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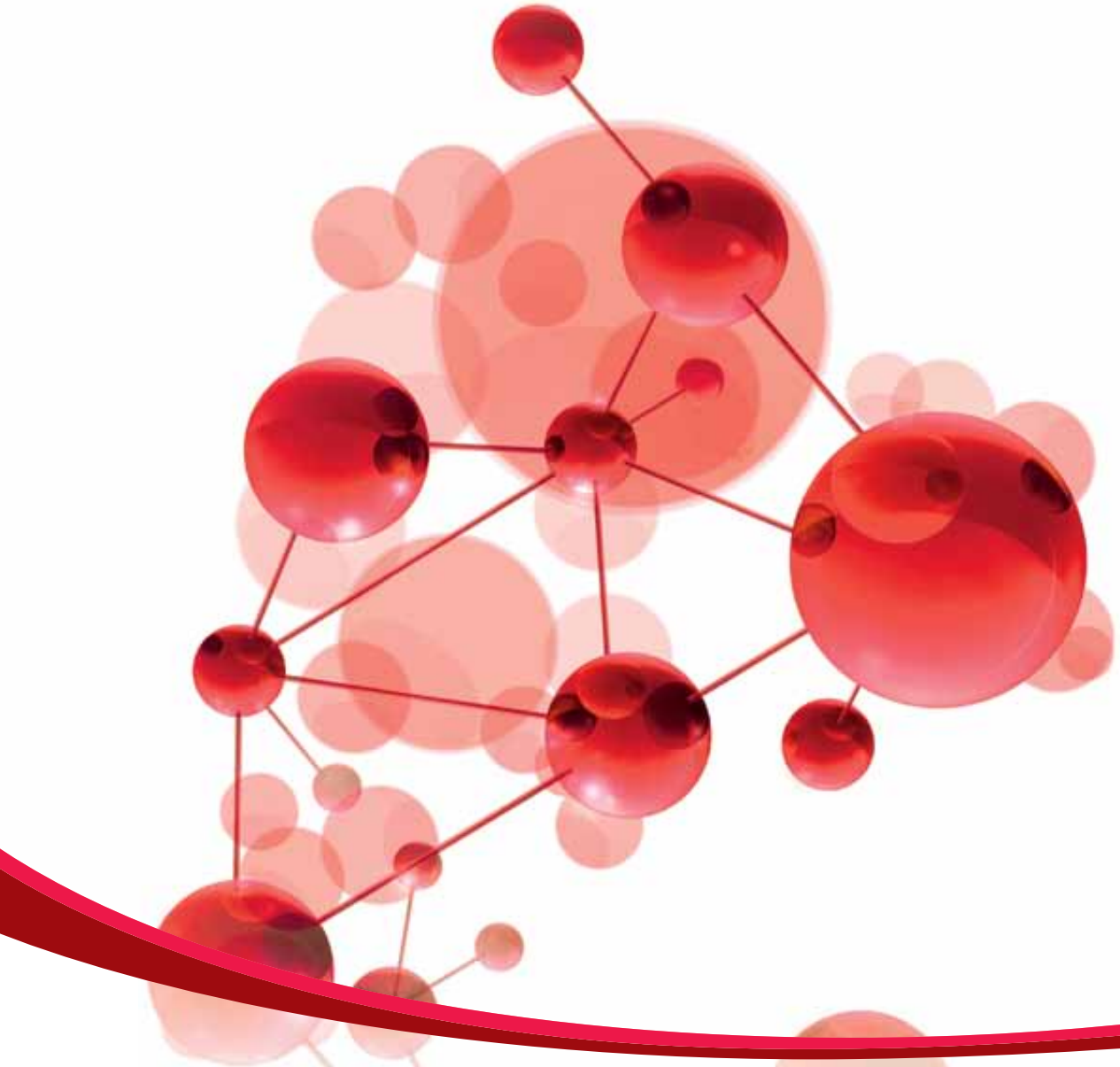

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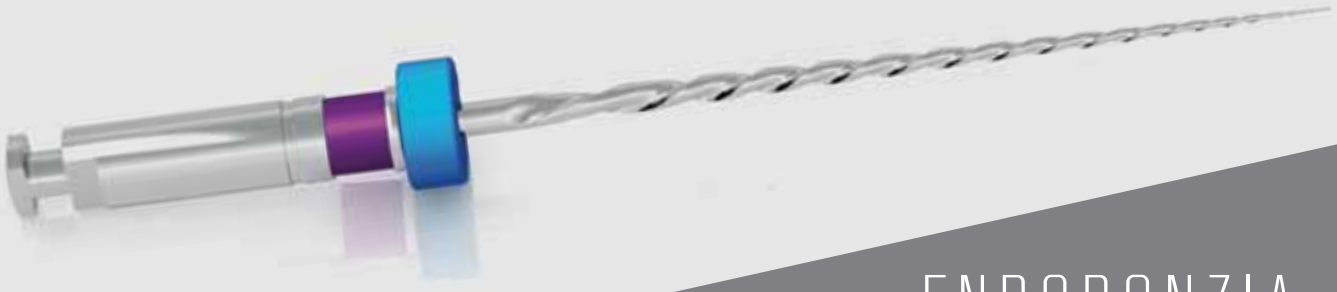

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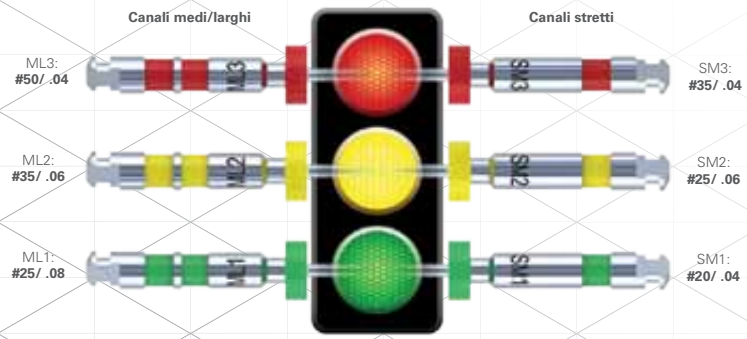

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EDITORIAL/EDITORIALE

An uncertain science or lack of knowledge

Scienza incerta o ignoranza della scienza

Learning from masters is always a good thing; so I did reading a very smart editorial published on International Endodontic Journal, August 2013[1] by Gunnar Bergenholtz & Thomas Kvist. A "summa" of all the needs that the endodontic discipline should have in order to improve its future outcomes.

In summary, diagnostic procedures both for the pulpal status assessment and periapical inflammatory lesions are still uncertain, instrumentation techniques, irrigations and filling materials have too many variables and most of them lack of precision.

In addition, whether going through most of the decision-making processes, we could find a broad spectrum of conflicting answers and clinical behaviours.

In a few words a scientific field that is only apparently highly developed.

This might be in contrast with some papers made on longitudinal studies reporting a satisfactory outcome in more than 95% of the treated cases.

A question should be rised: are we much ignorant about this contemporary endodontics rather then outlining the lacks of the actual knoledge in endodontics?

The answer could be a possible guideline for further future improvements.

