Journal of Contemporary Issues in Business and Government Vol. 27, No. 2, 2021
https://cibg.org.au/

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.02.059

Association of Arch Forms in Class Ii Malocclusions - A Retrospective study

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Abstract: The vertical proportions of the face are significant in determining the esthetics and harmony of the face. Dental arch form is a reflection of underlying bone morphology, size and its shape. Correct identification of a patient's arch form is an important aspect to achieve a stable, functional and esthetic orthodontic treatment result. To evaluate the maxillary and mandibular dental arch forms in class II malocclusion. A retrospective cross-sectional study was conducted using the patient records from a dental hospital from June 2019 until March 2020. Patients diagnosed with class II malocclusion were selected and evaluated for its association with dental arch form. Data was collected and then subjected to statistical analysis. Statistical analysis: Microsoft Excel 2016 data spreadsheet was used to collect data and later exported to the SPSS software. Among 308 individuals diagnosed with class II malocclusion, ovoid arch form was the most frequent dental arch form found in both maxillary and mandibular arches. Broad and narrow arch forms showed nearly equal distributions in both arches among males and females. Within the limitation of our study, ovoid arch form seems to be the most prevalent arch form in Class II malocclusions subjects

Keywords: Class II malocclusion, dental arch form, maxillary arch, mandibular arch

INTRODUCTION

Vertical proportion of an individual influences the facial form which later decides the future growth direction and treatment planning. This is because it can affect the anchorage type needed and achieves the treatment required (Schudy, 1964)(Kamisetty *et al.*, 2015). A good proportion in all three dimensions of space that are transverse, sagittal and vertical required for a balanced-face. Esthetics and harmony of the face truly depend on the vertical proportions of the face (Forster, Sunga and Chung, 2008). Different authors described vertical facial forms as hypodivergent, hyperdivergent and normal divergent or short angle, long angle and normal angle(Opdebeeck and Bell, 1978)(Vikram *et al.*, 2017). Increased vertical condylar growth and reduced vertical growth of alveolar process and/or anterior facial sutures can be seen in hypodivergent(Krishnan, Pandian and Kumar S, 2015). In contrast, decreased condylar growth and enhanced vertical growth of alveolar process and/ or anterior facial sutures presented in hyperdivergent (Forster, Sunga and Chung, 2008)(Samantha *et al.*, 2017).

Malocclusion is described as the faulty arrangement of the dentitions in any of the three planes of space. Based on Edward Hartley Angle, father of modern orthodontics, he classified malocclusion based on the dental component. Skeletal or dental or combination of both components are regarded in case of class II malocclusion. The class II malocclusion can be divided into division I and II. The classification is based on axial inclination of upper anteriors. As mentioned in previous literature, class I division found to be more common in comparison to class II division (Indukuri *et al.*, 2014).

Dental arch form is the arch formed by the buccal and facial surfaces of the teeth when viewed from their occlusal surfaces(Dinesh *et al.*, 2013). Basic types of dental arch form are parabolic, hyperbolic, ellipsoidal, square, and omega (Slaj *et al.*, 2010). Arch form is a determination of the multifactorial trait. The genetic component may influence vertical growth patterns and environmental components involved in functional, muscular, and local factors (Harris and Johnson, 1991)(Felicita and Sumathi Felicita, 2018). Arch forms determine the orthodontic treatments in order to prevent consequences like iatrogenic impairment to dentition being moved beyond their bone edges (Felicita, Chandrasekar and Shanthasundari, 2012)(Felicita, 2017a). Orthodontists are able to select the most suitable orthodontic arch wires for each patient as they are

manufactured in some different forms of dental arch (McConal and Scher, 1949)(Currier, 1969)(Ferrario *et al.*, 1994). Thus, numerous arch wires produced by the manufacturer for different arch forms as it is inconvenient to choose the most suitable for the patients(Ramesh Kumar *et al.*, 2011)(Pandian, Krishnan and Kumar, 2018). None of the commercial arch wire fits exactly the patient arch form in a research that analysed the arch form of the Italian population (Camporesi *et al.*, 2006)(Sivamurthy and Sundari, 2016).

