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# Frequency of Arch forms in a Pakistani sample and its association with the Curve of Spee and Gender

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## Abstract

**Introduction:** Arch form and curve of Spee are two important parameters in diagnosing malocclusion before the start of orthodontic treatment. The study aimed to determine the frequency of different dental arch forms in the Pakistani population and their association with the Curve of Spee (COS).

**Material and Methods:** The study used 322 mandibular pretreatment casts obtained from patients reporting for orthodontic treatment at the Orthodontic Department, RIHS, Islamabad. Arch forms and COS were measured on the casts. The frequency of arch forms and the association between COS and gender were assessed with the help of statistical analysis.

**Results:** The study found that the majority of the sample had (40.37%) square AF followed by (43.48%) round, and (16.15%) oval AF. There was a significant association between the dental arch form and gender, with males having square and females having round arch forms predominantly. Most of the square and round AF had normal COS, while oval AF had medium COS. The Spearman correlation between arch form and COS was statistically insignificant.

**Conclusion**: This study helped in the diagnosis of arch form type with respect to gender and enhanced the knowledge about the depth of COS in three different types of arch forms in the context of orthodontic treatment planning.

**Key words:** Arch form (AF), Curve of Spee (COS), Dental arch.

## Introduction

Arch forms (AF) play a pivotal role in the orthodontic diagnostic process and the formulation of treatment plans. Constraints on tooth movement, particularly in relation to incisor retractions, are contingent upon the basal bone, where the teeth are anchored.[1] Excessive tooth displacement over the alveolar bone may give rise to complications such as periodontal issues, unstable treatment outcomes, and, in extreme cases, tooth exfoliation. Orthodontic practitioners widely recognize that the architectural characteristics of the basal bone significantly influence dental arch expansion. The prevalence of common complications in orthodontic treatments, such as relapse, is closely associated with the morphology of the basal bone.[2]

The Curve of Spee (COS) is delineated as a gracefully curved line tangential to the anterior condylar border, buccal cusps of the 2nd molar, and the mandibular incisal edges.[3] Depth of COS is affected by sagittal, vertical and transverse maxilla-mandibular relations. Variation in its depth can effect treatment outcome, stability and tendency to rlapse.[4]

A study undertaken by Naureen et al unveiled a statistically significant disparity ($P<0.05$) among the Angle's classes in both genders. An exaggerated Curve of Spee has the potential to disrupt muscular equilibrium, precipitating improper functional occlusion

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and a distorted distribution of occlusal forces.[5]

The maxilla-maandibular dental AF compatibility is pivotal for aesthetic and functional excellence in treatment outcome. As posited by Tiwari et al. and articulated by Barrow and White, there exist five fundamental dental AF, 1. Parabolic, 2. Hyperbolic, 3. Ellipsoidal, 4. Square, and 5. Omega. Different AF depicts different response to aesthetic and functional considerations.[6-8] The association of dental AF with COS and gender is unclear and scarce work is done on it. So our study aims to find the frequency of dental AF in the Pakistani population and its association with the COS and gender.To understand this association AF will be studied with respect to gender and COS will be measured in round, oval and square AF on dental casts. The inherited AF of the patient should be maintained during orthodontic treatment, while COS should be leveled during orthodontic treatment. Exaggerated COS can alter the distribution of occlusal forces, so this study will help us to relate different AF with normal, medium, and deep COS, which will enhance the treatment planning abilities of orthodontists. Orthodontists will also be able to estimate the COS simply by examining the arch form.

## Material and Methods

This study was a prospective cross-sectional observation study conducted at the Department of Orthodontics, Rawal Institute of Health Sciences, RIHS Islamabad. The samples were comprised of 322 mandibular pretreatment casts obtained from subjects reporting for orthodontic treatment in RIHS from January 2022 to July 2023. All patients were Pakistanis and of Asian descent. The study protocol was approved by the Ethical Committee of RIHS and the Reference no. was RIHS/IRB/D/23100. The sample size from population of N=1200 and population proportion 50% was determined using the WHO calculator with a C.I of 95%,.margin of error was 5%. Inclusion criteria were patients who have not started orthodontic treatment, Class I, II, and III malocclusions without an open, traumatic, and posterior crossbite. No age limit was set in our sample. Exclusion criteria were cleft and syndromic patients, patients with missing teeth and arch asymmetry, and patients with any perverted habit like thumb sucking or bottle feeding.