Reference

1. Bergenholtz Gunnar, Kvist Thomas. - *Editorial - International Endodontic Journal* 2013;**46**:697—9.

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ARTICOLO ORIGINALE/ORIGINAL ARTICLE

Analisi alla Cone Beam Computed Tomography della simmetria anatomica in molari superiori ed inferiori

CBCT Analysis of anatomycal symmetry of maxillary and mandibular molars

Luigi Tocci [1], Gianluca Plotino [1,*], Nicola Maria Grande [1], Luca Testarelli [1], Daniela Messineo [2], Mario Ciotti [2], Ferdinando D'ambrosio [2], Gianluca Gambarini [1]

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PAROLE CHIAVE
CBCT;
morfologia canalare;
simmetria;
molari superiori;
molari inferiori.

Riassunto
Obiettivi: Analizzare la simmetria riguardante la morfologia radicolare ed il sistema canalare dei molari superiori ed inferiori utilizzando la Cone Beam Computed Tomography (CBCT).
Risultati: 32 pazienti su 45 (71.1%) mostravano una perfetta simmetria delle radici e della morfologia canalare dei primi molari superiori dei due lati. Nei secondi molari superiori, la simmetria è stata osservata in 43 pazienti (79.6%) su 54. 24 pazienti su 34 (70.6%) mostravano una perfetta simmetria delle radici e della morfologia canalare dei primi molari inferiori dei due lati. Nei secondi molari inferiori, la simmetria è stata osservata in 47 pazienti (81%) su 58.
Conclusioni: L'anatomia di un dente di un lato non sempre rispecchia quella del dente omologo dell'altro lato, per quanto essi possano essere simili. La CBCT è uno strumento interessante e clinicamente utile per studiare la morfologia del sistema canalare e quindi per valutare la simmetria tra i denti omonimi.

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KEYWORDS
CBCT;
root canal morphology;
symmetry;
maxillary molars;
mandibular molars.

Abstract
Aim: To analyze the symmetry in root canal configurations in the maxillary and mandibular permanent molar teeth of a Caucasian population using Cone Beam Computed Tomography (CBCT).
Results: Of 45 patients who had both maxillary first molars, 32 (71.1%) had perfect symmetry in the root and canal morphology of homonym teeth on the opposite side. As regards the maxillary second molars, the symmetry was observed in 43 patients (79.6%) of 54. Of 34 patients who had both mandibular first molars, 24 (70.6%) showed a perfect symmetry in the root and canal morphology of homonym teeth on the opposite side. As regards the mandibular second molars, the symmetry was observed in 47 patients (81%) of 58.
Conclusions: CBCT is an exciting and clinically useful tool in studying root canal morphology and so the symmetry between homonym teeth.

Introduzione

Lo scopo del trattamento endodontico è rappresentato dalla meticolosa sagomatura e detersione del sistema canalare e dal suo completo riempimento con un materiale inerte biocompatibile. Di conseguenza, una conoscenza accurata della frequenza delle configurazioni anatomiche più comuni e delle varianti maggiormente riscontrabili è fondamentale per ridurre gli errori clinici ed aumentare le percentuali di successo delle terapie.

Numerosi studi[1–3] hanno potuto dimostrare la complessità del sistema canalare, che viene valutato clinicamente principalmente attraverso l'esame radiografico standard. Le indagini radiografiche rappresentano, infatti, gli ausili diagnostici più precisi e meno soggettivi a disposizione degli endodontisti per la diagnosi delle patologie che colpiscono la mascella e la mandibola[4]. I raggi X convenzionali, però, producono un'immagine bidimensionale di un oggetto che è, in realtà, tridimensionale[5], pertanto non sempre è possibile valutare il numero effettivo dei canali presenti nei denti ed il loro decorso[6]. In particolare, le strutture anatomiche che circondano il dente, si sovrappongono e rendono difficile interpretare la tradizionale immagine a raggi X[7,8]. Inoltre, si possono anche creare distorsioni geometriche delle strutture anatomiche che compongono l'immagine[9]. Queste problematiche possono essere superate utilizzando una nuova tecnica di imaging: la Cone Beam Computed Tomography (CBCT), o tomografia computerizzata a fascio conico, la quale è in grado di produrre immagini tridimensionali dei singoli denti e dei tessuti circostanti.

La CBCT è una tecnica radiologica di scansione tomografica utilizzata per acquisire dati e immagini di uno specifico volume del massiccio facciale o del cranio. Grazie a specifici e potenti software di elaborazione, sviluppati alla fine degli anni '90, questa tecnica offre immagini diagnostiche sui tre piani dello spazio e Volume Rendering (cioè immagini volumetriche), esponendo il paziente a dosi radianti relativamente basse, rispetto alla convenzionale Tomografia Computerizzata[10,11]. La CBCT supera diversi limiti delle radiografie convenzionali. Le sezioni possono essere selezionate per evitare la sovrapposizione delle strutture anatomiche, le quali provocano disturbi di visualizzazione dell'immagine. Per esempio, le radici dei denti posteriori del mascellare superiore e i loro tessuti periapicali possono essere visualizzati separatamente e in tutti e tre i piani dello spazio senza sovrapposizione della sovrastante arcata zigomatica, dell'osso alveolare e delle radici adiacenti. Il rapporto spaziale esistente tra le radici dei denti pluriradicolati può essere visualizzato tridimensionalmente[12] e queste valutate nelle loro reali dimensioni. Ad oggi non sono presenti in letteratura studi anatomici effettuati con la CBCT che analizzino la simmetria degli stessi elementi dentari tra lato destro e sinistro dello stesso paziente.

Lo scopo di questo studio è stato quindi quello di utilizzare le immagini CBCT, eseguite per la diagnosi e la pianificazione del trattamento, per valutare la simmetria dei primi e secondi molari mascellari e mandibolari tra i lati destro e sinistro dello stesso paziente allo scopo di evidenziare in che percentuale di casi questi denti avevano la stessa anatomia.

Materiali e metodi

In questo studio sono stati analizzati 201 pazienti, che richiedevano un esame CBCT come parte del loro trattamento odontoiatrico. Le immagini sono state prese nel contesto degli esami di routine, allo scopo di formulare una valida diagnosi ed una corretta pianificazione del trattamento in pazienti che avevano subito un trauma facciale, che erano affetti da sinusite mascellare, che necessitavano di una valutazione pre-operatoria per il posizionamento di impianti, o che avevano bisogno di un trattamento ortodontico a causa di un dente incluso. I pazienti analizzati avevano un'età media di 43 anni (da 19 a 70 anni) ed erano rappresentati da 121 donne e 80 uomini. Sono stati analizzati un totale di 596 denti (161 primi molari superiori, 157 secondi molari superiori, 117 primi molari inferiori e 161 secondi molari inferiori).

