Chapter 9

Identification of Lower Central Incisors

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Abstract

Unlike the other teeth, the permanent lower central incisors have great symmetry between the proximal surfaces, being difficult to distinguish them. It was intended to facilitate the study of the anatomy of the lower central incisor for dentistry students, that this study searched for a better way to differentiate the third quadrant element (31) from the fourth quadrant element (41). The purpose of this chapter was to evaluate 100 permanent lower central incisors of the didactic collection of the Discipline of Anatomy of the Department of Morphology of the School of Dentistry of Araraquara - UNESP and to verify the presence of correlation between the some anatomical features. Besides, it was evaluated if there was difference between 31 and 41. It was verified that the systematic methodology used for the evaluation of the incisors in this study facilitated the identification of the teeth. There was no statistically significant difference between the measurements of 31 and 41. Distinguishing the right from the left central incisor is difficult, even for experienced practitioners. We could observe that the measurements do not facilitate the identification of teeth of different quadrants. Therefore, the anatomical features are relevant for the study of the dental anatomy in the identification of the lower central incisors.

Keywords: dental anatomy, lower central incisor, dental crown, dental root, tooth morphology

1. Introduction

In dentistry, it is essential to have a wide knowledge of the dental anatomy. The study of basic anatomical characteristics combined with the extensive knowledge about the richness

of details present in a single tooth is the factor that can differentiate a high-level dentist from other professionals.

In esthetic procedures, where there is a great need to know the morphology of each tooth, we have the anterior dental teeth acting as protagonists. Incisors and canines are the group of teeth that require most attention of dentists, since alterations in their anatomical structures are easy to perceive.

In this chapter, there is a search for a better understanding of the external shape and appearance of one of these components: the permanent lower central incisors.

It is already known that, unlike the other teeth, the permanent lower central incisors have their mesial surface shorter or equal compared to the distal surface (if observed by their free surfaces), converging to the cervix of the teeth [1]. Although being almost equal to the proximal surfaces, the distal one is more convex and with a clearer configuration. The mesial surface, on the other hand, is smaller (at least in weary teeth) and less inclined than the distal surface [1]. However, there is great symmetry between both surfaces of the permanent lower central incisor, with a tendency to parallelism, being difficult to distinguish the proximal surfaces [2]. Another feature that hinders the identification of the proximal surfaces is the intersection of the incisal margin with the mesial and distal margins of the proximal surfaces. This intersection occurs at almost right, very little rounded, or not rounded angles [2, 3].

The deciduous lower central incisor differs from the deciduous lower lateral incisor mainly because of the size, since the lateral incisor is larger than the central incisor. This difference in size is, in many people, more pronounced in deciduous than in permanent teeth [4].

The teeth that may be confused with the permanent lower central incisors during the individual study in dental anatomy classes are the permanent lower lateral incisors. However, the lower lateral incisor is slightly larger in all dimensions [2]. Its crown is not symmetrical bilaterally as the one of the central incisor [5]. Its proximal surfaces present greater convergence to the cervix, and the mesial surface is slightly higher than the distal one [1, 2, 5]. The almost right angles observed on the permanent lower central incisors are not present on the lateral incisors, but they have a distoincisal angle more rounded and obtuse [1, 2, 5]. The most significant difference between the permanent lower incisors is the projection of the distoincisal angle to the lingual surface of the lateral incisors, because the incisal edge is rotated to the distal-lingual direction. The cingulum, located on the lingual surface, also accompanies the edge rotation, with its greater prominence slightly distal. With respect to the roots, the lower lateral incisors present them longer, more robust, and with deeper grooves, with the apex angled to distal [2, 5].

Due to the absence of sufficient wear to alter the dental structure, in newly erupted teeth, the mesial surface is still larger than the distal one, although this condition is transient and, over time, the situation is reversed, since wear is more pronounced in the mesial part of the incisal margin [1, 2].

According to Madeira and Rizzolo [2], the cervical line describes a very closed curve, which extends incisally up to one-third of the length of the crown and is even more closed on the mesial side.