Arch form can be determined by measuring linear distances, such as intercanine and intermolar widths.(Viswanath *et al.*, 2015) It was concluded that dental arch width is associated with vertical morphology (Opdebeeck and Bell, 1978). A long face, leptoprosopic individual usually has narrower arch dimensions and a short face individual, euryprosopic has wider arch dimensions (Ricketts *et al.*, 1982)(Felicita, 2017b). The shape of the tooth arch is related to the vertical dimension as well as the jaw transverse is related to the vertical skeletal growth. Isaacson et al documented that subjects with long faces presented decreased maxillary intermolar width(Isaacson *et al.*, 1971). Individuals with long face and short face predominantly had wide arches while normal divergent have variable arch forms (Anwar and Fida, 2010)(Rubika, Sumathi Felicita and Sivambiga, 2015).

Dental arch form can be measured by using study models. Korkhaus three-dimensions caliper (Dentaurum) and digital caliper used to perform study model measurements in Khera et al. 2012 (Khera *et al.*, 2012). The measurements include cumulative mesiodistal crown width, intercanine width, first inter premolar width that is from buccal cusp tip, first intermolar width which is from buccal, and lingual surface, arch length and palatal height (Jain, Kumar and Manjula, 2014).

Our university is passionate about research we have published numerous high quality articles in this domain over the past years ((Kavitha *et al.*, 2014) , (Praveen *et al.*, 2001),(Devi and Gnanavel, 2014), (Putchala *et al.*, 2013), (Vijayakumar *et al.*, 2010), (Lekha *et al.*, 2014a, 2014b) (Danda, 2010) (Danda, 2010) (Parthasarathy *et al.*, 2016) (Gopalakannan, Senthilvelan and Ranganathan, 2012), (Rajendran *et al.*, 2019), (Govindaraju, Neelakantan and Gutmann, 2017), (P. Neelakantan *et al.*, 2015), (PradeepKumar *et al.*, 2016), (Sajan *et al.*, 2011), (Lekha *et al.*, 2014a), (Neelakantan, Grotra and Sharma, 2013), (Patil *et al.*, 2017), (Jeevanandan and Govindaraju, 2018), (Abdul Wahab *et al.*, 2017), (Eapen, Baig and Avinash, 2017), (Menon *et al.*, 2018), (Wahab *et al.*, 2018), (Vishnu Prasad *et al.*, 2018), (Uthrakumar *et al.*, 2010), (Ashok, Ajith and Sivanesan, 2017), (Prasanna Neelakantan *et al.*, 2015).The present study was carried out in order to assess the maxillary and mandibular dental arch forms in class II malocclusions.

MATERIALS AND METHODS

This retrospective study was conducted by reviewing 86,000 patient records of the dental hospital. A total of 308 case records diagnosed with class II malocclusion were included in the study. The data of patients' details were retrieved from the dental hospital records from the month of June 2019 until March of 2020. This study has been approved by the University hospital research committee with ethical approval number SDC/SIHEC/2020/DIASDATA/0619-0320. This study was conducted to evaluate the maxillary and mandibular dental arch forms in class II malocclusion individuals.

The inclusion criteria were untreated class II malocclusion subjects in permanent dentition. The exclusion criteria were history of orthodontic treatment, presence of edentulous spaces and periodontally compromised. The pros of the study are large and diverse samples, low cost, less time consumption and automated data collection and the cons are researcher bias and lack of time frame.

Collected data was subjected to statistical analysis using SPSS version 23. Frequency distribution was performed to assess the arch forms in class II malocclusions based on age and gender. Chi-square association was done to find the association of dental arch forms in maxillary and mandibular arches with age and gender. P value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

This study included 308 patients who were diagnosed with class II malocclusion and the case records were reviewed. The outcome of the study was to study the maxillary and mandibular dental arch forms in Class II malocclusion patients attending a dental hospital. The data were enumerated through the analysis of the data records at a dental hospital.