In questo studio, la CBCT è stata eseguita senza la somministrazione di mezzo di contrasto, con il supporto di un apparecchio di ultima generazione, il NewTom VGi Vertical Cone Beam (Verona, Italia). Abbiamo utilizzato i seguenti parametri tecnici per acquisire, in maniera volumetrica, la regione che doveva essere analizzata: 110 kVp, 1-20 mAs (modo pulsato), focal spot 0.3 mm, FOV (field of view) 15 cm x 15 cm, pannelli di silicio amorfo. Un'acquisizione dell'immagine di 20 secondi ha determinato un'esposizione di, approssimativamente, 3.5 secondi (modo pulsato), con una dose stimata di circa 50 μSv; questa dose è considerata più bassa di quella della TC spirale. Le immagini sono state poi rielaborate secondo i piani assiale, sagittale e coronale.

Le immagini CBCT sono state visionate sulle ricostruzioni secondo il piano assiale, scorrendo il cursore in direzione corono-apicale prima, e apico-coronale poi, per avere una dettagliata visualizzazione del sistema canalare dei denti esaminati. L'azione descritta è stata ripetuta più di una volta per essere sicuri di non incorrere in errore. In casi particolari, in cui l'immagine sul piano assiale non era molto chiara, si è preferito analizzare l'elemento dentario ricostruito in 3D per avere una visione più completa dell'anatomia. Durante la visualizzazione degli elementi dentari oggetti dello studio, si è valutato se fosse presente simmetria tra i denti omonimi dei due lati, destro e sinistro, dello stesso paziente, prendendo in considerazione determinate caratteristiche: il numero delle radici e la loro morfologia, il numero di canali per radice e il tipo di configurazione del sistema canalare, che è stato classificato secondo il metodo di Vertucci (1984). I dati sono stati quindi ben catalogati e suddivisi a seconda dell'elemento dentale analizzato.

Risultati

Primi molari superiori (Tabella 1)

Su 45 pazienti che presentavano gli elementi dentari esaminati in entrambi i lati destro e sinistro, 32 (71.1%) mostravano una perfetta simmetria delle radici e della morfologia canalare dei denti dei due lati. Tra questi 32 pazienti che risultavano essere simmetrici, 17 (37.8%) presentavano primi molari superiori con tre radici e tre canali (1 canale per ciascuna radice) e 15 (33.3%) con tre radici e quattro canali (2 canali nella radice mesio-vestibolare, 1 canale nella radice disto-vestibolare e 1 canale nella radice palatale). Tra questi ultimi 15 pazienti, 12 presentavano una configurazione canalare di Vertucci della radice MV dei denti dei due lati di tipo II, 1 di tipo III, 1 di tipo IV e 1 di tipo V.

In 13 pazienti (28.9%) l'anatomia dei primi molari superiori è risultata essere asimmetrica. Tra questi, 7 (15.6%) presentavano primi molari superiori con tre radici e tre canali da una parte e tre radici e quattro canali dall'altra, di cui 4 presentavano primi molari superiori con una configurazione canalare della radice MV di tipo II da una parte e di tipo I dall'altra, 2 con un tipo III da una parte ed un tipo I dall'altra ed, infine, 1 con un tipo IV da una parte ed un tipo I dall'altra. 4 pazienti (8.9%) avevano in entrambi i lati primi molari superiori con tre radici e quattro canali, ma questi si distinguevano perché la configurazione canalare della radice MV, dove si trovava il quarto canale, era differente tra i due lati secondo la classificazione di Vertucci: 2 avevano primi molari superiori con una configurazione canalare della radice MV di tipo II da una parte e di tipo IV dall'altra e 2 con un tipo III da una parte ed un tipo IV dall'altra. Gli ultimi 2 pazienti (4.4%) avevano denti che erano diversi morfologicamente: 1 presentava primi molari superiori con tre radici e tre canali da una parte e con due radici e quattro canali dall'altra e 1 aveva primi molari superiori con tre radici e tre canali da una parte e due radici e due canali dall'altra.

Secondi molari superiori (Tabella 1)

Su 54 pazienti che presentavano gli elementi dentari esaminati in entrambi i lati destro e sinistro, 43 (79.6%) mostravano una perfetta simmetria delle radici e della morfologia canalare dei denti dei due lati. Tra questi 43 pazienti che risultavano essere simmetrici, 34 (62.9%) presentavano secondi molari mascellari con tre radici e tre canali, 5 (9.2%) con tre radici e quattro canali (il quarto canale si trovava costantemente nella radice MV e la configurazione canalare era sempre di tipo II), 1 (1.9%) con una sola radice e due canali (la configurazione canalare era di tipo II), 2 (3.7%) con due radici e due canali e 1 (1.9%) con due radici e tre canali (il terzo canale si trovava nella radice vestibolare e la configurazione canalare era di tipo II).

In 11 pazienti (20.4%) l'anatomia dei secondi molari superiori è risultata essere asimmetrica. Tra questi, 8 (14.8%) presentavano secondi molari superiori con tre radici e tre canali da una parte e tre radici e quattro canali dall'altra, di cui 5 presentavano secondi molari superiori con una configurazione canalare della radice MV di tipo IV da una parte e di tipo I dall'altra e 3 con un tipo II da una parte ed un tipo I dall'altra. 1 paziente (1.9%) aveva in entrambi i lati secondi

Tabella 1 Valutazione della simmetria dei primi e secondi molari superiori.

Primi Molari Superiori (n=45)		n (%)	Secondi Molari Superiori (n=54)		n (%)
Simmetrici 71.1% (n=32)	Tre radici e tre canali	17 (37.8)	Simmetrici 79.6% (n=43)	Tre radici e tre canali	34 (62.9)
	Tre radici e quattro canali	15 (33.3)		Tre radici e quattro canali	5 (9.2)
				Una radice e due canali	1 (1.9)
				Due radici e due canali	2 (3.7)
				Due radici e tre canali	1 (1.9)
Non Simmetrici 28.9% (n=13)	Tre radici e tre canali e tre radici e quattro canali	7 (15.6)	Non Simmetrici 20.4% (n=11)	Tre radici e tre canali e tre radici e quattro canali	8 (14.8)
	Tre radici e tre canali e due radici e due canali	1 (2.2)			
	Tre radici e tre canali e due radici e quattro canali	1 (2.2)		Tre radici e tre canali e due radici e due canali	2 (3.7)
	Tre radici e quattro canali con configurazione differente del canale MV	4 (8.9)		Tre radici e quattro canali con configurazione differente del canale MV	1 (1.9)

Tabella 2 Valutazione della simmetria dei primi e secondi molari inferiori.

