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CROSS-SECTIONAL STUDY/STUDIO TRASVERSALE

33° CONGRESSO NAZIONALE VINCITORE PREMIO MIGLIOR TESI DI LAUREA IN AMBITO ENDODONTICO

Analysis of the apical constriction using micro-computed tomography and anatomical sections

Analisi della Costrizione Apicale con Micro-Tomografia Computerizzata e Sezioni Anatomiche

Filippo Citterio*, **Alberto Pellegatta, Claudio Luigi Citterio, Marcello Maddalone**

Degree Course in Dentistry and Dental Implants, Department of Surgery and Translational Medicine, University of Milano-Biocca, Italy

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KEYWORDS
Apical constriction;
Apical foramen;
Working length;
Micro-computed tomography;
Endodontic anatomy.

Abstract
Objectives: The aim of this study is to assess the morphology, the prevalence and the topography of the apical constriction (AC) through a tridimensional analysis and compare the results with the available data reported in the literature.
Materials and methods: 15 teeth were selected. The teeth were intact and atraumatically extracted, without signs of radicular resorption or previous root canal treatments. Each tooth was scanned with the micro-computed tomography at a resolution of 9 μm. Through computer reconstruction the roots were made transparent, in order to reveal the endodontic anatomy; two calibrated examiners assessed the prevalence and the morphology of the AC on two different projections for each tooth. The AC was classified as present (single, multiple, tapered) or absent (flaring, parallel, apical delta). Inter-rater agreement was computed applying Cohen's kappa.

* Corresponding author at: Via Vittorio Emanuele II, 21, 20052 Monza, MB, Italy. Tel.: +39 039380188.
E-mail: f.citterio4@campus.unimib.it (F. Citterio).
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The distance between the AC and the apical foramen was determined by means of a digital ruler.
Results and conclusion: 52.6% of the observed ACs was ambiguous (present on one projection but not on the other one). Only 21.0% of the canals showed a tridimensional AC (present on both projections). Inter-rater agreement was very good (k = 0.839). The morphology, from greater to least, was flaring (25%), single (21.1%), parallel (21.1%), tapered (19.7%), apical delta (10.5%) and multiple (2.6%). Inter-rater agreement was again very good (kappa = 0.869). Root canal anatomy as described in the literature is more conceptual than real. The presence of AC appears to be an exception rather than a canon.

PAROLE CHIAVE
Costrizione apicale;
Forame apicale;
Lunghezza di lavoro;
Micro-TAC;
Anatomia endodontica.

Riassunto
Obiettivi: l'obiettivo di questo studio è valutare attraverso un'analisi tridimensionale, la prevalenza, la morfologia e la topografia della costrizione apicale (CA) e paragonare i risultati ottenuti con quelli riportati dalla letteratura classica.
Materiali e Metodi: sono stati selezionati 15 denti estratti integri ed in modo atraumatico, i quali non mostrassero segni di riassorbimento radicolare, né di precedenti trattamenti canalari. Ogni dente è stato sottoposto ad una scansione con micro-tomografia computerizzata ad una risoluzione spaziale di 9 μm. Sono state generate ricostruzioni 3D rese poi semi-trasparenti in modo tale da rendere visibile l'anatomia canalare. Due esaminatori, precedentemente calibrati, hanno determinato la prevalenza e la morfologia della CA su due differenti proiezioni per ogni dente. La CA è stata classificata come: presente (singola, multipla, conica) o assente (a clessidra, parallela, delta apicale). La concordanza inter-esaminatore è stata testata tramite il test kappa di Cohen. La posizione della CA rispetto al forame apicale è stata calcolata grazie ad un righello digitale.
Risultati e Conclusioni: il 52.6% delle CA osservate era ambiguo (CA presente in una proiezione, ma non sull'altra). Solamente il 21.0% dei canali osservati presentava una CA tridimensionale (presente su entrambe le proiezioni). La concordanza inter-esaminatore è stata molto buona (k = 0.839). Le morfologie ossevate, in ordine di prevalenza sono state: a clessidra (25.0%), singola (21.1%), parallela (21.1%), conica (19.7%), delta apicale (10.5%) e multipla (2.6%). La concordanza interesaminatore è stata ancora molto buona (k = 0.869). L'anatomia apicale, com'è descritta in letteratura, è più concettuale che reale. La presenza della CA sembra essere un'eccezione piuttosto che una regola.

Introduction

Traditionally, the apical constriction (AC) has been considered the ideal landmark to determine the working length during root canal treatment (RCT).[1,2] However, the prevalence, the morphology, and the topography of the AC have not been assessed precisely and the tridimensional features of the AC have been hardly investigated.[1,3–5]

Recently, some researchers have suggested the idea that the AC may not be universally present. If this was true, new landmarks for RCT should be further investigated.[6]

The aim of this study is to assess the morphology, the prevalence and the topography of the AC through a tridimensional analysis and compare the results with the available data reported in the classical literature. Finally, the validity of the AC as a clinical landmark is been questioned.

Materials and methods

A sample of 15 teeth was selected. The teeth were intact and atraumatically extracted, without signs of radicular resorption or previous RCTs. Each tooth was disinfected, preserved in formalin and then placed in a plastic case in order to facilitate the micro-computed tomography (micro-CT) scanning. Each tooth was scanned with the micro-CT at a resolution of 9 μm. After all scans were completed, individual slices were cropped. 3D images were obtained by processing the cropped slices. Through computer reconstruction, the roots were made ransparent so that the endodontic anatomy was visible.

The apical region was observed in two different projections (mesio-distal and bucco-lingual projections) in order to make tridimensional assessments (Figs. 1 and 2). The presence and the morphology of the AC were evaluated by 2 different examiners, which had undergone a calibration session. Cohen's kappa was applied to evaluate inter-rater agreement of examiners.

The topography of the AC was determined measuring the distance between the AC ad the apical foramen (AF) by means of a digital ruler. Finally, each observed AC was classified as a clinically valid AC, whenever it was tridimensional (i.e. observed on both projections by at least one examiner), symmetric (i.e. the plane of the AC is perpendicular to the long axis of the root canal)[7] (Fig. 3), and placed at a distance from the AF smaller than 2 mm.[8]

Results and discussion

Results are resumed in Table 1. Among the observed ACs, only a limited proportion (21.0%) was classified as tridimensional