Original Article

# Determination of Mandibular Arch Form During Mixed Dentition Using Custom Made Template in Sulaimani Governorate

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## Abstract

**Objectives:** The dental arch form and dimensions change continuously and systematically during human growth and development, but this decreases adulthood. During mixed dentition, changes in dental arch forms and the occlusion occur due to teeth movements and growth of the alveolar bone. Usually, changes in the mandibular arch are followed by changes in the maxillary arch. The research aimed to determine the most frequent mandibular dental arch form and its relationship with gender.

**Methods:** The mandibular arch forms of 115 schoolchildren with mixed dentition were examined using their dental casts. Adobe Photoshop© (21.0.0, 2019) program was used to construct a template from photographs of the casts and printed on transparent paper to overlay the casts. The data were collected and calculated using statistical software to determine the frequencies of different arch forms among the studied sample.

**Results:** The sample was composed of 61 males (53%) and 54 females (47%). The oval arch form was the most frequent type with 70 cases (60.9%), followed by the square arch form with 38 cases (33%), and finally the tapered arch form with 7 cases (6.1%). No significant relationship was found between the arch form and the gender of the participants.

**Conclusions**: Oval arch form was the most predominant type of arch form of the mandible in the mixed dentition, and there was no relationship with gender.

**Keywords:** *Mandibular arch form, Mixed dentition, Custom made template.*

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## Introduction

The width, length, and depth of dental arches have had considerable implications in orthodontic diagnosis and treatment planning in modern dentistry based on prevention and early diagnosis of oral disease. These dental arch forms and dimensions change continuously and systematically during human growth and development, but this lessens naturally in adulthood[1]. In mixed dentition, dental arch forms and the occlusion change because of the movement of teeth and growth of the alveolar bone[2]. Moyer et al.[3] and Van der Linden[4,5] suggested an important relation between dental arch width expansion and vertical growth of alveolar bone. The maxillary alveolar processes diverge, whereas the mandibular alveolar processes are more parallel. Many studies suggest a moderate increase in the arch width before the permanent canine eruption, and following that, it decreases[3]. The inter canine and intermolar widths increase greatly between 6 weeks and one year of age in the lower arch, and between 1 and 2 years in the upper arch, as well as between 3 and 13 years, which reflects the growth peaks during different periods of age as stated by WR Proffit[6].

However, this decreases in both the upper and lower arches after 12 or 13 years of age. It has been indicated that growth and development are affected by environmental factors, nutrition, ethnic variations, systemic health, and individual variations[7]. Some studies suggest that arch size has a limited genetic component, the environmental factors also influence the growth of the jaws, and arch length and width are independent. It appears that the arch width is more genetically affected than its length[7]. Moreover, the arch length was observed to decrease more than the width due to secular changes[8]. For some time, clinicians and researchers have attempted to classify the human dental arch form[9]. Longitudinal studies have reported a slight increase in arch width and decreased arch depth during adolescence, but the changes are too subtle to be detected without serial data[2]. To achieve stable and functional arch forms, a key objective is identifying a suitable arch form to use in the treatment of each case[10,11]. Many studies have shown that the oval arch form is the most predominant type[12-14].

As treatment aimed at the mandible typically affects the maxilla, the maxilla follows the mandible[15]; this study aims to determine the mandibular arch form among mixed dentition schoolchildren and determine the relation between mandibular arch forms and gender.

## Materials and methods

### *Study Design*

This cross-sectional study was conducted on study casts of schoolchildren within the age range of 8-10 years old to determine the mandible's predominant mixed dentition dental arch form. Ethical approval was obtained from the ethical committee of the medical colleges in the University of Sulaimani (Ethical approval number: 155) in accordance with the Helsinki declaration.

### *Study sample*

In total, 115 mandibular casts of schoolchildren in the age range of 8-10 years old in urban and rural areas of Sulaimani Governorate were produced after obtaining verbal consent from the participants and their parents. The study sample was collected through a random selection method, specifically the multistage cluster sampling technique. Examination of more than 1350 primary school children was carried out. From these, 115 participants were selected as a study sample after fulfillment of the sample selection criteria.

The form of the dental arch was defined based on buccal cusps of the 1st molars, cusp tips, and incisor edges and then classified as ellipse (Oval), parabola (V-Shape or taper), or segments of circles joined to straight lines (Rectangular)[16].

The age range of 8-10 years was selected. During this mixed dentition, period changes occur in the dental arches due to tooth movement and growth of supporting bone, besides a modest genetic component[9]. These naturally occurring changes, which happen in untreated individuals, have been used many times as comparative "gold standards" to assist in orthodontic diagnosis and planning[16].

### *Inclusion criteria*

1. Class I canine and molar relationships, normal overjet and overbite
2. Well-aligned upper and lower dental arches.
3. Mixed dentition period (children aged 8-10 years).
4. No systemic diseases.
5. No history of trauma.
6. No previous orthodontic or prosthodontic treatment.
7. No dental caries, especially Class II.