Primi Molari Inferiori (n=34)		n (%)	Secondi Molari Inferiori (n=58)		n (%)
Simmetrici 70.6% (n=24)	Due radici e tre canali	21 (61.8)	Simmetrici 81% (n=47)	Due radici e tre canali	40 (68.9)
	Due radici e quattro canali	3 (8.8)		Due radici e due canali	4 (6.9)
				Una radice ed un canale C-shaped	3 (5.2)
Non Simmetrici 29.4% (n=10)	Due radici e tre canali e due radici e quattro canali	7 (20.6)	Non Simmetrici 19% (n=11)	Due radici e tre canali e due radici e due canali	5 (8.6)
	Due radici e tre canali e due radici e due canali	1 (2.9)		Una radice ed un canale e una radice e due canali	1 (1.7)
	Due radici e tre canali con configurazione differente del canale mesiale	1 (2.9)		Due radici fuse e tre canali e due radici separate e tre canali	1 (1.7)
	Due radici e quattro canali con configurazione differente del canale distale	1 (2.9)		Una radice ed un canale C-shaped e due radici e tre canali	2 (3.5)
				Due radici e tre canali con configurazione differente del canale mesiale	2 (3.5)

molari superiori con tre radici e quattro canali, ma questi si distinguevano perché la configurazione canalare della radice MV, dove si trovava il quarto canale, era differente tra i due lati secondo la classificazione di Vertucci: aveva secondi molari superiori con una configurazione canalare della radice MV di tipo II da una parte e di tipo III dall'altra. Gli ultimi 2 pazienti (3.7%) avevano denti che erano diversi morfologicamente: entrambi presentavano secondi molari superiori con tre radici e tre canali da una parte e con due radici e due canali dall'altra.

Primi molari inferiori (Tabella 2)

Su 34 pazienti che presentavano questi elementi dentari in entrambi i lati destro e sinistro, 24 (70.6%) mostravano una perfetta simmetria delle radici e della morfologia canalare dei denti dei due lati. Tra questi 24 pazienti che risultavano essere simmetrici, 21 (61.8%) presentavano primi molari inferiori con due radici e tre canali (il terzo canale si trovava sempre nella radice mesiale e la configurazione canalare di questa radice era in 6 pazienti di tipo II e in 15 pazienti di tipo IV) e 3 (8.8%) con due radici e quattro canali (2 pazienti presentavano primi molari inferiori con una configurazione canalare di tipo IV sia nella radice mesiale che in quella distale e 1 con una configurazione canalare di tipo IV nella radice mesiale e di tipo III nella radice distale).

In 10 pazienti (29.4%) l'anatomia dei primi molari inferiori è risultata essere asimmetrica. Tra questi, 7 (20.6%) presentavano primi molari inferiori con due radici e tre canali da una parte e due radici e quattro canali dall'altra, di cui: 3 presentavano primi molari inferiori con una configurazione canalare di tipo II sia nella radice mesiale che in quella distale da una parte ed una configurazione canalare di tipo II nella radice mesiale e di tipo I nella radice distale dall'altra; 2 presentavano primi molari inferiori con una configurazione canalare di tipo IV nella radice mesiale e di tipo II nella radice distale da una parte ed una configurazione canalare di tipo IV nella radice mesiale e di tipo I nella radice distale dall'altra; 1 aveva primi molari inferiori con una configurazione canalare di tipo IV nella radice mesiale e di tipo III nella radice distale da una parte ed una configurazione canalare di tipo IV nella radice mesiale e di tipo I nella radice distale dall'altra; 1 aveva primi molari inferiori con una configurazione canalare di tipo VIII nella radice mesiale e di tipo I nella radice distale da una parte ed una configurazione canalare di tipo II nella radice mesiale e di tipo I nella radice distale dall'altra. 1 paziente (2.9%) presentava primi molari inferiori con due radici e due canali da una parte e due radici e tre canali dall'altra (il terzo canale si trovava nella radice mesiale e la configurazione canalare di questa radice era di tipo II). 2 pazienti (5.8%) avevano, in entrambi i lati, primi molari inferiori con uguale numero di radici e di canali, ma questi si distinguevano perché la configurazione canalare, secondo la classificazione di Vertucci, era differente tra i due lati: 1 (2.9%) aveva primi molari inferiori con due radici e quattro canali in entrambi i lati, che si distinguevano per la diversa configurazione canalare della radice distale che era di tipo II da una parte e di tipo III dall'altra (la configurazione canalare della radice mesiale era di tipo II in entrambi i lati); 1 (2.9%) aveva primi molari inferiori con due radici e tre canali in entrambi i lati, che si distinguevano per la diversa configurazione canalare della radice mesiale che era di tipo II da una parte e di tipo IV dall'altra (la configurazione canalare della radice distale era di tipo I in entrambi i lati).

Secondi molari inferiori (Tabella 2)

Su 58 pazienti che presentavano questi elementi dentari in entrambi i lati destro e sinistro, 47 (81%) mostravano una perfetta simmetria delle radici e della morfologia canalare dei denti dei due lati. Tra questi 47 pazienti che risultavano essere simmetrici, 40 (68.9%) presentavano secondi molari inferiori con due radici e tre canali (il terzo canale si trovava sempre nella radice mesiale e la configurazione canalare di questa radice era in 10 pazienti di tipo II, in 1 paziente di tipo III e in 29 pazienti di tipo IV), 4 (6.9%) con due radici e due

canali e 3 (5.2%) con una sola radice ed un canale a forma di C.

In 11 pazienti (19%) l'anatomia dei secondi molari inferiori è risultata essere asimmetrica. Tra questi, 5 (8.6%) presentavano secondi molari inferiori con due radici e due canali da una parte e due radici e tre canali dall'altra, (il terzo canale si trovava sempre nella radice mesiale e la configurazione canalare di questa radice era in 4 pazienti di tipo II e in 1 paziente di tipo IV). 1 paziente (1.7%) presentava secondi molari inferiori con una radice ed un canale da una parte ed una radice e due canali dall'altra (tipo II). 1 paziente (1.7%) aveva secondi molari inferiori con due radici fuse e tre canali da una parte e due radici separate e tre canali dall'altra (il terzo canale si trovava nella radice mesiale e la configurazione canalare di questa radice era di tipo IV in entrambi i lati). 2 pazienti (3.5%) presentavano secondi molari inferiori con una radice ed un canale a forma di C da una parte e due radici e tre canali dall'altra (il terzo canale si trovava sempre nella radice mesiale e la configurazione canalare di questa radice era in 1 paziente di tipo II e in 1 paziente di tipo IV). 2 pazienti (3.5%) avevano in entrambi i lati secondi molari inferiori con due radici e tre canali, ma questi si distinguevano perché la configurazione canalare della radice mesiale, dove si trovava il terzo canale, era differente tra i due lati secondo la classificazione di Vertucci: 1 (1.7%) aveva secondi molari inferiori con una configurazione canalare della radice mesiale di tipo II da una parte e di tipo IV dall'altra e 1 (1.7%) con un tipo II da una parte ed un tipo III dall'altra.

Discussione

Questo studio ha utilizzato la CBCT per valutare la simmetria dei molari superiori ed inferiori, nei pazienti che presentavano i denti omologhi in entrambi i lati.

