Evaluation of Arch Form among Patients Seeking Orthodontic Treatment

Jeevan Maniklal Khatri, Jyoti Bhagwandass Madaan

ABSTRACT

Aim: The purpose of this study was to evaluate the nature of arch form among patients seeking orthodontic treatment and morphological differences in arch form among different classes of Angle’s malocclusion classification.

Materials and methods: The sample consisted of 200 randomly selected orthodontic patients with age range from 12 to 30 years from the outpatient department of CSMSS Dental College, Aurangabad. On each tooth of the mandibular cast, glass bead of 1.5 mm diameter was glued to simulate the ideal position of an orthodontic brace. The bead positions were transferred on polyester sheet. The arch forms were obtained by joining these points.

Results: Commonest arch form found was ovoid (50%), followed by tapered (32.5%) and square (17.5%). When male and female arch forms were compared, it was found that next to ovoid, square arch forms were more common in males and tapered were more common in females. No correlation was found between Angle’s classification of malocclusion and particular arch form.

Conclusion: In a caseload of orthodontic patients, one should expect about 50% of ovoid arch forms, 32% of tapered arch forms and 18% of square arch forms. Females exhibit more of ovoid and tapered arch forms, whereas males exhibit more of ovoid and square arch forms. No single arch form is unique to any of the Angle’s classification of malocclusion.

Keywords: Arch form, Angle’s classification, OrthoformTM templates.

INTRODUCTION

The achievement of a stable, functional and esthetic arch form has long been one of the prime objectives of orthodontics. A key aspect in the achievement of this goal is the identification of a suitable arch form to use in the treatment of each case. The patient’s pretreatment arch form is the best guide to future arch form and stability. Arch form tends to return to its pretreatment shape after retention. The greater the treatment change, the greater is the tendency for postretention change.

Recently, there is widespread use of preformed archwires with varied arch forms in orthodontic practice. So, it might be more clinically appropriate and accurate to select the most suitable arch form according to each patient’s pretreatment arch form, ethnicity, and type of malocclusion to achieve a stable, functional and esthetic goal.

As this type of data is not available from previous researches for Indian population, the present study was undertaken to evaluate the nature of arch form among patients seeking orthodontic treatment and evaluate morphological differences in the arch forms present among different classes of Angle’s malocclusions. This study provides important information regarding arch forms present among orthodontic patients and a practicing orthodontist can imply this data when treating the patients and maintaining the stock of preformed archwires.

MATERIALS AND METHODS

The sample consisted of 200 randomly selected patients coming for orthodontic treatment to the outpatient department (OPD) of Department of Orthodontics and Dentofacial Orthopedics, CSMSS Dental College and Hospital, Aurangabad. All the patients were informed about the study and written consent of the patient or the guardian was taken. Among 200 selected patients, 80 were males and 120 were females. The age range of the selected patients was between 12 and 30 years.

All cases were subjected to following inclusion criteria: (1) Full complement of permanent teeth (with exception of third molars), (2) Normal tooth size and shape, (3) 5 mm or less arch length discrepancy, (4) No subdivision malocclusions, (5) No missing, deciduous, ectopically erupted teeth, (6) No asymmetric mandibular arches, (7) No prior orthodontic treatment of any type and (8) No extensive restorations, cast restorations or cuspal coverage.

Mandibular dental casts for all the subjects were obtained and on each tooth, from the left second molar to the right second molar, glass bead of 1.5 mm diameter was glued using Fevibond (Pidilite Industries Limited) to simulate the ideal position of an orthodontic bracket. A thin film of glue was applied on glass bead with the help of applicator and it was positioned in the
center of clinical crown of incisors, canines and premolars and in the middle third of mesiobuccal cusps of first and second molars (Fig. 1).