Figure 1 shows frequency distribution among males and females based on type of malocclusion. Both males and females showed higher prevalence in class II division I compared to class II division II. Based on gender, females seemed to be more prevalent in class II division I (43.83%) while males recorded with 41.88%. Both genders showed equal frequency in Class II division II, about 5.52% in females and 8.77% in females. In the context of our investigation, we found that females presented higher prevalence in class II division I. As reported by Khera at al 2012, the study determining the relationship between dental arch dimensions and vertical facial morphology were done by type I malocclusion (Khera *et al.*, 2012). In Grippaudo et al 2013, no specific results recorded in Class II division presented with studies done in Class II subjects (Grippaudo *et al.*, 2013). The prevalence showed in these studies varied due to geographical base, age, sex and urbanization.

Based on types of maxillary arch form, 'average' reported with the highest frequency (83.77%). Narrow and broad arch forms reported with 9.42% and 6.82% respectively as displayed in Figure 2. The association between dental malocclusion and maxillary arch form was statistically significant [Chi-square value-; p=0.02 (p<0.05)] as shown in Figure 3. Figure 4 presents the types of arch form in the mandibular arch. Mandibular arch form showed similar incidence as maxillary arch with 'average' arch form, 70% recorded the highest incidence. Broad and narrow arch forms reported with almost similar frequency, approximately 16.2% and 14.8% respectively. Figure 5 shows the association between dental malocclusion and mandibular arch form was statistically significant [Chi-square value-; p=0.0042 (p<0.05)].

Based on type arch form, present study showed that average arch form recorded as the most type of arch form in both maxillary and mandibular arches. Based on Giuntini et al 2011, he found that the maxillary arch dimension was smaller(Giuntini *et al*., 2011). This is supported by study done by Grippando et al 2012. Thus, it proved that transverse efficiency of maxillary arch is a common finding in grown subjects with Class II malocclusion. Grippaudo et al 2013 mentioned that there was no statistically significant difference in mandibular arch forms (p>0.05).

Figure 6 represents the types of maxillary arch form among different genders. Males recorded a higher prevalence of average arch form with 45.1% than females, 38.6%. Both broad and narrow arch forms in both genders showed lower prevalence with percentage less than 5%. Broad and narrow arch forms in males were 3.57% and 4.87% whereas in females were 3.25% and 4.55% respectively. As displayed in Figure 7, prevalence of broad and narrow arch forms was slightly greater than that of maxilla. Males presented with 9.74% and 7.14% while females showed 6.49% and 7.47% respectively. Average arch form presented as the most common arch form in the mandibular arch, 36.69% in males and 32.47% in females.

Regarding the gender distribution, in present study showed that both males and females reported with average arch form. Based on Bhowmik et al 2012 found a difference among gender, showing that female occurrence is usually smaller than that of males (Bhowmik, Hazare and Bhowmik, 2012). As reported by Eroz et al 2000 and Foster et al 2008, they found a well-established sexual dimorphism in the arch dimension in which males presented with larger arch width as compared with females. These findings that showing different dimensions can possibly be explained by different influences of the vertical facial pattern and arch dimension for both the gender ones to different impacts of genetic factors on males and females.

The results of the study provide data for the arch dimensions of males and females subjects. The study also provides a comprehensive evaluation of arch dimension in both maxillary and mandibular arches for both genders. As people from various ethnic groups showed different physiologic conditions, thus clinicians should predict the dissimilar in size and form instead of threatening all cases to a single ideal (Khera *et al*., 2012).

The present study showed several limitations that can cause unreliable results. Demographic features, small sample size and population, unequal distribution of participants among genders and limited time frame lead to bias in data analysis. In addition, the dimensions of the arch form were not measured properly as only images provided in the DIAS system, hence no accurate measurement were done. This study can be made more comprehensive by a proper measurement of study models and studying the effects of muscle activity on arch dimensions to assess if there is any influence.

CONCLUSION

Within limitation of our study, it can be concluded that the 'average' arch form was prevalent in both males and females with Class II malocclusion. Prevalence of broad and narrow arch forms reported with lower percentages.

