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Direct Measurements of Root Canal Length in Primary Anterior Teeth for Educational and Clinical Purposes

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Abstract

Background: The root canal length (RCL) estimates is an essential step for total endodontic therapy procedures. The aim of this study was to measure the RCL in a sample of extracted primary anterior teeth and compare the data obtained with the literature for educational and clinical purposes. **Materials and methods:** Seventy extracted primary anterior upper and lower teeth were selected according to the following inclusion criteria: absence of root resorption and/or internal root canal anatomy complications, and no previous root canal manipulation. The teeth were assigned to six groups: upper central incisors (UCI; n = 15), upper lateral incisors (ULI; n = 13), upper canines (UC; n = 20), lower central incisors (LCI; n = 6), lower lateral incisors (LLI; n = 3), and lower canines (LC; n = 13). RCL was measured by the direct method after insertion of a #15 K-file with a silicone stopper in the root canal until the root apex and measuring with a millimetre rule. **Results:** Mean RCL values (mm) obtained were UCI = 14.33 ± 1.69; ULI = 14.00 ± 1.63; UC = 16.07 ± 2.43; LCI = 15.41 ± 3.20; LLI = 15.00 ± 1.73; and LC = 16.38 ± 1.51. **Conclusions:** The RCL direct measurement method and the results obtained were in accordance with the literature reports and can be useful for educational purposes aiming at knowledge of dental anatomy and the clinical determination of root canal treatment viability and treatment of primary teeth, as RCL is one of the parameters for the indication/contra-indication of this therapy.

Keywords

Root Canal Therapy, Root Canal Preparation, Root Canal, Tooth, Deciduous, Dentition, Primary, Education, Clinical Competence

1. Introduction

Paediatric dentistry encompasses all procedures aimed at the maintenance of healthy primary dentition until normal physiological exfoliation. Therefore, when non-resorbed primary teeth show irreversible pulp disease or signs of necrosis, they are indicated for total endodontic treatment (pulpectomy). The procedure includes root canal debridement, shaping, disinfection, filling with a proper root canal filling material (AAPD, 2015), and a final crown restoration. Although different protocols for pulpectomy in primary teeth have been described in the literature (Mortazavi & Mesbahi, 2004; Trairatvorakul & Chunlasikaiwan, 2008; Barcelos et al., 2012), they all agree that pulpectomy procedures are feasible only in teeth exhibiting minimal physiological or pathological root resorption, not exceeding 1/3 of the root length.

The root canal length (RCL) estimates is a fundamental step for establishing endodontic therapy procedures, as it guides the chemo-mechanical preparation and the final root canal sealing, avoiding damage to both the periapical tissues and the permanent successor tooth germ. Clinically, RCL estimates have been conventionally performed by pre-operative radiographic evaluation (Rodd et al., 2006; Neena et al., 2011; Nelson-Filho et al., 2011; Chougule, Padmanabhan, & Mandal, 2012; Saritha et al., 2012; Ahmad & Pani, 2015). However, anatomical variation in the apical foramen as well as superimposition of structures and periapical lesions may hinder appropriate RCL determination (Haffner, Folcwaczny, Galler, & Hicckel, 2005).

In vitro measurements of RCL in a large sample (n = 70) of extracted primary teeth obtained by the standard direct tactile method might contribute to the knowledge of the anatomy of such teeth and to clinical endodontic procedures (Kottor, Albuquerque, Velmurugan, & Kuruvilla, 2013), since few studies had been published (Mello-Moura et al., 2010; Subramaniam, Konde, & Mandanna, 2005; Oznurhan et al., 2014; Wankhade, Kumar, Singh, & Chandra, 2013), most with smaller samples (Mello-Moura et al., 2010; Subramaniam, Konde, & Mandanna, 2005; Oznurhan et al., 2014). In addition, teaching and exploring the dental anatomy in integration with clinical procedures emphasizes the clinical relevance of basic sciences (Hagen, Cooke, & Wright, 2017) while increases the clinical competence of dental students to perform endodontic procedures. Therefore, the aim of this study was to describe the RCL direct tactile method, to measure the RCL in a sample of extracted primary anterior teeth and compare the data obtained with the literature for educational and clinical purposes.