I risultati mostrano che i primi molari superiori sono risultati essere simmetrici, per quanto riguarda il numero di radici e la morfologia del sistema canalare, nel 71.1% dei pazienti, mentre i secondi molari superiori lo sono stati nel 79.6%. Il restante 28.9% e 20.4% dei pazienti rispettivamente, mostravano asimmetria. Per quanto riguarda i primi molari superiori, il 15.6% dei pazienti presentavano denti con tre radici e tre canali da una parte e tre radici e quattro canali dall'altra, mentre nei secondi molari superiori il 14.8% dei pazienti mostrava questo tipo di asimmetria. Quindi il quarto canale può non essere presente da un lato, ma ciò non vuol dire che non si possa trovare dall'altro. Questo dato è molto importante dal punto di vista clinico, poiché la mancata identificazione, sagomatura ed otturazione di un secondo canale mesio-vestibolare (MB2) può condurre ad una scarsa prognosi a lungo termine a causa di un'infezione intracanalare residua[13–15]. E' stato dimostrato come al trattamento dei molari superiori sia correlato il più alto tasso di insuccesso clinico[16,17], probabilmente perché questi denti presentano l'anatomia radicolare e canalare più complessa[18] con variazioni sostanziali in corrispondenza della radice mesio-vestibolare, che è stata oggetto di numerosi studi[16,17,19–26]. Tra i casi di asimmetria registrati, bisogna poi considerare che, nei primi molari superiori, l'8.9% dei pazienti aveva in entrambi i lati denti con tre radici e quattro canali, ma questi si distinguevano perché la configurazione canalare della radice mesio-vestibolare, dove si trovava il quarto canale, era differente tra i due lati secondo la classificazione di Vertucci. Nei secondi molari superiori, questo tipo di asimmetria si è riscontrata nell'1.9% dei pazienti. Infine, nei primi molari superiori, il 4.4% dei pazienti presentava denti a destra e a sinistra che erano diversi tra loro per quanto riguarda il numero delle radici presenti, mentre la percentuale nei secondi molari superiori era del 3.7% dei pazienti. Quest'insieme di dati suggerisce che una buona parte dei molari superiori analizzati sono asimmetrici per quanto riguarda l'anatomia endodontica e, quindi, il sistema canalare; a livello morfologico essi invece si presentano molto simili esibendo, quasi sempre, lo stesso numero di radici. Una superficiale valutazione morfologica del dente, eseguita per esempio attraverso l'analisi di una radiografia endorale, non è quindi sufficiente per affermare che i due denti omologhi siano simmetrici, avendo frequentemente costatato che l'anatomia endodontica è assai variabile anche in denti simili.

Così come è stato fatto per i molari superiori, anche nei molari inferiori, laddove possibile, si è valutato se tra i denti esaminati ci fosse una analoga simmetria: per quanto riguarda i primi molari inferiori, il 70.6% dei pazienti mostrava una perfetta simmetria della radice e della morfologia canalare dei denti dei due lati; mentre per i secondi molari inferiori, questo data arrivava all'81%. Il restante 29.4% e 19% rispettivamente dei primi e secondi molari inferiori analizzati, mostravano invece una asimmetria. Per quanto riguarda i primi molari inferiori, la maggior parte dei pazienti (20.6%) che mostrava asimmetria presentava denti con due radici e tre canali da una parte e due radici e quattro canali dall'altra. I primi molari inferiori sono stati trovati sempre con due radici, quindi i denti omologhi che non risultavano simmetrici si sono differenziati o per le differenze di configurazione del sistema canalare o per il numero di canali per radice. I secondi molari inferiori, invece, sono stati, tra i denti analizzati, quelli che più si sono differenziati tra i due lati per quanto riguarda la morfologia: l'1.7% dei pazienti aveva denti con due radici fuse e tre canali da una parte e due radici separate e tre canali dall'altra, il 3.5% dei pazienti presentava denti con una radice ed un canale a forma di C da una parte e due radici e tre canali dall'altra. In questo studio solo i secondi molari inferiori sono stati descritti con una configurazione a C, nonostante Cooke & Cox[27] abbiano affermato che questa configurazione particolare sia stata anche riportata nei primi molari inferiori, nei primi e secondi molari superiori e nei primi premolari inferiori.

I risultati dei molari inferiori sono simili a quelli riscontrati nei molari superiori dove circa il 30% dei primi molari superiori e circa il 20% dei secondi molari superiori mostravano asimmetria. Considerando che le maggiori differenze tra un lato e l'altro sono attribuibili principalmente all'anatomia endodontica, si può pensare che i primi molari, siano essi superiori o inferiori, dimostrino una maggiore variabilità del sistema canalare rispetto ai secondi molari. Ciò può essere spiegato dal fatto che i canali accessori (nella radice mesio-vestibolare nei primi molari superiori, nella radice mesiale nei primi molari inferiori) siano stati trovati in maggior numero nei primi molari rispetto ai secondi molari. Questi dati trovano conferma da diversi studi[16–26] che hanno analizzato il sistema canalare della radice mesio-vestibolare dei primi molari superiori ed hanno dimostrato la sua

complessità, rispetto invece ai secondi molari superiori in cui l'anatomia standard è rappresentata da tre radici e tre canali[14,26,28]. Per quanto riguarda i primi molari inferiori, la variabilità del sistema canalare della radice mesiale è stata riportata anche da Vertucci[14] e da Zhang et al.[29].

Conclusioni e rilevanza clinica

L'analisi della simmetria nei pazienti selezionati risulta essere una prerogativa del presente studio e pertanto non è possibile fare un confronto con altri studi presenti in letteratura. I risultati di questo studio hanno dimostrato come l'anatomia di un dente di un lato non sempre possa rispecchiare quella del dente omologo dell'altro lato, per quanto essi possano essere simili, riportando una percentuale di asimmetria variabile tra il 19 ed il 30% dei denti analizzati. Questi risultati dovrebbero essere attentamente presi in considerazione quando si ha la necessità di trattare due molari opposti dello stesso paziente, che possono risultare simili ad una radiografia tradizionale ma non esserlo realmente.

La CBCT si è dimostrata estremamente utile per l'analisi anatomica e quindi della simmetria dei molari superiori ed inferiori. Inoltre, essa permette di valutare il sistema canalare dei denti in 3D e quindi di esplorarlo in tutte le direzioni, cosa che non è possibile fare con le tradizionali radiografie o con altre tecniche d'impiego clinico. Ulteriori studi dovrebbero essere condotti per valutare la simmetria anatomica di altre classi di denti ed in popolazioni differenti.

Conflitto di interessi

Gli autori dichiarano di non avere alcun conflitto di interessi

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ORIGINAL ARTICLE/ARTICOLO ORIGINALE

Periapical healing after simplified endodontic treatments: A digital subtraction radiography study

Guarigione periapicale a seguito di trattamenti endodontici semplificati: studio con digital subtraction radiography

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KEYWORDS
Carrier-based systems;
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Abstract
Aim: To evaluate the 6-month outcome of endodontic treatment of periapical lesions with integrated systems by clinical examination and digital subtraction radiography (DSR).
Methodology: Eighty-four patients with chronic periapical pathosis were randomly allocated to two groups and received endodontic treatment with Revo-S/One Step Obturator (G1, $n = 41$) or GTX/GTX Obturator (G2, $n = 43$). Six months later, clinical examination and DSR analysis were performed. Non-parametric statistical methods were used ($p < 0.05$).
Results: Total healing, partial healing and failure occurred in 48.4%, 48.4% and 3.2% of cases in G1, in 50.0%, 43.8% and 6.2% of cases in G2, respectively. No significant difference was detected.
Conclusions: The integrated endodontic techniques allowed for a high 6-month success rate in both groups in accordance with literature data.