It was intended to facilitate the study of the anatomy of the lower central incisor for dentistry students that this study searched for a better way to differentiate the third quadrant element (31—permanent left lower central incisor) from the fourth quadrant element (41—permanent right lower central incisor).

This chapter had as a purpose to evaluate permanent lower central incisors of the didactic collection of the Discipline of Anatomy, Department of Morphology, School of Dentistry of Araraquara, São Paulo State University (UNESP) and to verify the presence of correlation between the structures mentioned below: proximal surface with the smallest cervical-incisal dimension, mesio-incisal and disto-incisal angles, cervical line on the proximal surfaces, the flattest proximal surface in the cervix region, root grooves, and root apex, intending to identify the proximal surfaces by those structures. Measurements of the cervical-incisal dimension of the crown, the root length, mesio-distal dimension of the crown and root, buccolingual dimension of the crown and root, and total tooth length were made. Besides, it was evaluated whether there was difference between 31 and 41.

2. Methodology

This project was approved by the Ethics Committee of the School of Dentistry of Araraquara, São Paulo State University (UNESP) (CAAE 61522516.2.0000.5416).

One hundred permanent lower central incisors, with no information about sex and age, were evaluated, and those belong to the collection of the Laboratory of Anatomy of the Department of Morphology of the São Paulo State University (UNESP), School of Dentistry, Araraquara were evaluated. The teeth were cleaned with dental instruments and solution of hydrogen peroxide and ammonium hydroxide. The teeth were stored dry, without any solutions, in glass containers. Those teeth are routinely used in the dental anatomy classes.

The proximal faces were randomly determined with the letters A and B, and the following structures were evaluated by visual method:

1. Proximal surface with the smallest cervical-incisal dimension: A, B, or W (without identification, when no difference was observed between A and B).
2. The most pointed incisal angle: A, B, or W.
3. The greatest curvature of the cervical line: A, B, or W.
4. The flattest proximal surface in the cervix region: A, B, or W.
5. Surface with less deep root groove or a more convex surface: A, B or S.
6. Angulation of the root apex: A, B, or R (rectilinear).

Each tooth was identified by a number. The teeth were evaluated by two experienced anatomy professors who checked, at the same time, the classifications and reached a consensus.

From the evaluated features, the teeth were identified as 31 or 41 by the sum of the features observed in each surface, their association, and the most striking structures. The professors also classified the identification of the incisors as easy, moderate difficulty, and difficult, and they noted which features were considered to make the identification.

Subsequently, measurements were made on the same teeth by a single examiner using a digital caliper (Mitutoyo® Sul Americana LTDA).

The following measurements were performed:

- Measurement of the cervical-incisal dimension of the crown (CIC): measurement from the cervical line to the incisal edge made on the buccal surface.
- Measurement of the root length (RL): measurement of the most cervical region of the cervical line up to the root apex made on the buccal surface.
- Measurement of the mesio-distal dimension of the crown (MDC): measurement on the incisal edge of the crown made on the buccal surface.
- Measurement of the mesio-distal dimension of the root (MDR): measurement between the mesial and distal root surfaces in the dental cervix made on the buccal surface.
- Measurement of the buccolingual dimension of the crown (BLC): measurement between the buccal and lingual surfaces of the crown in the dental cervix made on the mesial surface.
- Measurement of the buccolingual dimension of the root (BLR): measurement between the buccal and lingual surfaces of the root in the dental cervix made on the mesial surface.

The measurement of total tooth length (TL) was obtained by the sum of the cervical-incisal dimension of the crown (CIC) and the measurement of the root length (RL).

Descriptive statistics was performed. The t-test was applied to evaluate the relation between the right lower first premolars and the left lower first premolars. A correlation study was performed using the Pearson correlation coefficient (r) among the six evaluated features.

3. Results

Table 1 presents the mean, the minimum, and maximum values of the measurements made on 31 and 41. There was no statistically significant difference between the measurements made on 31 and 41 ($p > 0.05$; t-test; **Table 1**).

As there was no significant difference between 31 and 41, the measurements were presented together, without considering the sides.

