v. 4, n. 104, 2024

International Journal of Health Science

FORAMINAL LOCATOR IN DECIDUOUS ENDODONTICS: A LITERATURE REVIEW

Caroline França Stahlhofer

Acceptance date: 13/12/2024

Abstract: Endodontic treatment due to caries lesions or trauma with pulp involvement is often necessary to preserve primary teeth in the oral cavity until the time of their physiological exfoliation, since the child's development and growth depend very significantly on these teeth. Due to the fact that there are many techniques, different types of materials and a lack of scientific evidence, there is still a lot of discussion about radical pulp therapy. In addition, the child patient has a difficult behavior and a complex anatomy of the deciduous teeth, which ends up justifying the low quality of the endodontic technique. Therefore, the aim of this study is to showcase technologies such as foraminal locators and mechanized systems, which are already widely used in the permanent dentition and are increasingly being used in the deciduous dentition with the aim of reducing consultation time for the patient and the professional, simplifying the technique and improving the quality of treatment.
Keywords: Endodontic therapy. Pulpectomy. Deciduous tooth. Electronic foraminal locators.

INTRODUCTION

The child's growth and development depends very significantly on the deciduous teeth (GUEDES-PINTO; DUARTE, 1999). These teeth are essential for muscle development, jaw bone formation and achieving correct occlusion in the permanent dentition. It is therefore extremely important to keep them in the arches until their normal physiological exfoliation time (GUEDES-PINTO; IMPARATO; MENDES, 2017).

The incidence of caries in the deciduous dentition is highly significant, often resulting in the need for pulp intervention so that the tooth can be restored and consequently kept in the arch (GUEDES-PINTO; SANTOS, 2017). In addition, the occurrence of dentoalveolar trauma is also another factor that can compromise pulp vitality, justifying the need for endodontic therapy. (SOUSA et al., 2014).

Currently, there is still a lot of variability in pulpectomy in deciduous teeth, and this is due to the fact that there are many materials and techniques associated with the scarcity of scientific evidence (SRINIVASAN; PATCHETT; WATERHOUSE, 2006). Also, the endodontic technique is often a challenge due to the fact that deciduous teeth have a complex internal anatomy and that children are more difficult to treat (ASSED et al., 2005).

Thus, some techniques and technologies already used in permanent teeth have been introduced into deciduous endodontics with the aim of reducing clinical time and improving treatment quality (MELLO-MOURA et al., 2013). Examples include foraminal locators (CRESPO et al., 2008).

With this in mind, this study aims to review the literature on the use of these technologies for endodontic treatment in deciduous teeth. The aim is to present and discuss the scientific evidence on the subject and provide clinical pediatric dentists with new perspectives and possibilities for clinical applicability.

LITERATURE REVIEW

It is known that a very important factor for the success of endodontic treatment is obtaining an adequate filling of the root canals (BARCELOS et al., 2011). Therefore, achieving a correct working length ensures that the obturating materials are restricted to the root canal space, avoiding filling beyond or below the apex (BAWAZIR; SALAMA, 2006). In deciduous endodontics, both factors are of great importance, since the deciduous tooth is very close to the germ of the permanent successor (KATZ; MASS; KAUFMAN, 1996).

Therefore, in order not to damage the periapical tissues and the germ of the successor permanent tooth and to reduce the permanence of necrotic remains and bacteria inside the root canal, it is extremely important to correctly establish and maintain the working length (HOER; ATTIN, 2004).

The precise determination of working length in deciduous teeth is challenged by their anatomy, as they present continuous changes in shape, dimension and position of the root apex resulting from the balance of root resorption and hard tissue deposition (GOERIG; CAMP, 1983). In addition, a well-defined apical contour is not always present in the root canals of deciduous teeth (WU; WESSELINK; WALTON, 2000) and bevel rhizolysis is not always visualized in radiographic examinations. Traditionally, the most common method used to determine the working length of deciduous teeth is radiography using diagnostic radiography, which is also important for obtaining information about the anatomy of the root canal and periapical tissues (BELTRAME et al., 2011).

In 1962, with the advance of studies into the electrical resistance properties of oral tissues, the first electronic foraminal locator was developed by Sunada with the aim of achieving more precise measurements of endodontic length. What makes electronic measurements possible is the difference in electrical potential between the endodontic space and the periodontium (ASSED et al., 2005). Its operation is based on the fact that the electrical conductivity of the tissues adjacent to the apex is greater than the conductivity within the canal system (GOLDBERG et al., 2008).. In the permanent dentition, foraminal locators are widely accepted, with high measurement accuracy and reproducibility (HOER; ATTIN, 2004).