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PAROLE CHIAVE
Digital subtraction radiography;
Guarigione;
Paradentite periapicale;
Sistemi carrier-based;
Trattamento endodontico.

Riassunto
Obiettivi: Valutare la guarigione a sei mesi di lesioni periapicali trattate con sistemi endodontici integrati tramite esame clinico e digital subtraction radiography (DSR).
Materiali e metodi: Ottantaquattro pazienti con patologia periapicale cronica sono stati assegnati a due gruppi, trattati con Revo-S/One Step Obturator (G1, $n = 41$) o GTX/GTX Obturator (G2, $n = 43$). Dopo sei mesi sono stati eseguiti esame clinico e analisi DSR. L'analisi dei dati è stata condotta con test non parametrici ($p < 0,05$).
Risultati: Guarigione totale, parziale e fallimento si sono verificati rispettivamente nel 48,4%, 48,4% e 3,2% dei casi in G1, nel 50,0%, 43,8% e 6,2% in G2. Non è emersa differenza significativa.
Conclusioni: Le tecniche endodontiche integrate hanno consentito un elevato tasso di successo in entrambi i gruppi, in linea con i dati della letteratura.

Introduction

Radicular cysts and periapical periodontitis are common inflammatory odontogenic lesions of the jaws[1] and they arise as result of pulp necrosis and microbial root canal infection.[2–4] It is known that the healing of these lesions depends on proper mechanical and chemical removal of the infected endodontic content and three-dimensional canal obturation.[5]

Traditionally, the outcome of endodontic therapy has been assessed by means of clinical examination and periapical radiographs.[6] The endodontic success is reached when the following requirements are satisfied one year after the treatment: (i) absence of signs and symptoms, (ii) preservation of masticatory function, and (iii) normal radiographic appearance of the periodontal ligament width.[7]

Periapical radiographs have some shortcomings that can hinder the image reading. Radiograph misinterpretation may derive from the superimposition of three-dimensional structures on a two-dimensional plane, the interference caused by the maxillary sinus and root overlapping in case of multirooted teeth.[8,9] The introduction of the digital subtraction radiography (DRS) improved the ability to distinguish the variations of bone mineralization, with the capability of detecting quantitative and qualitative changes of bone structure after only 90—180 days.[8]

Among root canal filling techniques, several warm gutta-percha compaction methods and devices have been described. Carrier-based systems consist on a semi-rigid core coated with gutta-percha that matches the shape of the canal preparation. These systems were found to be less operator-dependent than the continuous wave of condensation technique when used by novices.[10] Nowadays, manufacturers of endodontic instruments promote a trend of technique simplification, offering systems characterized by fewer files and shape correspondence among the shaping, drying and filling instruments. Both Revo-S (Micro-Mega, Besançon, France) and GTX rotary files (Dentsply Tulsa Dental Specialties, Tulsa, OK, USA) have dedicated root-filling systems, namely, the One-Step Obturator (CMS Dental ApS, Copenhagen, Denmark) and GTX Obturator (Dentsply Tulsa Dental Specialties). The correspondence between nickel—titanium rotary riles and carrier-based filling instruments is an expression of classic techniques simplification and may be advantageous for clinicians.[11]

The aim of the present study is to compare by DRS and clinical examination the 6-month healing rate of chronic periapical lesions in patients treated with Revo-S/One-Step Obturator or GTX/GTX Obturator integrated techniques.

Materials and methods

All the patients involved in the study were informed on the purpose and methods of the experimentation. Each patient expressed his/her own agreement to join the study by signing a dedicated form and was free to leave the experimental project in every phase. All the experimental procedures were conducted in full accordance with the Helsinki Declaration (version 2008).

Eighty-four patients with a tooth without previous endodontic treatment presenting periapical chronic periodontitis were randomly assigned to two treatment groups. Rubber dam was used for field isolation in all treatments. A composite resin build-up restoration was performed if needed. The canals were scouted with a size 10K file (Dentsply Maillefer, Ballaigues, Switzerland) and the working length was determined by means of an electronic apex locator (Root ZX, Morita Co., Tokyo, Japan). The canal shaping and filling protocols were the following, according to the manufacturers indications:

- Group 1 (G1, $n = 41$). The canals were shaped with Revo-S (Micro—Mega) nickel—titanium rotary files in the following sequence: SC 1 (25/.06), SC 2 (25/.04), SU (25/.06), AS 30 (30/.06), AS, 35 (35/.06), AS 40 (40/.06). Apical enlargement was carried out with manual files according to the apical gauging. Canals were irrigated with 2 ml 5.25% sodium hypochlorite (Niclor 5, Ogna, Muggiò, Italy). Sterile paper points were used to dry the canal at the end of the shaping procedure. Canal walls were smeared with the sealer Sicura-Seal (Dentalica, Milano, Italy) with a size 15K file. An obturator of the One-Step Obturator system (CMS Dental ApS) corresponding to the apical preparation size was heated in the in the One-Step Obturator Oven (CMS Dental ApS), inserted into the root canal to working length and cut at the orifice level with a dedicated bur.
- Group 2 (G2, $n = 43$): The canals were shaped with GT Series X (Dentsply Tulsa Dental Specialties) nickel—titanium rotary files in the following sequence: 20/.04, 20/.06, 30/.04, 30/.06, 40/.06, 40/.08. Apical enlargement, canal

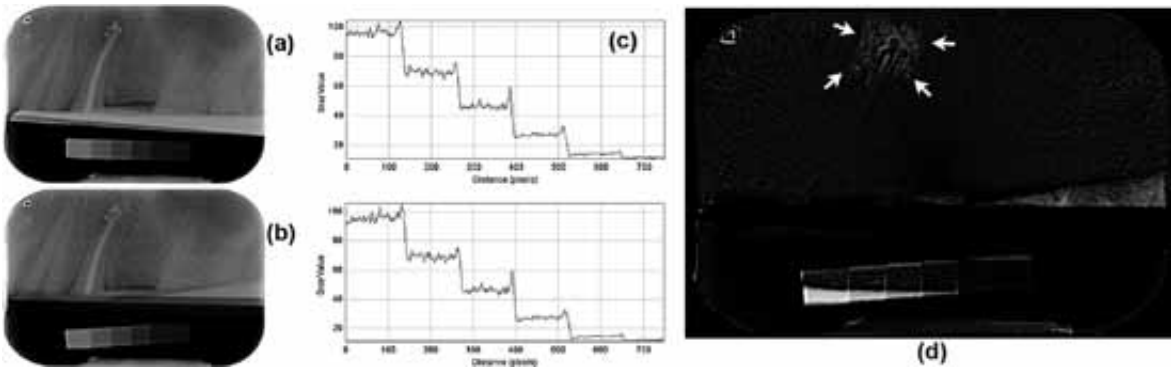

Figure 1 Digital subtraction of radiographic images: (a) postoperative radiography at baseline; (b) radiographic control after 6 months; (c) equalization of the two histograms representing the mean gray level measured on the reference scales; (d) product of the imagine subtraction, arrows indicate the mineralization area of newly formed bone.

irrigation and drying were the same as G1. The Pulp Canal Sealer (SybronEndo, Orange, CA, USA) was placed at the canal orifice with a size 15K file. An obturation procedure similar to G1 was performed, but making use of GT Series X Obturators and Thermaprep oven (Dentsply Tulsa Dental Specialties).