A direct visualization method was used to transfer the bead positions from cast to a polyester film to eliminate magnification error. A clear piece of acrylic sheet of 2 mm thickness was placed over the model to gain a stable platform for 100 micron thickness polyester film (Fig. 2). Then the model with beads glued was visualized from above so that the eye level was perpendicular to the acrylic sheet and bead positions were marked. The bead positions were transferred on polyester sheet with a permanent marking pen to simulate 14 clinical bracket points (Fig. 3).

Then these 14 points were joined so that maximum points were included in the arch form. The arch forms thus obtained were classified into square, ovoid or tapered according to arch form templates (Orthoform, 3M Unitek, Calif; Fig. 4). Such type of arch form templates were also used by Nojima et al.5 and Kook et al6 in previous studies. The arch form that best fitted minimum 8 clinical bracket points from right first molar to left first molar was considered (Fig. 5).

The frequency distribution of various arch forms among the sample of patients seeking orthodontic treatment was determined. Also, the gender difference in the distribution of arch forms was determined. Then the cases were divided into 4 groups according to Angle’s classification as Angle’s Class I, Angle’s Class II division 1, Angle’s Class II division 2 and Angle’s Class III. The frequency distribution of the three arch forms among these four groups were calculated to find out whether there is any arch form unique to any Angle’s class of malocclusion.

RESULTS

A total of 200 individuals were included in the study, among them 40% were males and 60% were females, with male to female ratio of 0.67:1. The cases were divided into square, ovoid and tapered arch forms on the basis of 3M Unitek arch form template. Table 1 shows the frequency distribution of the three arch forms among whole sample. It was found that 32.5% arches were of tapered form, 50% arches were of ovoid form and 17.5% arches were of square form.

Fig. 1: Glass beads glued on all the teeth of mandibular cast

Fig. 2: Acrylic sheet and polyester film laid over the cast

Fig. 3: Glass bead markings carried on the film

Fig. 4: Types of arch forms (Orthoform™ templates by 3M Unitek)

Fig. 5: Interpretation of arch form
Table 2 depicts the frequency distribution of arch forms according to gender. In males, 20% arches were of tapered form, 47.5% arches were of ovoid form and 32.5% arches were of square form whereas, in females, 31.67% arches were of tapered form, 52.5% arches were of ovoid form and 15.83% arches were of square form. Pearson Chi-square test was applied to determine correlation of arch form with gender. Statistically significant correlation was found with p-value 0.0137. It was seen that there was more frequency of ovoid and tapered arch forms among females, whereas in males there was more frequency of ovoid and square arch forms.

Table 3 depicts the frequency distribution of arch forms according to Angle’s classes of malocclusion. In Class II malocclusion, there was more frequency of tapered arch forms as compared to Class I and III malocclusion. In Class II Division 1, more tapered and ovoid arch forms were present while in Class II Division 2, more square and ovoid arch forms were present. In Class III malocclusion, all the arch forms found were of square and ovoid form; not a single tapered arch form was seen. The correlation between Angle’s classes of malocclusion and arch form was determined by Pearson’s Chi-square test. The results showed no significant correlation with p-value = 0.858.

**DISCUSSION**

Many of the conventional studies included normal untreated samples for determining arch form mathematically or for characterizing arch form through various measurements using the incisal edges and cusp tips as landmarks.3,4 While this methodology may suffice for anthropological arch form assessment and comparison among different ethnic groups, it may be inappropriate from the standpoint of post-treatment occlusal stability to clinically apply data obtained in these studies to orthodontic treatment of malocclusions. The present study evaluated arch forms among patients seeking orthodontic treatment.

Clinical bracket points corresponding to a bracket slot were used in some studies.5-7 The advantage of this method is the use of points representing the clinical bracket slot on labial tooth surfaces instead of incisal edges and tips of the buccal cusps. Points defined in this manner represent the actual clinical orthodontic arch form and simulation of the effects of archwire form used in orthodontic therapy.

Arch forms were first classified as square, ovoid and tapered by Chuck8 in 1932. Numerous investigators and clinicians have used this classification over the years, and eventually orthodontic manufacturers began producing arch forms based on this classification. Such a three arch form approach allows for greater individualization than the single arch form approach, especially in the early archwire stages.