In the deciduous dentition, information on the use of electronic devices to measure root canal length is still more limited (LEONARDO et al., 2008)However, some studies have already demonstrated the effectiveness of this method in pediatric dentistry (ODABAS et al., 2011) (BELTRAME et al., 2011)(BHAT; SHETTY; ANANDAKRISHNA, 2017).

The aim of foraminal locators is to achieve the most accurate measurements, even in the presence of root resorption, which is especially important in deciduous teeth. They are also quick , painless and comfortable for both the dentist and the patient, which contributes to good child patient behavior. They are advantageous over radiography because they eliminate the overlapping of structures and subjective interpretation. (SUBRAMANIAM; KONDE; MANDANNA, 2005) and are able to detect root perforations since any connection between the pulp tissue and the periodontal/ periapical tissue will be recognized by the device (GOLDBERG et al., 2005).

It is recommended that the canal does not have too much irrigating solution to measure the working length, but the canal must be damp so as not to negatively affect the effectiveness of the locator (MATTOS et al., 2016). The pulp chamber should be dry and the irrigating solution should be restricted to the canals (ASSED et al., 2005). According to Welk; Baumgartner; Marshall, (2003)respectively. These differences were statistically significant ($p < 0.001$the type of irrigating solution chosen does not influence the accuracy of the device. It is recommended that the file used be closer to the caliber of the apical foramen so that the working length reading is more accurate (RAMOS; BRAMANTE, 2005).

Before using the locator, the canal must be patented at a provisional working length established on the diagnostic radiograph using a manual file with a diameter compatible with the canal (ASSED et al., 2005). The device has a handle that is divided into two loops. While one is placed in contact with the oral mucosa by means of a hook, the other is attached to the file (GORDON; CHANDELER, 2004). At the time of reading, the file is introduced into the canal in an apical direction and at a certain point, the device will emit a continuous audible alarm signifying that the file is in the region of the apical foramen. To begin instrumentation, the file has to be adjusted to the working length (ASSED et al., 2005).

A study carried out by Beltrame et al., (2011) compared the effectiveness of using the Root ZX foraminal locator to determine the working length of deciduous teeth with and without root resorption. Fifteen teeth were selected, totaling 30 root canals, which were measured with the locator initially *in vivo, in* the patient's mouth and then extracted and divided into two groups: canals without root resorption (*n=13*) and canals with root resorption (*n=17*). After division, they were evaluated *ex vivo* in a sponge moistened with saline solution using the locator and also directly with the file alone. The authors concluded that the locator showed no significant differences regardless of the presence or absence of root resorption and both *in vivo* and *ex vivo* measurements.

Odabas et al. (2011) conducted a study to assess the accuracy of the Root ZX foraminal locator in deciduous dentition. First, 28 teeth (46 root canals) were measured *in vivo in* the patient's mouth using the locator. The teeth were then extracted and divided into two groups according to the presence or absence of root resorption: canals without root resorption (*n=24*) and canals with root resorption (*n=22*). After dividing the canals, they were visually measured using a file. It was concluded that there were no statistical differences between the lengths determined electronically and the lengths measured directly, regardless of the presence or absence of resorption.

Bhat; Shetty; Anandakrishna, (2017) conducted a study comparing the Ipex foraminal locator with the conventional radiographic method for deciduous teeth. A total of 30 posterior teeth (65 root canals) were measured with the electronic locator *in vivo in* the patient's mouth and then measured radiographically with a file, which was introduced at the working length determined with the diagnostic radiograph. It was concluded that there was no difference between the two methods for determining the working length.

Corroborating the previous study, Oznurhan et al. (2015) concluded in an *in vivo* study carried out directly in the mouth that there was no significant difference between the conventional radiographic method and the EndoMaster foraminal locator for determining the working length of deciduous teeth. In this study, measurements were first taken with the aid of the locator and then a file was inserted at the previously determined working length and the same 32 molars (96 roots) were radiographed to compare the two methods.

In an *ex vivo* study, Leonardo et al., (2008) evaluated 17 deciduous incisors and 16 deciduous molars totaling 57 root canals with different stages of resorption. First, the length of the root canals was measured visually with the aid of a file and then they were fixed in a sponge of saline solution and measured with two types of electronic foraminal locators (Root ZX II and Mini Apex) concluding that there was a high correlation regardless of the type of tooth (incisor or molar) or the presence/absence of root resorption.