The mean, the minimum, and maximum values of the measurements of all evaluated lower central incisors are shown in **Table 2**.

Measurements	31	41	p
CIC			
Minimum	10.6	7.9	
Maximum	15.7	11.3	
Mean	9.4	9.3	0.4315
RL			
Minimum	10.6	8.5	
Maximum	15.7	15.1	
Mean	12.9	12.5	0.2167
MDC			
Minimum	4.4	4.7	
Maximum	6.3	5.9	
Mean	5.4	5.3	0.5
MDR			
Minimum	3.1	3.1	
Maximum	4.5	5.6	
Mean	3.5	3.6	0.8224
BLC			
Minimum	4.7	5.0	
Maximum	7.0	6.7	
Mean	5.8	5.8	0.8035
BLR			
Minimum	4.6	4.8	
Maximum	6.7	6.5	
Mean	5.7	5.7	0.5133
TL			
Minimum	19.4	16.7	
Maximum	26.2	24.8	
Mean	22.2	21.8	0.1366

Table 1. Mean, minimum, and maximum values of the measurements (mm) made on 31 and 41.

From the 100 permanent lower central incisors, one was not classified as 31 or 41, because the two professors considered more appropriate not to classify it due to the features presented of the tooth and the difficulty in identifying it.

Table 3 shows the frequency of the anatomical features observed on the lower inferior central incisors.

	N	Minimum	Maximum	Mean
CIC	100	7.6	11.7	9.3
RL	100	8.5	15.7	12.7
MDC	100	4.4	6.3	5.3
MDR	100	3.1	5.6	3.6
BLC	100	4.7	7.4	5.8
BLR	100	4.6	6.7	5.7
CTD	100	16.7	26.2	22.0

Table 2. Mean, minimum, and maximum values of the measurements (mm) made on the lower central incisors.

Anatomical features	Frequency	%
Proximal surface with the smallest cervical-incisal dimension		
Mesial	57	57.6
Distal	28	28.3
Without identification	14	14.1
Total	99	100
The most pointed incisal angle		
Mesial	55	55.6
Distal	22	22.2
Without identification	22	22.2
Total	99	100
Proximal surface with the greatest curvature of the cervical line		
Mesial	51	51.5
Distal	23	23.2
Without identification	25	25.3
Total	99	100
The flattest proximal surface		
Mesial	65	65.7
Distal	17	17.2
Without identification	17	17.2
Total	99	100
Surface with less deep root groove or a more convex surface		
Mesial	74	74.7
Distal	15	15.2

Anatomical features	Frequency	%
Without identification	10	10.1
Total	99	100
Angulation of the root apex		
Mesial	6	6.1
Distal	35	35.4
Rectilinear	58	58.6
Total	99	100

Table 3. Frequency of the anatomical features observed on the lower inferior central incisors.

4. Discussion

The professors verified that the most pointed incisal angle did not show reliability in the selection of the features for the identification of the proximal surfaces. Therefore, it was not included in the sum of the features for decision making. According to Madeira and Rizzolo [2], the incisal angles are almost right, very little rounded, or not rounded.

Thirty-one teeth were considered easy to identify by the anatomy professors, 22 were considered moderate difficulty, and 46 teeth were considered difficult to classify.

From the 31 teeth considered easy to classify, 19 incisors were identified by adding and associating 4 features, 8 by 3 features, and 4 by 5 features. From the 22 teeth considered with moderate difficulty, 13 were identified by 3 features, 7 by 2 features, and 2 by 4 features. From the difficult teeth, 29 incisors were identified by 2 features, 8 by 3 features, 2 by 4 features, and 7 teeth only by 1 feature.

From the teeth considered easy, most of them were chosen by adding the shortest proximal surface feature to the root features (surface with less deep root groove or a more convex surface and the angulation of the root apex), associated or not to the proximal surface with a cervical line with the greatest curvature, or a flatter proximal surface. Therefore, it was verified that the more items found which characterize a certain proximal surface according to the literature, the easier it becomes to identify them. Only five teeth from the 31 considered easy to identify, the shortest proximal surface did not help the identification of the proximal surfaces, and no root features were observed for the identification of four incisors.