The dental casts were properly trimmed and shaped, and then arch form was diagnosed through template method and arch forms were classified as follows:

Square=1, Round=2, Oval=3, representing square, round, and oval shapes.

Similarly, Curve of Spee (COS) was gauged using the standard method of COS assessment from mandibular incisal edges o buccal cusp tips of 2nd molars and depth was subsequently measured using vernier caliper. Based on the average measured depth (right +left ) /2 in millimeters, the COS was categorized into three groups.

Normal COS = 0mm to 1.5 mm • medium COS= 1.51mm-2.5 mm and deep COS above 2.5mm.

### Statistical analysis

Data was then analyzed through SPSS version 23. The mean and standard deviation of age and COS were calculated. Frequency as a percentage was calculated for gender and arch form. The chi-square test was used to find any association between arch form and gender. Spearman correlation was used to find the relationship between arch form and COS.

## Results

The age of the sample ranged between 12-45 years with a mean value of 17.6 ± 7.98 year. Our sample comprised 118 (36.6%) males and 204 (63.4%) females. The mean value of COS was found to be 1.49mm ± .755mm. The frequency of arch forms is shown in Figure I. Our sample showed 130 (40.37%) square, 140 (43.48%) round, and 52 (16.15%) oval arch forms. Table I shows the number of cases having normal, medium, and deep COS in three different arch forms. The highest

number of round and square AF had normal COS (0-1.5mm), while most of the oval AF had medium COS (1.51-2.5). The chi-square test (Table II) showed a p-value of .004 depicting a significant association between arch form and gender. In males, the highest number (52) of the arch forms were square, and in females, (106) of the arch forms were round predominantly. Shapiro Wilk test was significant for the two variables i-e arch form and COS depicting that data is not normally distributed, so we converted COS values to ordinal data by ranking, as explained in the methodology and applied the Spearman correlation test (Table III). Results show a correlation co-efficient of 0.862 for COS and arch form which is though positive but statistically insignificant.

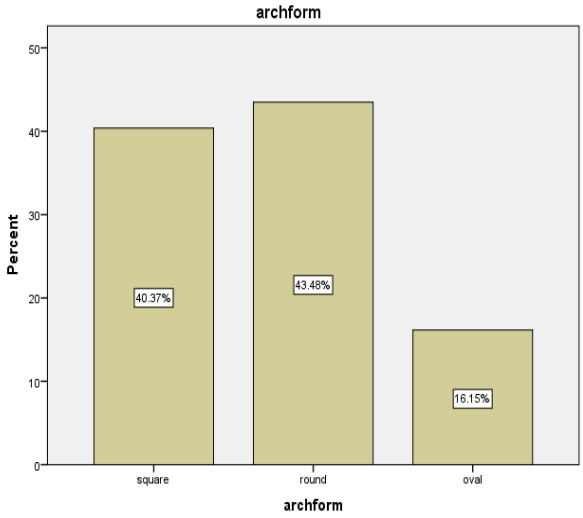


**Figure I: Frequency of Arch Forms**

| | | Arch form | | | Total |
|---|---|---|---|---|---|
| | | Square | round | Oval | |
| COS | 1 | 74 | 90 | 24 | 188 |
| | 2 | 42 | 46 | 27 | 115 |
| | 3 | 14 | 4 | 1 | 19 |
| Total | | 130 | 140 | 52 | 322 |

1= normal, 2=medium, 3= deep

**Table I: Frequency of COS in different arch forms**

| | Value | df | Significance (2-sided) |
|---|---|---|---|
| Chi-Square | 15.597[a] | 4 | .004 |

