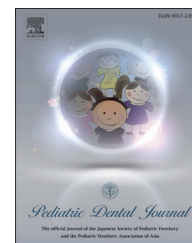


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Original Article

Determination of H-file sizes being more suitable for measuring of working length in immature teeth using an EAL



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ABSTRACT

Successful root canal treatments of immature permanent teeth require data on the exact working length (W.L.) for the preparation of root canal in the clinic. The author and colleagues have previously reported that root canal length of an immature tooth can be measured using an electronic apex locator (EAL; Apit 11[®], Osada Electric Co., Ltd., Tokyo, Japan) in *in vitro* experiments. This study aimed to find the sizes of H-files that are more suitable for root canal length measurements of immature teeth using Apit 11[®]. Extracted human immature permanent teeth were prepared to have accesses to their pulp cavities, and the root canal length of each tooth was measured physically and electronically using H-files, rular and Apit 11[®] in the *in vitro* experimental system. Six types of file diameters that are generally utilised in the clinic were used to take measurements in order to observe the relationship between the position of the file tip and the meter-indicated area. The results suggest that, of the H-files of sizes No. 10 to No. 70, No. 15 is probably the most reliable to locate the apical foramen when it is used with Apit 11[®].

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1. Introduction

Removal of the pulp tissue and necrotic dentine in a root canal is essential for the success of endodontic therapy [1]. This is achievable first and foremost if the root canal length has been accurately determined in the clinic. Electronic apex locators (EALs), which are electric root canal length measurement apparatuses, offer the possibility of ready, comfortable, accurate, safe and painless use, and they are able to reduce the number of X-ray photographs of the patient that need to be

taken with a dose of ionising radiation [2]. However, it has been reported that some EALs have failed to obtain accurate results with immature permanent teeth with broad apical foramens [3,4]. In a previous report, the author and my colleagues have suggested that the Apit 11[®] (Osada Electric Co., Ltd., Tokyo, Japan), which is an EAL, could be useful for root canal length measurements of immature teeth with apical foramen diameters of 1–3 mm. However, files of different sizes gave different meter-indicated areas when the file tip reached the apical foramen in the *in vitro* experimental system

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[5]. This study, therefore, aimed to find the sizes in diameters of H-files that are more suitable for root canal length measurements of immature permanent teeth using an EAL; Apit 11[®].

2. Materials and methods

The sample included 20 human immature permanent teeth with single root, free of caries and fractures and with diameters of the apical foramen of 1–3 mm. Their stages of root development were from three-fourths of root completed to root almost completed with open apex. The teeth were extracted for the orthodontic treatment after obtaining informed consent from the patients or the patient’s parents. Pulp cavities of the sample teeth were accessed from the coronal side in order to prepare the root canal and they were stored in saline and kept in a refrigerator at 4 °C.

H-files (28-mm long, stainless steel; by Zipperer) of sizes No. 10, No. 15, No. 20, No. 30, No. 50 and No. 70 were used for the root length measurements. The actual root canal length was recorded by inserting the No. 10 H-file to the apical foramen from the incisal reference point. Thereafter, the length from the tip to the incisal reference point was measured with calipers. A rubber stopper was fitted to a position that corresponded to a certain distance from the file tip so that the tip of the measuring file would reach fixed positions in 1-mm increments from 3 mm inside (–3 mm) to 1 mm outside (+1 mm) the apex of each tooth.

An EAL; Apit 11[®] was used for the measurement of the root canal length in accordance with the manufacturer’s instructions and set to the auto-adjustment mode.