The identification of the teeth became more difficult, when one or more features were contrary to the others or when it was not possible to verify differences between the surfaces. Therefore, the professors took into account the most striking elements.

The mesial surface presented the smallest cervical-incisal dimension in 57 teeth (**Figures 1** and **2**), followed by the distal surface (28), and 14 incisors the incisal edge was rectilinear, with mesial and distal surfaces with similar cervical-incisal dimension (**Figure 2** and **Table 3**). The

Figure 1. Tooth 31 presenting the mesial surface with smaller cervical-incisal dimension compared to the distal surface.

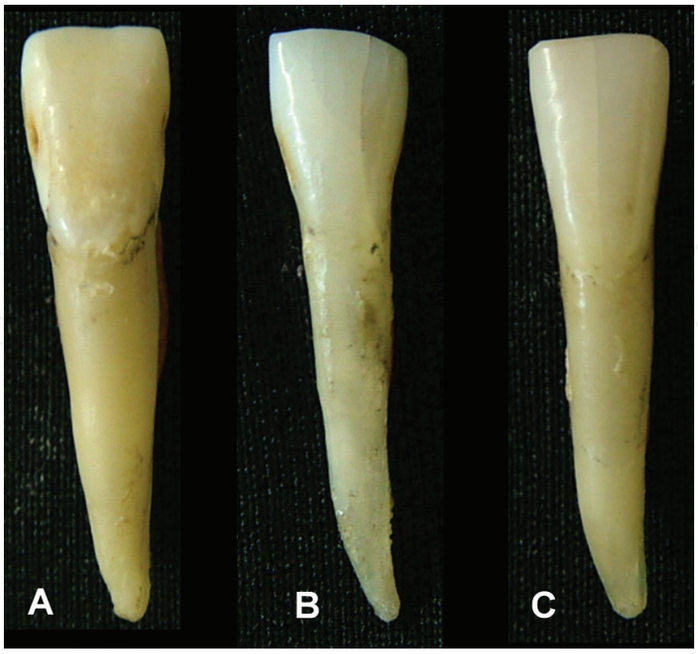

Figure 2. Permanent lower central incisors. (A) Rectilinear incisal edge, (B) incisor with the distal surface with smaller cervical-incisal dimension, and (C) incisor with the mesial surface with smaller cervical-incisal dimension.

mesial edge of the buccal surface is usually smaller than the distal one (the inverse of what is observed on the other teeth) because the wear is more pronounced on the mesial half of the incisal edge [1, 6]. Due to the wear, a beveled shape is identified in the incisal edge of the mesial surface, which extends through the buccal surface [1, 2, 7]. The incisal edge is rectilinear and obliquely directed, from top to bottom, in the disto-mesial direction (at least in the teeth with certain wear); the mesial angle becomes more obtuse and the distal one becomes more acute [1]. Possibly, due to the presence of wear, it was observed in the present study that the most pointed incisal angle was the mesial one (55 incisors; **Table 3**). Pagano et al. [7] reported that the mesial and distal angles are slightly rounded or acute, with no significant differences between them.

The cervical line presents a greatest curvature on the mesial surface according to Madeira and Rizzolo [2]. This feature was verified in 51.5% of the teeth in this study (**Figure 3**; **Table 3**).

According to Picosse [6], the distal edge of the buccal surface is more angled, but it is difficult to notice. Della Serra and Ferreira [1] reported that the mesial surface is smaller and less inclined than the distal one. In the present study, it was observed that the distal surface was more inclined compared to the mesial surface, this being the flattest one (65.7%) (**Figure 4** and **Table 3**).

Regarding the root grooves, the authors have reported that the lower central incisors have evident longitudinal grooves, the distal groove being the deepest one [2–4, 8]. In the present

Figure 3. Permanent lower central incisors. (A) The cervical line presents a greatest curvature on the mesial surface. (B) The cervical line presents a smaller curvature on the distal surface.