**Table II: Chi-Square Test between gender and arch form**

| Co-relation (r) | Arch Form |
|---|---|
| COS | 0.862 |

**Table III: Spearman Correlations between COS and arch form**

## Discussion

Our study results indicate that round AF is the most frequent shape, while oval AF is the least common. Males predominantly have square AF, while females have round AF. These findings align with a recent investigation by Tervahauta et al, affirming that dental arches exhibit larger dimensions in males compared to females. However, in subjects with Class II (CII) occlusion, a more frequent occurrence of a square or tapered maxilla and a tapered or ovoid mandible was observed in contrast to subjects with Class I (CI) occlusion.[9] This contrasts with the results of Paranhos et al, whose study identified oval (41%) as the most prevalent dental arch shape, followed by square (39%) and tapered (20%) shapes.[10] In a similar study, Sharaf et al. reported that oval arch form (58%) and square arch form (29%) were the most common among Egyptian children and adolescents, trailed by tapered arch form (13%).[11] It is evident that disparities in racial origins and environmental factors may elucidate the statistically significant differences in dental arch dimensions among children from distinct continents with diverse genetics and varied living conditions.[12]

The classification of malocclusion is imperative due to its profound impact on devising appropriate treatment plans for patients. Its significance spans multiple facets, including functionality, aesthetics, and techniques employed for oral hygiene. Arch form assumes a pivotal role in the categorization of malocclusion, as it dictates the configuration of the individual dental arch. The arch form may manifest as ovoid, square, or tapering, thereby influencing the facial profile, which can be characterized as convex, concave, or straight. Past research has proposed additional arch form classifications,

such as narrow ovoid and narrow tapering. Furthermore, variations in arch form size, gauged by arch length and width, contribute to the complexity. A decrease in arch length is often accompanied by an increase in arch width, exemplified in a square arch. Studies have unveiled associations between class II and arch form, implying a discernible link between malocclusion and arch form.[13] According to the USA National Health and Nutrition Examination (1988–1991), approximately 57% of the 7000 sample assessed necessitated orthodontic management due to malocclusion or bizarre arch form. In about 15% of cases, the anomaly was deemed critical, significantly impacting both social aesthetics and function.[14] The COS is also influenced by the severity of malocclusion, prompting speculation regarding a potential relationship between COS and arch form.

Nayar et al in a cross-sectional study on 30 casts of the Indian population evaluated the depth of COS in different angle malocclusion. They found that the highest value for COS was in class I malocclusion, followed by class III and class II.[15] Similar results were found by Naureen et al in this study on Pakistani sample.[5] Although AF and COS both are strongly related to malocclusion, but no statistically significant correlation was found between COS and arch form. However, most of the square and round AF had normal COS, while oval AF mostly had medium COS. The mean value of COS in our study was 1.49mm. Interestingly, so far no studies have investigated the relationship between COS and arch form, this makes our study unique. Both COS and AF were measured manually, as previous studies have found insignificant difference between manual and digital measurements.[16,17] Implementing educational strategies that advocate for both dental and overall bodily health is crucial, as early intervention may mitigate the duration of associated side effects.[18]

In terms of the influence of occlusal factors on determining dental arch form, the trajectory of tooth eruption, have a significant impact. The abnormal eruption or impaction of maxillary canines, for instance, can markedly affect inter-canine width. Conversely, the absence or palatal displacement of lateral incisors may lead to the deformation of the arch shape.[19,20] Skeletal and dental inter arch relationships also have an effect on the arch form and this is particularly evident in class II div 2 and class III.[21]

The limitation of our study is that we used a manual method for defining AF and measuring the COS. Digital orthodontics is at boom these days and measurements should have been taken on 3D digital models. We could not manage this because of financial constraints and a large sample size. Future research can focus on investigating the clinical implications of our findings in treating malocclusion and temporo-mandibular disorders.

## Conclusion

This study provides valuable insights into the prevalence of dental arch forms and the depth of COS in a Pakistani population seeking orthodontic treatment. Arch forms were predominantly square (40.37%), followed by round (43.48%) and oval (16.15%). Strong association was found between AF and gender $p = .004$. Males predominantly have square AF, while females have round. Although no significant correlation was found between AF and COS showing that different AF do not follow a consistent pattern of depth of COS.

## Ethical Approval

The study was approved by the Institutional Ethical Review committee of Rawal Institute of Health Sciences, Islamabad.

## Disclaimer

No external funding.

## Conflict of Interest

No conflict of interest

## Authors' Contribution

**SN:** Conception of study, Data collection, statistical analysis.
**HGK:** Introduction, and Discussion writing.
**KA:** Data collection Reference checking and proof reading.

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