The literature has shown the superiority of the Root ZX locator for measuring the canal in the deciduous dentition compared to other foraminal locators (AHMAD; PANI, 2015)(ANGWARAVONG; PANITVISAI, 2009). Due to the wide variety of locators on the market, this information is relevant, as it shows the importance of the care that must be taken when choosing a locator in order to optimize and qualify endodontic treatment and achieve greater clinical success.

Although studies in the literature show that the foraminal locator is an effective and safe method for determining the working length of deciduous teeth, diagnostic radiography is still important and should not be replaced, as it provides anatomical and morphological information on the root and periapical tissues. Electronic locators can be considered an auxiliary resource to the conventional radiographic te-

chnique, since deciduous teeth have a different anatomy and are subject to physiological and pathological resorption and root perforations that can often not be detected by radiography.

FINAL COMMENTS

Endodontics for deciduous teeth is an extremely important treatment in the clinical practice of the pediatric dentist, as it allows the tooth to remain in the oral cavity and perform its functions until the appropriate time. Successful endodontic treatment requires knowledge of the complex anatomy of deciduous teeth, a correct diagnosis and a technique based on scientific evidence. In addition, knowledge of the management of child patients contributes to excellent treatment. Foraminal locators are tools that are widely used in the endodontics of permanent teeth and are increasingly being used in the endodontics of deciduous teeth, with the aim of achieving faster treatment and more predictable results.

Foraminal locators precisely detect the position of the apical foramen/communication, allowing the professional to carry out the chemical-mechanical preparation stages, as well as the filling, with a greater chance of not invading the periapical region, preventing damage to the periapical tissues and the permanent successor tooth. In addition, the locators detect areas of resorption and perforations, which is very important when treating deciduous teeth. Based on the studies presented, it is possible to state that foraminal locators have proven to be accurate when used in deciduous teeth, but they should not replace radiographic techniques but rather complement them in their limitations.

REFERENCES

AHMAD, I. A.; PANI, S. C. Accuracy of electronic apex locators in primary teeth : a meta-analysis. **Int. Endod. J.**, Oxford, v. 48, n. 3, p. 298–307, 2015.

ANGWARAVONG, O.; PANITVISAI, P. Accuracy of an electronic apex locator in primary teeth with root resorption. **Int. Endod. J.**, Oxford, v. 42, n. 2, p. 115–121, 2009.

ASSED, S. et al. Tratamento Endodôntico em Dentes Decíduos. In: LEONARDO, M. R. **Endodontia: Tratamento de canais radiculares - princípios técnicos e biológicos**. 4ª ed. São Paulo: Artes Médicas, 2005. p. 167–232.

BARCELOS, R. et al. ZOE paste pulpectomies outcome in primary teeth: a systematic review. **J. Clin. Pediatr. Dent.**, Birminghan v. 35, n. 3, p. 241–8, 2011.

BAWAZIR, O. A; SALAMA, F. S. Clinical evaluation of root canal obturation methods in primary teeth. **Pediatr. Dent.**, Chicago, v. 28, n. 1, p. 39–47, 2006.

BELTRAME, A. P. C. A. et al. Electronic determination of root canal working length in primary molar teeth: An in vivo and ex vivo study. **Int. Endod. J.**, Oxford, v. 44, n. 5, p. 402–406, 2011.

BHAT, K. V.; SHETTY, P.; ANANDAKRISHNA, L. A Comparative Evaluation of Accuracy of New-generation Electronic Apex Locator with Conventional Radiography to determine Working Length in Primary Teeth: An in vivo Study. **Int. J. Paediatr. Dent.**, Oxford, v. 10, n. 1, p. 34–36, 2017.

CRESPO, S. et al. Comparison Between Rotary and Manual Instrumentation in Primary Teeth. **J. Clin. Pediatr. Dent.**, Birminghan v. 32, n. 4, p. 295–298, 2008.

GOERIG, A. C.; CAMP, J. H. Root canal treatment in primary teeth: a review. **Pediatr. Dent.**, Chicago, v. 5, n. 1, p. 33–37, 1983.

GOLDBERG, F. et al. In vitro evaluation of the ability of three apex locators to determine the working length during retreatment. **J. Endod.**, Baltimore, v. 31, n. 9, p. 676–678, 2005.

