facial morphology, and population groups. During orthodontic treatment, he suggests to use individualized arch wires according to each patient's pre-treatment archform and widths.

Jasmeet Singh Sodhi[18]et.al., conducted his study to evaluate the archform and dimension in a local population in southern India. The arch dimensions showed that males had significantly larger maxillary arch as compared to that of females. The results of his study seem to highlight the need for distinct idealized archforms for males and females. Nivedita Sahoo[19]et.al., compared and classified Indian and Bhutanese archforms of adults. The most important finding of their study is that the Bhutanese subjects have highest prevalence of wider archforms as compared to the Indian subjects.

4. Conclusion

- The universal ideal arch form is one of the most persistent but exclusive task for most of the orthodontic researchers.
- Although literature review illustrates divergent views on the shape of arch form, it is now generally believed that the arch shape is determined by an interplay between genetic and many varied environmental factors such as pressure from soft tissues; shape and position of jaws; alteration in eruptive mechanism and morphology of teeth[24].
- Concerning the orthodontic treatment, basic principle is that the patients original arch from should be preserved. Therefore, if the preformed arch wires are to be used, it is to be kept in the mind that their shape should be considered a starting point for the adjustment necessary for proper individualization as all the presently available preformed arch wire do not reflect these variations in the arch form.
- The preformed archwires will not suit the archforms of all the populations.
- The preformed archwires simulate the archforms of some ethnic population with mild to moderate dimensional variations at canine or premolar or molar depths.
- A common archwire for each ethnic population can be developed and used clinically but as previously said, there may be variations in the archform of individuals belonging to the same ethnic group, customising the archwire according to the archform of individual is the best way to attain greater post treatment stabilities.

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