2. Materials and Methods

2.1. Specimen Selection

This study was approved by the institutional research ethics committee and was performed in accordance with ethical standards as laid out in the Declaration of Helsinki and its later amendments. From a pool of extracted primary teeth removed due to clinical reasons, anterior elements were selected according to the

following eligibility criteria: visual absence of root resorption; absence of internal root canal anatomy alterations, as observed by periapical radiographic examination; and no previous root canal manipulation (**Figure 1**). The sample was collected from 2007 to 2016 and kept in saline solution (pH 7.0) under refrigeration until measurements were performed. No gender or age classifications were made. Seventy upper and lower anterior primary teeth were selected and assigned to six subgroups: 1) upper central incisors (UCI; n = 15), 2) upper lateral incisors (ULI; n = 13), 3) upper canines (UC; n = 20), 4) lower central incisors (LCI; n = 6), 5) lower lateral incisors (LLI; n = 3), and 6) lower canines (LC; n = 13).

2.2. Root Length Measurements

Three experienced operators conducted the study. The teeth were examined at a 35x stereomicroscopy magnification (Olympus SZ-TR-BR-SIT, Micronal S. A., São Paulo, Brazil), and the root length was measured using a digital caliper (Beerendonk 042-750, Dentaurum, Germany) to confirm tooth integrity (**Figure 1**). Access cavities were prepared with a No. 2 round bur (Maillefer, São Paulo, Brazil) mounted on a high-speed handpiece and under water-cooling. RCL was measured by the direct method using a #15 K-file (Mani, Kyohara, Japan) passively inserted in the root canal until the tip could be noticed at the root apex. A silicone stop was then adjusted at the incisal/cuspid reference face, and the register was performed with the aid of a millimetre rule (Prisma produtos Odontológicos, São Paulo, Brazil) with 0.5 mm accuracy (Mello-Moura et al., 2010; Krishnan & Sreedharan, 2012) (**Figure 2**). Undergraduate dental students attended the activity and were trained to perform the RCL measurements by the direct method taught.

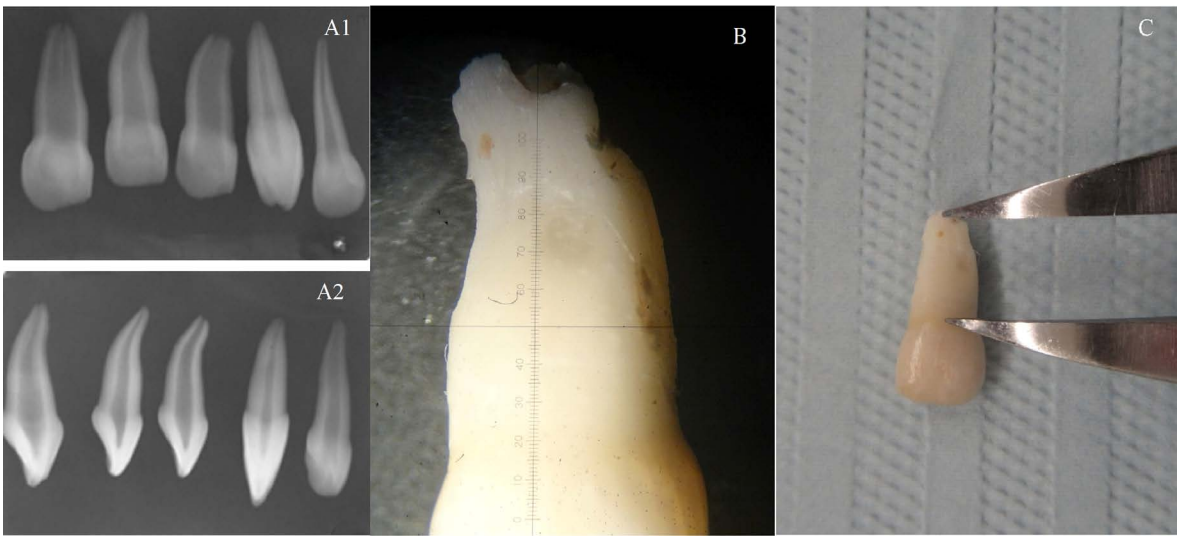

Figure 1. Evaluated tooth sample showing no signs of internal root canal anatomy alterations and no previous root canal manipulation: (A) periapical images showing the internal root canal morphology; (A1) buccal radiographic view; (A2) mesio-distal radiographic view; (B) root examination at 35× stereomicroscopy magnification; (C) root length measurement using a digital caliper.

2.3. Statistical Analysis

Data were tabulated in Excel worksheets, and statistical analysis was performed with SPSS (Chi., IL, USA) software. Descriptive statistics were presented as mean ± standard deviation for each group of primary anterior teeth.