### *Template construction*

A template of each form was constructed as follows: (Images are from the pilot study).

1. Three orthodontists selected each arch form from the sample (3 mandibular casts of each type).

2. Photographs for each cast were transmitted to a computer. [Images were taken by a digital SLR camera (Nikon D5600, 18-55 lens, and a ring flash) with a scale (ruler) adjacent to the casts to resize the images in a computer program and adjust the ruler scales with the scale inside the software (Adobe Photoshop© 21.0.0, 2019).] (Figure 1).
3. Geometrical shapes were designed and adjusted on the casts for each type (Figure 2).

Finally, the shapes were transferred to the templates, then printed on transparent flexible paper (Figure 3). The reuse of this template was subjected to copyright and required permission of the corresponding author.

**Statistical Analysis**

The data were analyzed using the statistical software package SPSS 24 (SPSS Inc., Chicago, IL, USA). The sample was distributed in tables according to age and sex. The prevalence of each arch form (Percentage) was recorded. A Chi-square test was used to find the correlation between 'patients' gender and type of arch form.

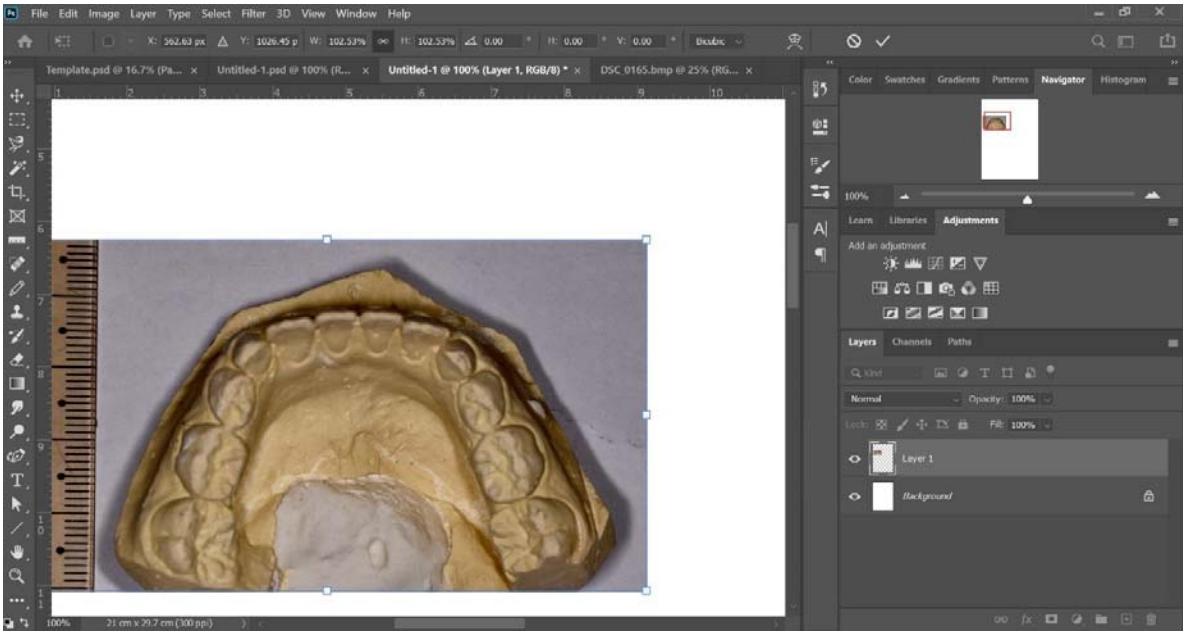


Figure 1: Transferring and resizing the size of the images using the software.

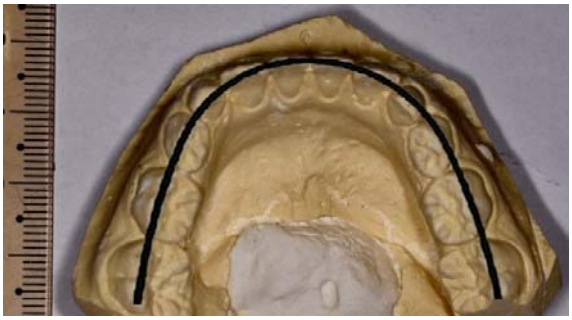

Figure 2: Superimposition of the geometric form and the arch.