For the experimental device, the tooth was securely fixed in an acrylic box filled with saline solution so as to have the full length of the root soaked in saline solution. Consequently, the full length of the root canal was automatically filled with saline. In addition, the Lip Clip (neutral electrode) of the Apit 11[®] was also securely fixed in the saline solution of the acrylic box (Fig. 1). The file fitted with the metal clip (Apit 7[®] File Holder) of the Apit 11[®] was inserted into the root canal from the access opening and advanced in the apical direction in order to confirm first on the meter display that the zero-point

adjustment was being performed automatically. Then, the meter-indicated area of the Apit 11[®] was recorded at the point where the rubber stopper reached an incisal reference point. Fig. 2 represents the meter-indicated areas and these included three areas: an area to the left of the working length (W.L.; LW), an area of W.L. to APEX (WL) and an area to the right of APEX (RA).

3. Results

Fig. 3–8 show the results of Apit 11[®] measurements using H-files of six types. The horizontal axis in each graph is the meter-indicated area of the Apit 11[®] and the vertical axis represents the number of teeth. For the position of the file tip in relation to the apical foramen, 0 indicates the file tip being just on the position of the apical foramen.

When comparing these graphs, the greater-sized files tended to have decreased numbers of teeth in which the indicator moved into the LW area, and increased numbers of teeth in which the indicator moved into the WL area. When the file tip comes outside from the root canal to 1 mm beyond the apical foramen, the indicator of Apit 11[®] moved into the RA area in every case. However, when the file tip comes just on the apical foramen, the indicator of Apit 11[®] remains in the WL area in some cases except when using files No. 15 and No. 30. When the file tip remained inside the root canal at 1 mm from the apical foramen, it was theoretically expected that the indicator would move into the WL area in every case. However, the indicator moved into the RA area in some cases of every file size utilised in this experiment. However, the number of such cases was minimum when the No. 15 file was used: the indicator moved into the RA area in two out of 20 cases. When the file tip remained inside the root canal at 3 mm from the apical foramen, the indicator of Apit 11[®] remained in the WL area in every case with No. 10 and No. 15 files.

The usability of the Apit 11[®] during measurements was characterised by the auto-adjust being sharply attained by the No. 15 and No. 20 files. However, in five teeth, the auto-adjust reacted poorly with the No. 50 and No. 70 files, which had two teeth and three teeth, respectively. In these cases, the adjustment button was pressed to run for zero-point adjustment.

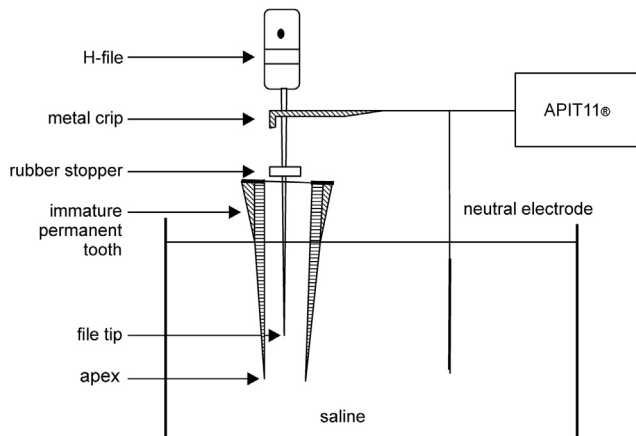


Fig. 1 – Experimental model for electronic apical location.

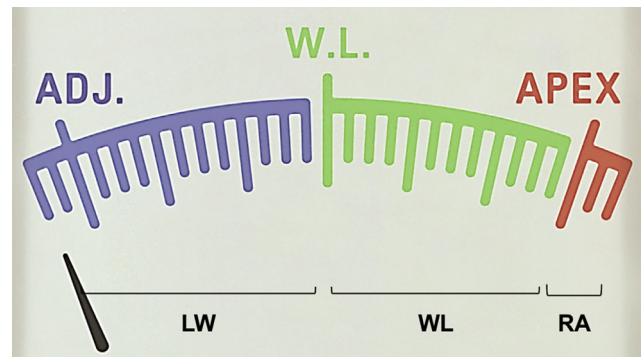


Fig. 2 – Division of area on digital display of APIT11[®]. LW area: an area to the left of W.L.; WL area: an area W.L. to APEX; and RA area: an area to the right of APEX.

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