Author Contribution

All authors have equal contribution in bringing out this research work

ACKNOWLEDGEMENT

Nil

Conflict of Interest

Nil

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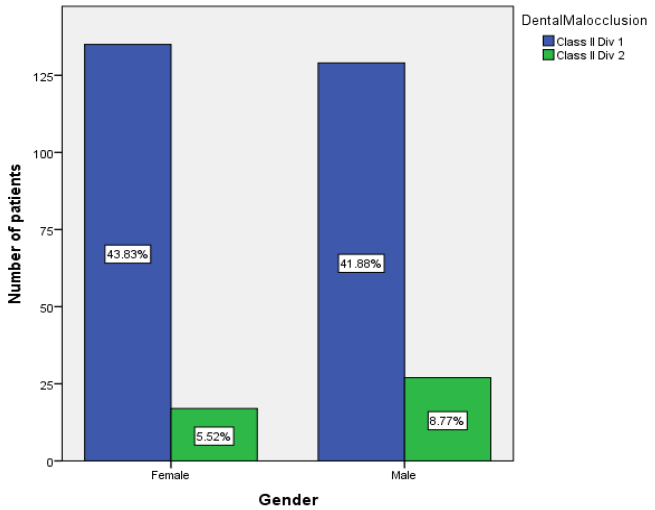

Fig.1: shows frequency distribution of different types of malocclusion in males and females. X axis represents the gender and Y axis shows number of patients. More females had class II div I malocclusion (43.8%%) compared to males (41.8%).

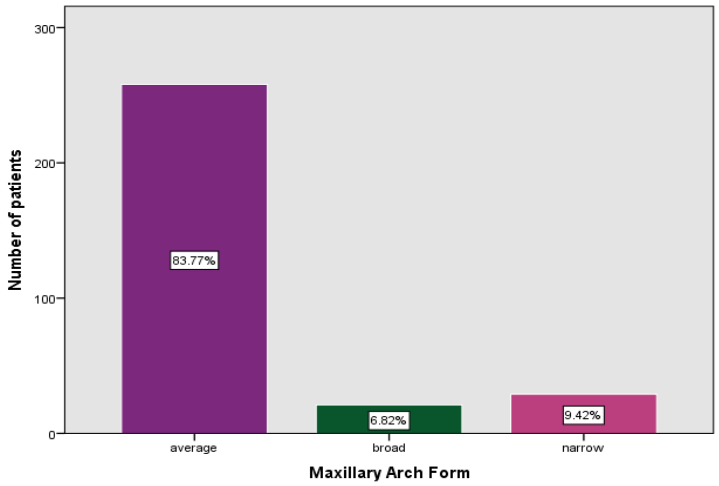

Fig.2: shows frequency distribution of different types of maxillary arch form. X axis represents the dental arch forms and Y axis shows the number of patients. Average arch form (violet) was the most common among arch forms(83.8%) in class II malocclusions.