The radiographic protocol consisted on two periapical radiographs: the postoperative control (t_0) and a second radiograph after 6 months (t_1). In order to have reproducible film position at the two experimental time points, the bite-block of a Rinn film mount (Dentsply Rinn, Elgin, IL, USA) was adapted to act as impression tray for silicon occlusal registration (Optosil putty, Heraeus Kulzer, Hanau, Germany). The digital films (Durr Dental, Bietighein-Bissingen, Germany) were exposed to the same X-ray source (2200 Intraoral X Ray System, Kodak Dental Systems, Rochester, NY, USA) set at 70 kV, 8 mA, 0.20 s. An aluminum scale presenting steps that were 8, 6, 4, 3, 2 and 1 mm high was included in the radiographs according to the protocol described by Benfica et al.[8]

The analysis of digital images was carried out by means of two computer programs: Adobe Photoshop CS (San Jose, CA, USA) and ImageJ (U.S. National Institutes of Health, Bethesda, Maryland, USA, http://imagej.nih.gov/ij/, 1997–2011). Gamma and contrast correction of the images taken at baseline and after 6 months were equalized according to the 8-bit gray-value arbitrary units histograms measured on the scale (0 = black, 255 = white). The two corrected images were superimposed and underwent digital subtraction.[12] The resulting images were assessed to identify remineralization areas inside the periapical radiolucencies (Fig. 1). The scoring method described by Katebzadeh et al.[13] was adopted:

1. Healed: normal trabecular bone aspect and periodontal ligament width.
2. Improved: reduction of lesion size.
3. Failed: bigger or unchanged lesion.
4. X: unreadable radiograph due to technical errors.

Before starting the treatment and at the 6-month recall, tooth vertical percussion test and palpation in the vestibular fold near the apical region of the root tips were also performed and registered as binary data (presence/absence).

Collected data were analyzed with statistical software (Statistical Package for Social Sciences v15.0, SPSS Inc., Chicago, IL, USA). The experimental groups were tested for the homogeneity of the baseline parameters (age, number of canals per tooth, maximum apical diameter, positivity to percussion and palpation) with the Mann–Whitney and Chi-squared tests. The same tests were used to assess the significance of the differences between the groups in terms of radiographic score and clinical examination (percussion and palpation), respectively. The value of α was set at 0.05.

Results

The patients' preoperative data, the outcome of clinical tests and the radiographic scores are summarized in Table 1. No differences were pointed out in terms of age, number of canals per tooth, maximum apical diameter, response to percussion and palpation preoperative tests. Of the 84 patients enrolled for the study, 63 (75%) attended controls. The radiographic success rate was: in G1, healing 48.4%, improvement 48.4% and failure 3.2%; in G2, healing 50.0%, improvement 43.8% and failure 6.2%. Only one patient per group was found to be positive to clinical tests after 6 months and both were scored as radiographic failure. No significant differences between groups in terms of radiographic score and positivity to clinical tests came forth from the statistical analysis.

Discussion

The statistical analysis of the baseline parameters did not identify any significant difference between experimental groups, thus attesting that the randomization process had been carried out effectively. The failure of endodontic treatment is the result of a microbial infection.[14] Areas of uninstrumented root canal wall, infected dentin tubules and voids in the root filling permit the survival of bacterial biofilm.[15] A great amount of scientific literature has been produced on the success of the endodontic treatment, but there is a remarkable variability of reported success rates.[16] The assessment methods for endodontic success used in the studies on human subjects involve clinical and radiographic examinations, but they are often different and not standardized. The success rate that can be drawn ranges from 75 to 97%.[6,15–19] These data are extracted from retrospective

Table 1 Anamnestic variables, endodontic data, clinical and radiographic parameters registered at baseline and after 6 months: comparison between groups.

	Age (y)	No. of canals per tooth (*n*)	Maximum apical diameter (mm)	Vertical percussion test at baseline (%)		Palpation test at baseline (%)		Vertical percussion test after 6 months (%)		Palpation test after 6 months (%)		Radiographic score (*n*)			
				+	−	+	−	+	−	+	−	1	2	3	4
G1	41.9 ± 16.6	2.0 ± 1.1	0.35 ± 0.06	5	95	10	90	3	97	3	97	15	15	1	0
n_b = 41															
n_{6m} = 31															
G2	45.1 ± 17.7	2.0 ± 1.0	0.37 ± 0.06	12	88	7	93	3	97	3	97	16	14	2	0
n_b = 43															
n_{6m} = 32															
Diff.	p = 0.405	p = 0.720	p = 0.203	p = 0.263		p = 0.645		p = 1.000		p = 1.000		p = 1.000			

n_b, sample size at baseline; n_{6m}, sample size after 6 months; Diff., statistical significance of difference between groups.

studies or reviews of the literature, where the success rates obtained in teeth with or without periapical disease are not always distinguished. A study comparing the outcome of endodontic treatments performed with nickel–titanium rotary instruments and Thermafil technique reported success rates of 94.4% in teeth without periapical lesion and 48.2% when the lesion was present.[20] According to Ng et al.,[21] the endodontic success is 8–13% lower in case of periapical radiolucency compared to the treatment of teeth with healthy periodontum. If one considers only the radiographic scores of complete healing, the present study found that the success rate were 48.4% in the group treated with Revo-S/One Step Obturator system and 50.0% in the GTX/GTX Obturator group. However, it is reasonable to suppose that at least a part of the improved periapical conditions could be expression of an ongoing healing process that has not ended yet. With this in mind, the findings of the present study have the potential to reveal success rates around 96% in G1 and 94% in G2; nevertheless, extending the follow-up time for these cases remains mandatory. In the present study, similar success rates were found regardless of the treatment protocol.

The nickel–titanium rotary files chosen for this study were selected because they are manufactured by following modern concepts and are offered with a dedicated carrier based-system, which tends to reduce the operator dependence. GTX instruments are the evolution of the GT rotary files. The manufacturer claims that the new cutting-edge design with coil angulation and variable radial planes can increase the cutting efficiency of the instrument. GTX files are constituted of M-Wire alloy, which is obtained through a series of thermic treatments with the intent to grant improved mechanical properties. There is still concern about this issue; in fact, the early studies did not find any significant increase of resistance to cyclic fatigue[22] and torsional stress,[23] whereas more recent works reported greater resistance to flection[24] and torsion[25] and prolonged cyclic fatigue life[26] when compared with GT files. Revo-S instruments are characterized by an asymmetric section with three different radii that generates as many cutting edges. This feature would make the activated instrument move inside the canal with a snake-like motion that, in the manufacturer's opinion, allows for better removal of dentin debris. Revo-S instruments have been introduced recently and only few studies have tested them. Basrani et al.[27] found that their prolonged use did not affect their fracture resistance under torsional stress. The incidence of dentinal microcrack formation associated with Revo-S files was lower than HERO Shaper (Micro-Mega), Twisted File (SybronEndo) and ProTaper (Dentsply Maillefer).[28] Recent studies on Revo-S files demonstrated their ability to maintain the original canal curvature assessed by cone-beam computed tomography[29] and a tendency to apical extrusion similar to manual files.[30]