3. Results

The RCL values obtained in this study are reported in Table 1. The overall mean RCL of upper incisors was 14.99 ± 2.19 mm, whereas the overall mean of the whole evaluated sample was 15.28 ± 2.18 mm.

4. Discussion

Descriptive and comparative studies of human primary dentition have been performed to understand the morphology of primary dentition and assist undergraduate teaching in dentistry (Barker, Parsons, Williams, & Mills, 1975). Knowledge of dental anatomy is essential for learning clinical operative dentistry procedures (Kottor, Albuquerque, Velmurugan, & Kuruvilla, 2013). Therefore, teaching clinical procedures substantiated by data on human dental anatomy reinforces its clinical relevance and the need for training (Hagen, Cooke, & Wright, 2017).

The terms *root canal length* (RCL) and *working length* (WL) have been used

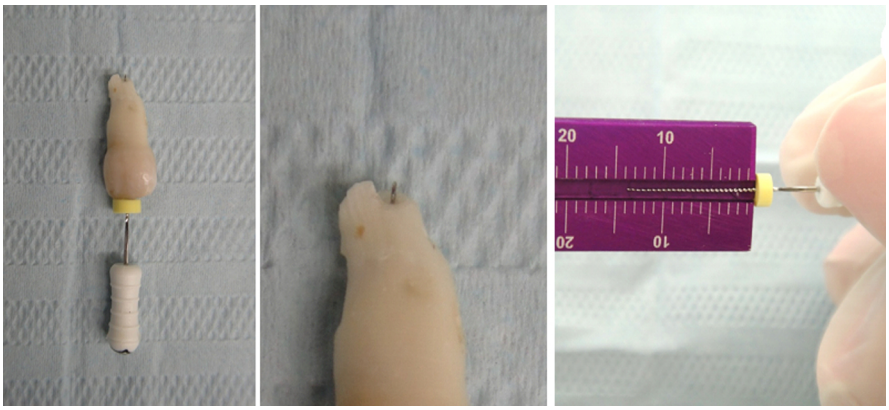

Figure 2. Root length measurement obtained by the direct method.

Table 1. Distribution of root canal length data (mm) for anterior primary teeth.

Arch	Dental groups	n	Minimum	Maximum	Mean	SD
Upper	Central incisors	15	11.0	16.5	14.33	1.69
	Lateral incisors	13	11.0	16.5	14.00	1.63
	Canines	20	11.0	19.0	16.07	2.43
Lower	Central incisors	6	11.0	19.0	15.41	3.20
	Lateral incisors	3	14.0	17.0	15.00	1.73
	Canines	13	14.0	19.0	16.38	1.51

indistinctively in primary teeth (Neena et al., 2011). However, the former refers to actual measurements made with the direct method or the estimated measure obtained from an initial radiograph (Mello-Moura et al., 2010), whereas the latter refers to the length at which chemo-mechanical preparation and sealing should be performed, usually reducing 1 mm from the RCL (Nelson-Filho et al., 2011). As an anatomical reference, RCL measurements obtained through the direct method are generally considered as the gold standard (Chougule, Padmanabhan, & Mandal, 2012; Mello-Moura et al., 2010; Subramaniam, Konde, & Mandanna, 2005; Oznurhan et al., 2014; Basso, Jeremias, Cordeiro, & Santos-Pinto, 2015). The present study described the RCL measurements obtained by the direct method and discussed the results obtained within the searched literature.

Considering the overall mean values for RCL of primary anterior teeth, the current results (15.28 ± 2.18 mm) were very similar to those reported by Subramaniam et al. (2005) for 20 single-rooted teeth evaluated through the direct method (15.91 ± 2.06 mm), and to those obtained by Wankhade et al. (2013) for 70 elements (16.44 ± 0.79 mm). In addition, the mean values for RCL of the central and lateral upper incisors obtained in the present study (14.99 ± 2.19 mm) were similar to WL data reported by Saritha et al. (2012) measured clinically using an electronic apex locator (15.55 ± 1.32 mm) and a digital radiograph method (15.93 ± 1.49 mm). The RCLs obtained in this Brazilian sample were similar to the values obtained in the pertinent literature for Indian populations.

5. Conclusion

The RCL direct measurement method and the results obtained in this Brazilian sample were in accordance with the literature reports and can be useful for educational purposes aiming at knowledge of dental anatomy and the clinical determination of root canal treatment viability and treatment of primary teeth, as RCL is one of the parameters for the indication/contra-indication of this therapy.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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