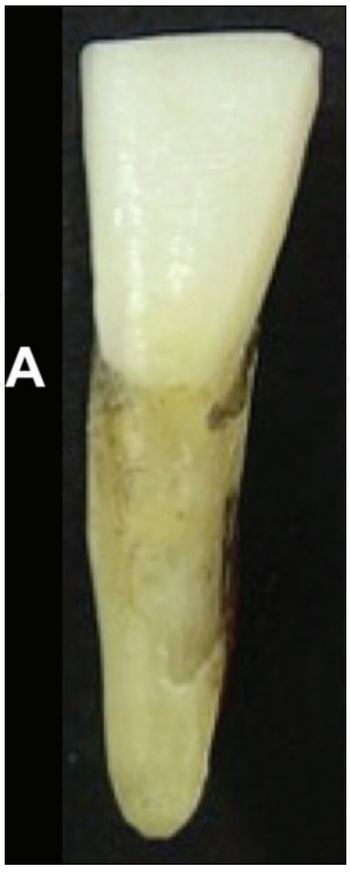

Figure 4. Permanent lower central incisor. (A) Mesial surface is flatter than the distal surface in the cervix region.

study, it was observed that the distal groove was the deepest one in many teeth. The mesial surface of the roots presented less deep grooves or a more convex surface (74.7%). However, the deepest groove was the mesial one on 15 teeth, and no difference was observed between the surfaces on 10 incisors (**Table 3**). According to Picosse [6], some teeth present the grooves so evident that they can separate the root, partially or totally, into two buccal and lingual segments. This feature described by Picosse [6] was not observed in any lower incisors of this study. Sanchez et al. [9] evaluated the presence of root concavities in the lower central incisors, improving the knowledge of tooth root morphology to result in a correct instrumentation and subsequent success in periodontal treatment. The authors observed that these concavities were present in 100% of the sample and were deeper and wider in the distal surface than in the mesial surface of the root. This feature coincides with the presence of deeper root grooves in the distal surface, already reported in the literature and also found in this study (**Figure 5**).

With the objective of understanding the morphology of the grooves present in the proximal surfaces of the roots of the upper and lower anterior teeth and its effect on the loss of periodontal insertion, Kaur et al. [10] evaluated 300 proximal surfaces of 150 teeth. The prevalence of proximal root grooves was 86.67%. The prevalence of grooves on maxillary teeth was 43.42% and on mandibular teeth was 56.67%. In mandibular teeth, it was 88% for mandibular central incisor, 90% for mandibular lateral incisor, and 80% for mandibular canines. Of the

Figure 5. Permanent lower central incisor. (A) Mesial surface with a shallow root groove and (B) distal surface with a deeper root groove.

total 300 surfaces that were examined, 228 had grooves, of which 110 (48.24%) were mesial and 118 (51.75%) were distal. The mean width for maxillary central incisor and mandibular incisors was seen to be 1.97 mm and 2.20 mm, respectively. It was observed that the loss of periodontal insertion was higher in teeth that had root grooves than those that did not had grooves, and teeth with deeper grooves presented greater loss. The observations made in the study also support the hypothesis that proximal root grooves when present play a significant role in the loss of attachment.

Madeira and Rizzolo [2] describe the root of the lower central incisor as rectilinear, with no angulation. However, anatomical variation is observed in teeth and also in other anatomical structures. In this study, the root was rectilinear in 58.6% of the lower central incisors; in 35.4%, the root apex was angled to distal, which would not be an uncommon situation; and in 6.1%, there was a mesial inclination of the root apex (**Figure 6** and **Table 3**). According to Della Serra and Ferreira [1], the root inclines to the distal approximately one degree, as well as for Figun and Garino [8], who reported that there is a slight radicular deviation to the distal side. Della Serra and Ferreira [1] cited a study in which rectilinear roots were observed in 66.7% of the lower central incisors, 12.5% presented an angled distal root apex, 2% presented an angled mesial root apex, and in 18.8%, the root apices were inclined to the buccal side. In the present study, no inclination to the buccal side of the root apex was observed.

