HEIGHT AND WIDTH OF ORTHODONTICALLY TREATED PALATES IN CLASS II DIVISION 1 PATIENTS: A LONGITUDINAL STUDY

Aim: To assess the relationship between palatal height and width on plaster casts from 33 growing individuals with Class II Division 1 relationships who received orthodontic treatment without extraction.

Methods: The palatal contours in the permanent canine and first molar regions were registered with a digital pantograph before treatment (T1), at the end of treatment (T2), and at least 5 years posttreatment (T3). Results: The anterior palatal height did not change between T1 and T2, but a significant reduction was observed between T2 and T3. In the posterior palatal region, the height increased between T1 and T2 but not thereafter. No significant transverse changes were found in the canine region between T1 and T2. In the posterior region, however, the width increased significantly between T1 and T2. Conclusion: Palatal morphology in orthodontically treated Class II patients changed from an initially more triangular into a more square shape due to an increase in height and basal width, as well as a decrease in cervical width. World J Orthod 2010;11:49–54.

Key words: palatal morphology, palatal height, palatal width, palatal dimensions, Class II Division 1 relationship

The shape and dimensions of the palate can determine or characterize the severity of a malocclusion. However, one cannot assume a pure cause-effect relationship, although the premise that craniofacial morphology determines the occlusion seems reasonable.1

To some degree, facial development obscures the growth of its individual anatomical units. Therefore, it is prudent to examine the bony components of the face separately so as to better understand total facial growth.2

Class II malocclusions have been frequently studied.3–7 Several of these studies suggest that the mandible in Class II patients is neither poorly developed nor retruded in relation to the skull base.8,9 Therefore, it is crucial to investigate other facial parts, such as the skull base and maxilla, to better comprehend the factors influencing the development of a Class II occlusion.

Shaw was a pioneer in measuring palatal dimensions.10 Lebret11 measured the palatal height in individuals aged 5 to 18 years, and, 4 years later, Redman et al12 published data on the palatal dimensions, including height, which were all measured directly in the mouth. None of these investigations specified their subjects’ type of malocclusion, nor did they refer to orthodontics. More recently, Heiser et al studied the palatal height in Class II Division 1 individuals treated orthodontically with or without extractions.5,6
However, the changes of palatal morphology in growing Class II patients are still insufficiently clarified. Therefore, this study aimed to evaluate the palatal height and width in Class II Division 1 individuals.

MATERIALS AND METHODS

The sample comprised 33 Caucasian subjects (10 males and 23 females) with a Class II Division 1 relationship who underwent nonextraction orthodontic treatment. The individuals were selected from the records of the Orthodontic Department of the University of Brazil (UFRJ) (n = 25) and from a private clinic (n = 8) in which the patients were treated by a practitioner trained in the UFRJ orthodontic program. All individuals had a bilateral Class II molar and canine relationship and an overjet of at least 5 mm before treatment (T1). At the end of treatment (T2), the occlusion was Class I and the overjet corrected. This correction was achieved primarily by cervical headgear and occasionally by Class II elastics; no patient was treated with a functional appliance.

The mean age of the patients at T1 was 10 years 9 months (range 8 years 8 months to 14 years 8 months). At T2, the mean age was 15 years 1 month (range 11 years 9 months to 18 years 0 months). Only four patients were older than 17 years of age at the end of the treatment. At follow-up (T3), the mean age of the patients was 26 years 3 months (range 20 years 5 months to 39 years 0 months).

On average, active treatment lasted 2 years and 8 months, maxillary retention 2 years and 3 months, and the non-retention period 7 years and 7 months.

Study model measurement

The palatal contours in the canine and molar regions were recorded with a digital pantograph (Fig 1).14

In the canine region, the reference points were at the cervicogingival junction of the permanent or primary maxillary right or left canine. In the first molar region, the reference points were at the cervicogingival junction of the mesiopalatal cusp of maxillary right and left first molar. Figure 2 shows the evaluated parameters. Each reading produced a file that was processed by software that automatically calculated the value for each variable.
Statistical evaluation

Mean values and standard deviations for palatal height and cervical and basal width in the canine and molar region at T1, T2, and T3 were calculated with SPSS for Windows 15 (SPSS). Because the data were normally distributed, the non-parametric Shapiro-Wilk test was used. With the Student paired t test, significant differences (P ≤ .01) between T1 and T2 and T2 and T3 based on the null hypothesis (H0) of the equality among the mean values were identified. The Student t test was applied for independent samples to compare the mean values between males and females.

The ratios (%) between height and cervical width (height × 100/cervical width), height and basal width (height × 100/basal width), and basal width and cervical width (basal width × 100/cervical width) was established to assess developmental discrepancies among these variables.

Method error

All readings were performed sequentially to minimize the systematic error. To enhance the precision, each dental region was measured 10 times. The arithmetic mean of these measurements was the final value. To determine the reproducibility of the measurements, 12 casts were randomly selected in which the pantograph was repeated at 4-week intervals. Comparisons between readings were evaluated with the Student t test for paired samples (95% significance level).15,16 No significant difference was found.

RESULTS

Table 1 shows the mean values and standard deviations for palatal height as for cervical and basal widths in the canine and molar regions. No significant difference (P ≤ .01) was found between the sexes.

The palatal height in the canine region was constant between T1 and T2; however, it decreased significantly between T2 and T3. In contrast, the palatal height in the posterior region increased significantly between T1 and T2, whereas it remained stable thereafter.