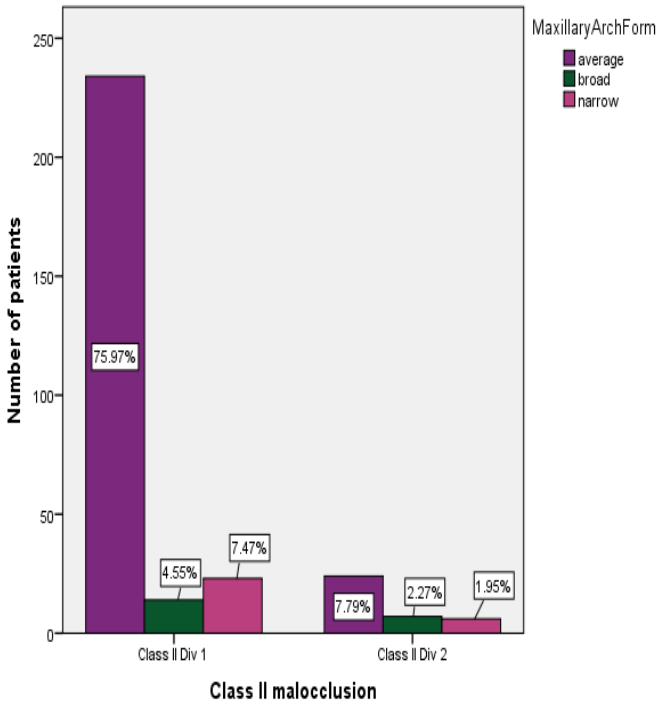

Fig.3: Bar graph depicts the association between type of class II malocclusion and maxillary arch form. X axis represents class II malocclusion and Y axis shows the number of patients with different arch forms. Chi-square test was done and the association between class II malocclusion and maxillary arch form was statistically significant [Chi-square value-; p=0.02 (p<0.05)]. Average(ovoid) arch form was the most common maxillary arch form in class II division I malocclusion (75.97%)

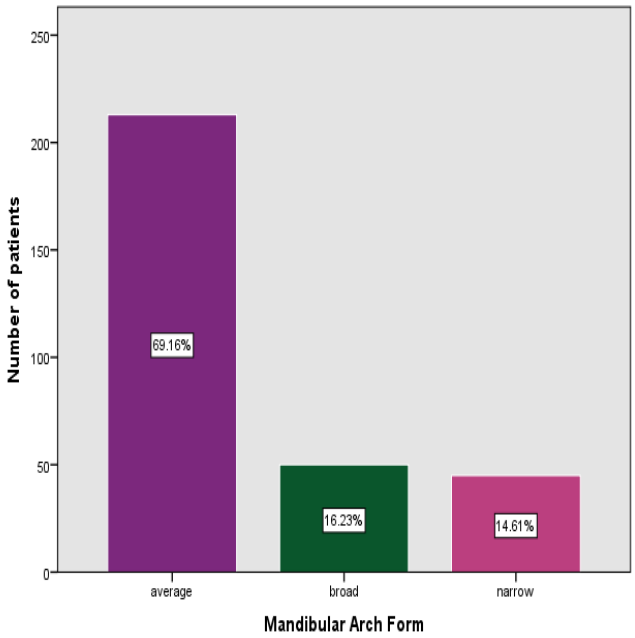

Fig.4: shows frequency distribution of different types of mandibular arch form. X axis represents the arch forms and Y axis shows the number of patients. Average arch form (violet) presented the highest percentage with 69.16%

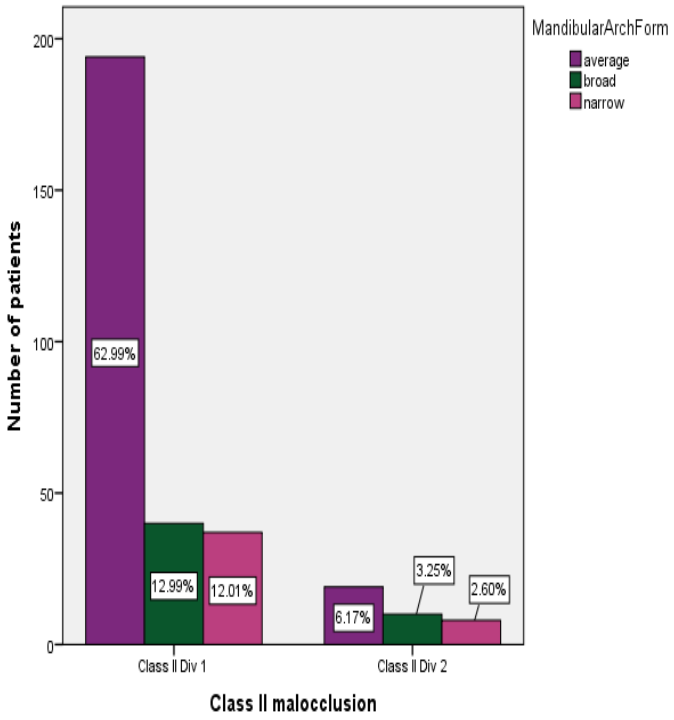

Fig.5: Bar graph depicts the association between dental malocclusion and mandibular arch form. X axis represents dental malocclusion and Y axis shows the number of patients with different arch forms. Chi-square test was done and the association between dental malocclusion and mandibular arch form was statistically significant [Chi-square value-; p=0.0042 (p<0.05)]. Average arch form (violet) was the most common mandibular arch form in class II malocclusions.