In this study, we evaluated the measurement of the cervical-incisal dimension of the crown (CIC). The mean value was 9.3 mm (ranging from 7.6 to 11.7 mm; **Table 2**). Della Serra and Ferreira [1] cited a variation from 6.7 to 11.5 mm, and Woelfel and Scheid [5] found a minimum

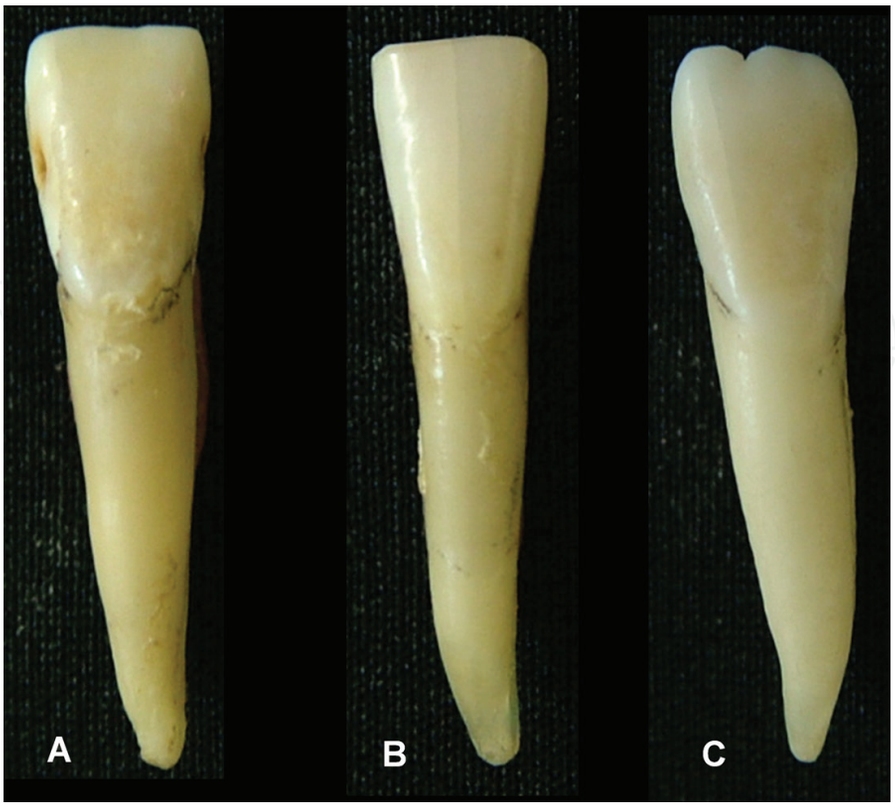

Figure 6. Permanent lower central incisor. (A) Rectilinear root, (B) root apex angled to distal, and (C) root apex angled to mesial.

value of 6.3 mm and a maximum value of 11.6 mm (mean 8.8 mm). The same result (8.8 mm) was found by Figun and Garino [8]. Sicher [11] reported a mean of 9.4 mm for the length of the dental crown. According to Picosse [6], the mean of the dental crown length of the lower central incisors in men was 8.51 mm, and in women, it was 7.95 mm. These results are lower than those found in our study and in the other reported studies.

Regarding the measurement of the root length (RL), the mean value was 12.7 mm (ranging from 8.5 to 15.4 mm; **Table 2**). Others authors reported a range from 8.8 to 16 mm [1], from 7.7 to 17.9 mm (mean value of 12.6 mm) [5], and 11.9 mm [8]. Picosse [6] verified that the mean of the root length was 12.27 mm in men and 12.65 in women. Sanchez et al. [9] measured the root length both on the distal and mesial surfaces. The authors found a mean value of 13.88 ± 1.4 mm on the distal surface and 13.76 ± 1.5 mm on the mesial surface, with no statistically significant difference between them. Besides we have made the same measurement on the buccal surface of the root, our results as well as those cited by Sanchez et al. [9] are within the standards.

Observing the mesio-distal dimension of the dental crown (MDC), we found in the literature a variation from 5.0 to 6.5 mm [1]; 4.4 to 6.7 mm [5]; and a maximum value of 6.87 mm [2]. In the present study, the same measurement ranged from 4.4 to 6.3 mm, with a mean value of 5.3 mm (**Table 2**). A mean value of 5.4 mm for the mesio-distal distance of the lower central incisors was cited by some authors [6, 8, 11].