GOLDBERG, F. et al. The evaluation of four electronic apex locators in teeth with simulated horizontal oblique root fractures. **J. Endod.**, Baltimore, v. 34, n. 12, p. 1497–1499, 2008.

GORDON, M. P.; CHANDELER, N. P. Electronic apex locators. **Int. Endod. J.**, Oxford, v. 37, n. 7, p. 425–437, 2004.

GUEDES-PINTO, A. C.; DUARTE, D. A. Pulpoterapia Odontopediátrica. In: GUEDES-PINTO, A. C. **Reabilitação Bucal em Odontopediatria**. 1ª ed. São Paulo: Santos, 1999. p. 105–119.

GUEDES-PINTO, A. C.; IMPARATO, J. C. P.; MENDES, F. M. Anatomia dos Dentes Decíduos. In: GUEDES-PINTO, A. C.; MELLO-MOURA, A. C. V. **Odontopediatria**. 9ª ed. Rio de Janeiro: Santos, 2017. p. 41–49.

GUEDES-PINTO, A. C.; SANTOS, E. M. Tratamento Endodôntico em Dentes Decíduos. In: GUEDES-PINTO, A. C.; MELLO-MOURA, A. C. V. **Odontopediatria**. 9ª ed. Rio de Janeiro: Santos, 2017. p. 463–484.

HOER, D.; ATTIN, T. The accuracy of electronic working length determination. **Int. Endod. J.**, Oxford, v. 37, n. 2, p. 125–131, 2004.

KATZ, A.; MASS, E.; KAUFMAN, A. Y. Electronic apex locator: a useful tool for root canal treatment in the primary dentition. **J. Dent. Child.**, Chicago, v. 63, n. 6, p. 414–417, 1996.

LEONARDO, M. R. et al. Ex vivo evaluation of the accuracy of two electronic apex locators during root canal length determination in primary teeth. **Int. Endod. J.**, Oxford, v. 41, n. 4, p. 317–321, 2008.

MATTOS, N. H. R. et al. Tecnologia e novos horizontes no tratamento endodôntico. In: MACHADO, M. E. DE L.; PAULO, A. DE O.; HADDAD FILHO, M. S. **Aspectos de interesse da endodontia comtemporânea**. 1ª ed. São Paulo: Napoleão, 2016. p. 24–47.

MELLO-MOURA, A. C. et al. Como podemos otimizar a endodontia em dentes decíduos? Relato de caso. **Rev. Assoc. Paul. Cir. Dent.**, São Paulo, v. 67, n. 1, p. 50–55, 2013.

ODABAS, M. E. et al. Accuracy of an Electronic Apex Locator : A Clinical Evaluation in Primary Molars with and without Resorption. **J. Clin. Pediatr. Dent.**, Birminghan, v. 35, n. 3, p. 255–258, 2011.

OZNURHAN, F. et al. Clinical evaluation of apex locator and radiography in primary teeth. **Int. J. Paediatr. Dent.**, Oxford, v. 25, n. 3, p. 199–203, 2015.

RAMOS, C. A. S.; BRAMANTE, C. M. **Odontometria: fundamentos e técnica**. 1ª ed. São Paulo: Santos, 2005.

SOUSA, P. M. et al. Acompanhamento clínico e radiográfico de dentes decíduos submetidos à terapia pulpar com a pasta CTZ Clinical and radiographic monitoring of primary teeth submitted to pulp therapy with CTZ paste. **Brazilian Research in Pediatric Dentistry and Integrated Clinic**, João Pessoa, v. 14, n. 3, p. 56–68, 2014.

SRINIVASAN, V.; PATCHETT, C. L.; WATERHOUSE, P. J. Is there life after Buckley's Formocresol? Part I - A narrative review of alternative interventions and materials. **J. Clin. Pediatr. Dent.**, Birmingham, v. 16, n. 2, p. 117–127, 2006.

SUBRAMANIAM, P.; KONDE, S.; MANDANNA, D. An in vitro comparison of root canal measurement in primary teeth. **J. Indian Soc. Pedod. Prev. Dent.**, Chandigarh, v. 23, n. 3, p. 124, 2005.

WELK, A.; BAUMGARTNER, J.; MARSHALL, J. An in vivo comparison of two frequency-based electronic apex locators. **J. Endod.**, Baltimore, v. 29, n. 8, p. 497–500, 2003.

WU, M. K.; WESSELINK, P. R.; WALTON, P. R. Apical terminus location of root canal treatment procedures. **Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics**, St. Louis, v. 89, n. 1, p. 99–103, 2000.