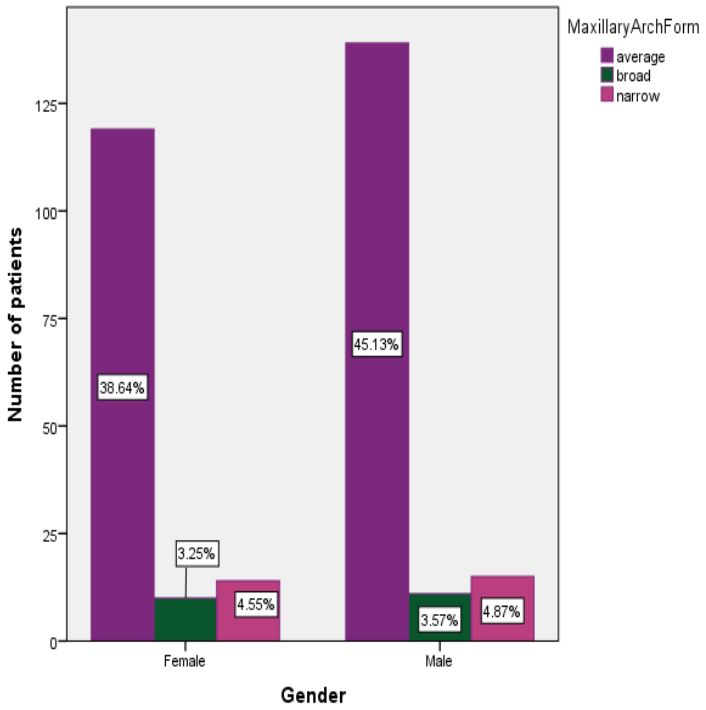

Fig.6: shows frequency distribution of maxillary arch forms among genders. X axis represents the genders and Y axis shows number of patients. Average arch form was most common among all the arch forms of maxilla both in males and females. Chi-square test was done and the association between gender and maxillary arch form was statistically not significant [Chi-square value-; p=0.97 (p>0.05)].

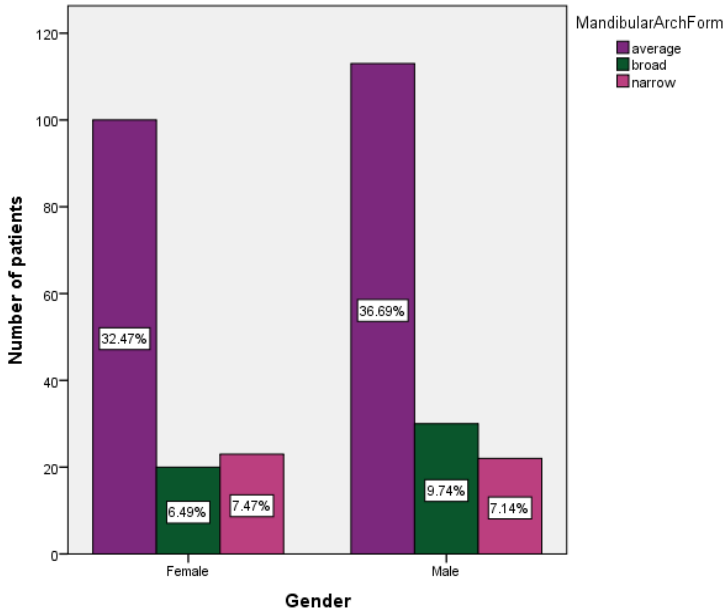

Fig.7: shows frequency distribution of mandibular arch forms among genders. X axis represents the genders and Y axis shows number of patients.Average arch form was most common among all the arch forms of mandible both in males and females Chi-square test was done and the association between gender and maxillary arch form statistically not significant [Chi-square value-; p=0.535 (p>0.05)].