It was observed that the mean value of the measurement of the mesio-distal dimension of the root (MDR) was 3.6 mm (ranging from 3.1 to 5.6 mm) (**Table 2**). Similar values were observed by Woelfel and Scheid [5] (mean value of 3.5 mm, ranging from 2.7 to 4.6 mm) and 3.9 mm by Sicher [11].

The buccolingual dimension of the crown (BLC) ranged from 4.7 to 7.4 mm (mean value of 5.8 mm; **Table 2**). In the literature, it was found a range from 6 to 8 mm [1] and from 4.8 to 6.8 mm, with a mean value of 5.7 mm [5].

A mean value of 5.7mm (ranging from 4.6 to 6.7mm, **Table 2**) was observed regarding the buccolingual dimension of the root (BLR). A dimension of 5.9 mm was cited by Sicher [11] and 5.4 mm (ranging from 4.3 to 6.5 mm) by Woelfel and Scheid [5]. According to Picosse [6], the mean of the maximum buccolingual dimension of the lower central incisors was 5.7 mm in men and 5.46 in women. Figún and Garino [8] found a buccolingual distance of 6 mm.

The measurement of total tooth length (TL) ranged from 16.7 to 26.2 mm (mean value of 22 mm) (**Table 2**). Others authors reported a range from 15.5 to 27.5 mm [1], from 16.6 to 26.7 mm (mean value of 20.8 mm) [5], 21.4 mm [11], 20.7 mm [8], and 20.78 mm in men and 20.6 mm in women [6].

According to Picosse [6], the mean of the measurements of the lower central incisors was higher in men than in women, except for the measurement of the root length. In our study, there was no information about sex and age. This is a limitation of this study because it was not possible to make associations between the measurements and those criteria.

The Pearson correlation coefficient between six anatomical features (21 possible associations) observed in the lower central incisors showed a weak positive correlation between the features: 1 and 2 ($r = 0.366$, $p = 0.0001$), 1 and 3 ($r = 0.327$, $p = 0.0016$), 1 and 4 ($r = 0.347$, $p = 0.0004$), 1 and 5 ($r = 0.412$, $p < 0.0001$), and 2 and 5 ($r = 0.309$, $p = 0.0018$) and weak negative for 2 and 6 ($r = -0.419$, $p < 0.0001$). The other associations were not significant. Therefore, it was verified that the evaluated features do not repeat in the same way in all incisors, demonstrating anatomical variation. Some patterns described in the literature were confirmed, but the percentage of anatomical variations was high for all studied features.

This makes the study of the lower central incisor quite difficult, especially for the first-year Dentistry graduation student. The lower central incisor is the smallest and most symmetrical tooth of the permanent dentition. Its anatomical elements, such as grooves and ridges, are the least evident [2].

The purpose of this study was to verify features that could facilitate the identification of the proximal surfaces of the lower central incisor. It was verified that the standard anatomical features described in the literature could not be observed in all teeth. However, the observation of the mentioned anatomical features, the sum of the features, the association of them, and the observation of the most striking structures consist of a method that assists in the identification of the permanent lower central incisors.

5. Conclusion

It was verified that the evaluated anatomical features do not repeat in the same way in all lower central incisors, demonstrating the presence of anatomical variation. However, the systematic methodology used for the evaluation of the incisors in this study facilitated the identification of the teeth. Therefore, the observation of the anatomical features mentioned in the literature, the sum and the association of the features, and the observation of the most striking structures are methods that facilitated to differentiate the third quadrant element (31—permanent left lower central incisor) from the fourth quadrant element (41—permanent right lower central incisor).

It was verified that there was no statistically significant difference between the measurements of 31 and 41. Distinguishing the right from the left central incisor is difficult, even for experienced practitioners. We could observe that the measurements do not facilitate the identification of teeth of different quadrants. Therefore, the anatomical features are relevant for the study of the dental anatomy in the identification of the lower central incisors.

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