Nojima et al used tapered, square and ovoid templates to evaluate arch forms of Class I, II and III cases in both Japanese and Caucasian samples. The Caucasian sample showed 18% square arch forms, 38% ovoid arch forms and 44% tapered arch forms. However, Nojima et al included an equal proportion of Class III cases (of which 44% have square arches) in both samples, and a typical Caucasian caseload would contain fewer Class III cases. Hence, the ratios of 8% square, 42% ovoid and 50% tapered are a more probable reflection of a predominantly Caucasian practice. Global differences are clearly significant and it is interesting that the Japanese sample showed ratios of 46% square, 42% ovoid and 12% tapered. This shows the opposite ratio of square to tapered arch forms, compared with the Caucasian sample.5

In a similar study, Kook et al compared arch forms in Korean and North American white samples. The Korean sample...
showed 18% square arch forms, 38% ovoid arch forms and 44% tapered arch forms. On the other hand, North American white sample showed 47% square arch forms, 34% ovoid arch forms and 18% tapered arch forms.\(^6\)

In the present study, the sample of patients seeking orthodontic treatment showed 32.5% arches of tapered form, 50% arches of ovoid form and 17.5% arches of square form. So, there was increased frequency of ovoid arch forms than tapered and square arch forms. This was contrary to Nojima et al\(^5\) and Kook et al\(^6\) studies in which Caucasians and Koreans had more of tapered arch forms and Japanese and North American whites had more of square arch forms. Thus, this study reveals that there is ethnic diversity and global differences present in the distribution of various arch forms.

It was seen that there was more frequency of ovoid and tapered arch forms among females, whereas in males there was more frequency of ovoid and square arch forms. These findings were contrary to results of other studies done by Raberin et al\(^3\), Ferrario et al\(^9\), Henrikson et al\(^10\), Haralabakis et al\(^11\) and Lombardo et al\(^12\). In these studies, no significant gender differences were present in the shape of the arch. Felton et al\(^1\) studied mandibular dental casts of untreated normal cases, Class I nonextraction cases, and Class II non-extraction cases. They reported that there was little difference between the arch forms of the Class I and II malocclusion groups. In the present study, however, the Class II Division 1 arches were associated with a decreased frequency of square arch form and an increased frequency of tapered arch form. This may be related to the compensating mechanism as narrower portion of mandibular dental arch articulates with the wider portion of the maxillary dental arch. Staley et al\(^13\) hypothesized that, during eruption, the maxillary posterior teeth of Class II Division 1 subjects compensate for the increased buccal overjet (resulting from the anteroposterior displacement of the jaws) by palatal movement into better interdigitation with the mandibular teeth. So, expanding the maxillary arch is an important way to decrease the arch form difference between Class II Division 1 and normal occlusion subjects.

In Class III malocclusion cases, on the other hand, square and ovoid arch forms were present and there was no tapered arch form. This can be explained by the common pathogenesis of Class III malocclusion and the resultant dental compensation by lingual tipping of the mandibular anterior teeth, causing the anterior part of the mandibular arch to flatten.

It was found that there is no arch form unique to any Angle’s class of malocclusion. This supports findings of other studies of Nojima et al\(^5\) and Kook et al.\(^6\)

**CONCLUSION**

The following conclusions were drawn:

1. In a case load of orthodontic patients, one should expect about 50% of ovoid arch forms, 27% of tapered arch forms and 23% of square arch forms. So, when keeping the stock of preformed archwires, a practicing orthodontist should take an idea from this valuable data and maintain the stock accordingly.

2. There is more frequency of ovoid and tapered arch forms among females whereas there is more frequency of ovoid and square arch forms in males.

3. No single arch form is unique to any of the Angle’s class of malocclusion but it is the frequency of a particular arch form that varies among Angle’s classification groups.

**REFERENCES**