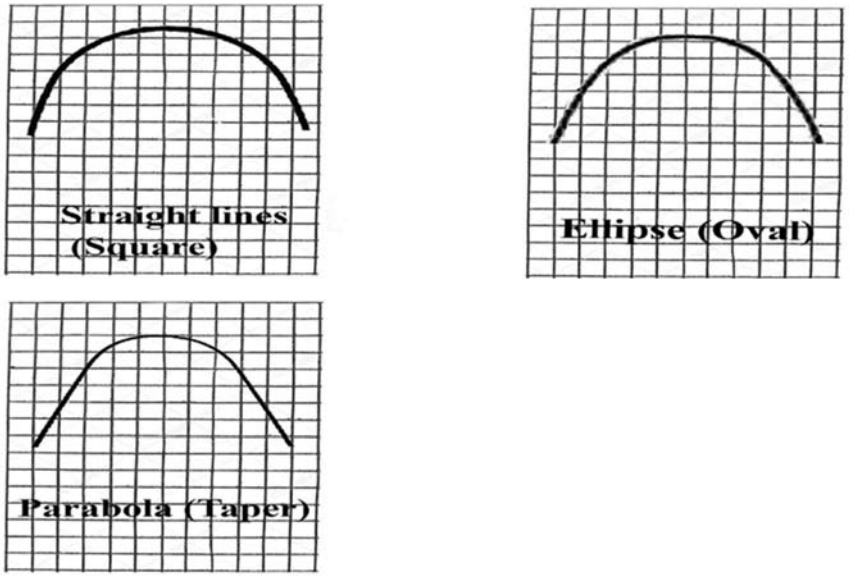


Figure 3: The templates of each arch form (actual size).

## Results

A total of 115 mandibular casts were examined by three orthodontists using the constructed template.

The distribution of the type of arch form according to age and gender is shown below in Table 1.

The most prevalent type is the oval form, which constituted 60.9% of the sample, followed by the square form, which constituted 38%, and the taper arch form constituted only 6.1% (Table 1). The result shows no significant relationship between 'patients' gender and type of arch (p-value=0.54), as shown in Table 2.

Table 1: Cross-tabulation of types of arch form in relation to 'patients' gender.

| | | Gender | | Total |
|---|---|---|---|---|
| | | Male | Female | |
| Arch form | Oval | 36 | 34 | 70 (60.9%) |
| | Square | 24 | 14 | 38 (33%) |
| | Taper | 1 | 6 | 7 (6.1%) |
| Total | | 61 (53%) | 54 (47%) | 115 |

Table 2: Chi-square test for the relation of gender with arch form.

| Crosstabulation of gender and arch form | | | | | | |
|---|---|---|---|---|---|---|
| Count | | | | | | |
| | | Arch form | | | Total | p-value |
| | | 1 (Oval) | 2 (Square) | 3 (Taper) | | |
| Sex | Mlaes | 36 | 24 | 1 | 61 | 0.54 |
| | Females | 34 | 14 | 6 | 54 | |
| Total | | 70 | 38 | 7 | 115 | |

## Discussion

Measuring arch dimensions and determining arch forms before orthodontic treatment are essential steps for proper diagnosis, treatment planning, treatment strategy, and post-treatment stability[17]. Thus, the study aimed to determine the most prevalent mandibular dental arch form in addition to finding out the relationship between gender and mandibular arch form.

In normal occlusion cases, the lower arch is regarded as the reference for the specific archwire for each orthodontic patient, and the upper arch form follows the lower arch form[18]. Accordingly, the mandibular arch form is the focus of the current study.

The method used in this study to investigate the arch form is new (to the extent of my knowledge) as it is the first time that a template has been constructed for mandibular teeth during mixed dentition. Precise images were taken using a high-quality digital SLR camera (Nikon D5600), with a high-quality lens (Macro lens by Sigma "105mm 1:2:8 DG MACRO HSM") to provide detailed images that could be relied on for template construction under restricted conditions of rescaling as mentioned in the materials and method section.

The result was in the same line with other studies as the most prevalent type was Ellipse (Oval)[15]. The oval arch form is also the most common type, even in permanent dentition[13,19,20]. In contrast to our work, the most frequent arch form was identified as a medium-sized square type in Jordanian primary dentition schoolchildren[21].

In a 2018 study by Oliva et al. on Italian schoolchildren, no significant differences were found in dental arch form between males and females, according to the findings of the current study[22].

This result does not recommend using the oval arch form wire as the standard form of orthodontic wire for every patient, as seen in most orthodontic clinics. Based on the technique used in this study, the recommendation of this study is to use a specific arch form for each patient. This is to decrease the chance of relapse and better esthetics after the orthodontic treatment. Also, this supports Omar et al. (2018) 's finding that the differences in arch dimensions among different ethnic groups suggest the need for specific orthodontic archwires for each patient, dependent on the initial arch form[23].

The findings of the present study will constitute baseline data regarding the shape of arch forms. Hence, this could facilitate and enhance the production of specific stock trays, prefabricated orthodontic archwires, and appliances specific for each patient.

## Conclusion

The oval arch form is the most common type in the present study, but not the only type, so the arch form consideration before orthodontic treatment is necessary. The authors recommend using custom-made archwires, especially during the arch development stage of orthodontic treatment.

This study was limited by restrictions on obtaining the ideal casts as mentioned in the methodology and by the sample size, which is also related to this study's standards.

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