Transversely, the anterior cervical region did not significantly change between T1 and T2. However, between T2 and T3, the cervical width decreased (0.86 mm), whereas the basal width increased (1.51 mm); both changes were significant (P ≤ .01). In the posterior region, both transverse measurements increased significantly (P ≤ .01) between T1 and T2 (cervical width = 2.75 mm; basal width = 1.07 mm). Between T2 and T3, a significant reduction (P ≤ .01) of 0.44 mm in the cervical width was found.

| Table 1 Descrptive statistical analysis of mean values and standard deviation (SD) of the changes (mm) in palatal height and cervical and basal widths in the canine and molar regions with respective mean differences between T2–T1 and T3–T2 |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                                | Canine T2–T1    | T3–T2           | Molar T2–T1     | T3–T2           |                 |
| Palatal height                 |                 |                 |                 |                 |                 |
| T1                             | 3.66 ± 0.57     |                 | 12.52 ± 1.89    |                 |                 |
| T2                             | 3.83 ± 0.71     | 0.17 (NS)       | 15.46 ± 1.94    | 2.94*           |                 |
| T3                             | 3.35 ± 0.81     | –0.48*          | 15.83 ± 2.10    | 0.37 (NS)       |                 |
| Cervical width                 |                 |                 |                 |                 |                 |
| T1                             | 24.11 ± 1.79    |                 | 31.50 ± 2.60    |                 |                 |
| T2                             | 24.60 ± 1.60    | 0.49 (NS)       | 34.25 ± 2.26    | 2.75*           |                 |
| T3                             | 23.74 ± 1.53    | –0.86*          | 33.81 ± 2.18    | –0.44*          |                 |
| Basal width                    |                 |                 |                 |                 |                 |
| T1                             | 8.13 ± 1.62     |                 | 13.77 ± 2.44    |                 |                 |
| T2                             | 8.89 ± 2.34     | 0.76 (NS)       | 14.84 ± 3.04    | 1.07*           |                 |
| T3                             | 10.40 ± 3.24    | 1.51*           | 15.15 ± 3.12    | 0.31 (NS)       |                 |

NS = not significant, * = statistically significant (P ≤ .01).
Table 2 shows the ratios (%) between palatal height and width, as well as between basal width and cervical width. In the canine region, palatal height decreased between T2 and T3 by approximately 11% in relation to basal width. In the molar region, however, the same index increased by 13% between T1 and T2. The ratio between palatal height and cervical width in the molar region increased by 5% between T1 and T2.

Also, in the canine region, the basal compared to the cervical width increased between T2 and T3 by 8%. The remaining ratio changes were too low to be of clinical importance.

**DISCUSSION**

Between T1 and T2, the canine region showed stability in basal and cervical widths, a finding supported by other authors, who deduced from this fact that the intercanine width should be maintained during orthodontic treatment.

However, between T2 and T3, significant changes were found, which were, in absolute values, greater in the transverse than in the vertical dimension. This result is supported by a study on nasomaxillary growth that revealed a downward development of the palate.

It is important to emphasize that the tendency toward a decrease in the relationship between height and width favors the stability of a Class II correction because posttreatment vertical growth of the alveolar processes would contribute to a clockwise rotation of the mandible.

Knott and Johnson conducted a follow-up study on the palatal height of girls receiving no orthodontic treatment and found mean values of 12.7 and 13.5 mm at ages 9 and 12, respectively. The authors did not specify the type of occlusion, but the dimensions they found are compatible with those found in the present study at T1 (12.5 mm). By age 17, these authors reported a palatal height of 14.1 mm, which is comparable to that found in the present study at phase T2 (15.4 mm). Despite being numerically greater, such a difference is not clinically relevant because of the large standard deviation and eventual methodologic differences.

The increased height in relation to the cervical and basal widths in the posterior portion of the palate between T1 and T2 was similarly demonstrated by Knott and Johnson because height represented 40% of the cervical width at 9 years, 42% at 15 years, and 43% at 17 years.

It is not possible to determine exactly how much change in the anterior and
posterior region is due to normal growth, remodeling, or corrective mechanical forces. Ferrario et al. evaluated the palate in adults without orthodontic treatment for 10 years and found stability between the third and fourth decades of life. However, Hesby et al. found increments when they assessed maxillary transverse measurements (first molar region) from untreated subjects at approximately 7, 10, 13, 17, and 26 years of age.

Cervical traction causes molar extrusion, resulting in an increase in vertical face dimension. Therefore, such an extraoral appliance should be carefully controlled during follow-up visits or a high-pull headgear should be considered.

The height increase in combination with a cervical width decrease leads to a change from a more triangular shape of the palate into a more square one with parallel alveolar processes. The insufficient growth pattern could ultimately reduce the possibility of achieving a harmonious maxillary complex.

Ladner and Muhi compared the palatal changes when using a Haas-type expander or a quadhelix for maxillary expansion. They found a significant increase in palatal height, which suggests that tooth extrusion is a consequence of rapid maxillary expansion. Therefore, especially in Class II patients, the vertical facial development following rapid maxillary expansion should be well controlled.

CONCLUSION

Palatal morphology in orthodontically treated patients with an Angle Class II relationship changes from an initially more triangular form into a squarer configuration because of a relatively larger increase in basal width and palatal height than cervical width.

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