Mirfendereski et al.[10] demonstrated by micro-computed tomographic analysis that a carrier-based technique, presenting similar characteristics to the systems tested in the present study, can produce a significant lower amount of voids in the apical 6 mm of the canal than the continuous wave of condensation technique. The root filling ability of Thermafil, forerunner of current carrier-based systems, has been largely investigated under several experimental conditions. It was found that Thermafil presents similar or superior

filling and sealing ability to cold lateral condensation and continuous wave of condensation technique.[31–33]

The DSR method was useful for the identification of radiographic changes of periapical lesions after 6 months. The examined endodontic techniques allowed healing rates nearly of half of the patients at the end of the observation period. Despite only three cases of failure, the improvement of clinical and radiographic parameters can be interpreted as an incomplete healing process. For these reasons, the follow-up time should be prolonged for near the half of the patients. A potential shortcoming of DSR analysis is that the images to be subtracted must be acquired very accurately at different experimental time points.[34] The effectiveness of this analysis strictly depends on the reproducibility of the radiograph regarding contrast, brightness and geometrical distortion.[12] The use of the long cone paralleling technique with an impression on the biteblock of film mount has been advocated to optimize image quality and reduce distortion.[35]

Cone-beam computed tomography is a recent alternative method whose high diagnostic sensibility has been already reported.[36] This analysis is unfortunately not free from disadvantages for the clinician, e.g. the generation of artifacts when metallic prostheses are present and the irradiation of the patient with a relatively higher radiation dose than conventional radiographs.[8]

The present study unveils the possibility to identify by DSR early bone tissue mineralization. That is a potential advantage from a clinical point of view, because it would be possible to anticipate the definitive rehabilitation of teeth with uncertain prognosis.

Conclusions

Within the limitation of the present study and bearing in mind that the registered success rates are consistent with the data available in literature, the considered integrated systems for endodontic treatment represent a valid alternative to traditional techniques, especially for their simplicity of use. The DSR method allows an early detection of bone remineralization and this can constitute an advantage for the anticipation of the final tooth restoration.

Clinical relevance

The shaping and filling examined systems have the potential to reduce the clinical therapeutic times and technical difficulties because they simplify the treatment techniques. At the same time, they allowed for high 6-month success rates.

Conflict of interest

The authors declare no conflict of interest.

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ORIGINAL ARTICLE/ARTICOLO ORIGINALE

Quality of canal obturation assessed by micro-computed tomography: Influence of filling technique and post placement in canals shaped with Reciproc

Qualità dell'otturazione canalare valutata con microtomografia computerizzata: influenza di tecnica di otturazione e posizionamento del perno in canali sagomati con Reciproc

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KEYWORDS
Continuous wave of condensation;
Endodontic post;
Micro-computed tomography;
Reciproc;
Single point technique.

Abstract
Aim: To assess by micro-computed tomography (μCT) the quality of fillings in canals shaped with Reciproc considering the effects of filling technique and post insertion.
Methodology: The canals of 60 single-rooted teeth were instrumented with Reciproc R40 and randomly assigned to four groups ($n = 15$): G1, single point; G2, as G1 + DT Light Post; G3, continuous wave of condensation; G4, as G3 + DT Light Post. The filling voids were quantified by μCT. Data were statistically analysed by non-parametric test ($p < 0.05$).
Results: Filling greater than 96% of the entire canal volume was observed in all groups. The volume of internal voids was greater in G3 than in G4 ($p < 0.005$).

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PAROLE CHIAVE
Microtomografia computerizzata;
Onda continua di condensazione;
Perno endodontico;
Reciproc;
Tecnica del cono singolo.

Conclusions: Our findings support the use of simplified techniques of canal shaping, filling with matching taper points and post cementation.

Riassunto
Obiettivi: Determinare con la microtomografia (μCT) la qualità dell'otturazione in canali sagomati con Reciproc in funzione di tecnica d'otturazione e inserimento del perno.
Materiali e metodi: I canali di 60 monoradicolati sono stati sagomati con Reciproc R40 e assegnati a quattro gruppi ($n = 15$): G1, cono singolo; G2, come G1 + DT Light Post; G3, onda continua di condensazione; G4, come G3 + DT Light Post. I vuoti di riempimento sono stati quantificati con (μCT). I dati sono stati analizzati con test non parametrici ($p < 0,05$).
Risultati: In tutti i gruppi il canale era riempito per più del 96%. In G3 il volume di vuoti interni era maggiore rispetto a G4 ($p < 0,005$).
Conclusioni: Il presente studio supporta l'utilizzo di tecniche endodontiche semplificate di sagomatura, otturazione con coni di conicità corrispondente e cementazione del perno.

Introduction

Traditionally, root canal shaping has been carried out by manual instrumentation with stainless steel files. The advent of nickel–titanium rotary files has introduced substantial improvements in the daily practice, reducing the operative steps and the time needed for instrumentation.[1,2] Nickel–titanium instruments are flexible[3] and have greater cutting ability of conventional hand files.[4] Nonetheless, the majority of nickel–titanium rotary systems available on the market have protocols involving several steps and requiring a multitude of instruments.

The reciprocating motion of root canal shaping files is a recent innovation that has raised the interest of both clinicians and researchers. In fact, some advantages have been reported deriving from the use of nickel–titanium instruments used in reciprocating motion, such as better canal centering ability[5] and resistance to cyclic fatigue.[6–8] To combine the need for simpler protocols and the potential benefits of reciprocating motion, single-file reciprocating systems have been conceived and created. Among them, the Reciproc and the WaveOne systems, both produced by the same manufacturer (VDW GmbH, Munich, Germany), have been already taken into consideration by scientific literature. It has been found that the former presents greater cyclic fatigue resistance[7,9–12] and require shorter preparation time than the latter.[13,14] Furthermore, similar disinfecting and shaping performance was reported between Reciproc and new-concept self-adapting instruments (SAF, ReDent-Nova, Ra'anana, Israel).[15,16]

The single point technique is a simplification of the cold lateral condensation, in which the amount of sealer is minimized not by inserting several accessory gutta-percha points, but rather using a single point matching the taper of root canal preparation. Since nickel–titanium instrumentation is capable of producing a precise taper in the root canal, manufacturers claim that the correspondence between shaping file and gutta-percha point allows for effective filling.[17] This has been confirmed by recent studies when this technique was applied in mostly round canals.[18,19] In the single point technique, the gutta-percha mass is homogeneous and compact and the procedure does not entail any possibility to introduce voids into the material. Contrariwise, the formation of undesired filling voids in the coronal and middle thirds is a typical shortcoming of the back-fill phase of warm gutta-percha vertical compaction techniques, especially if performed by inexperienced operators.[20]

The long-term prognosis of the endodontically treated teeth depends also on the quality of the crown restoration,[21] which can require the positioning of one or more posts. It has not been clarified yet whether the preparation of the post space and the post cementation affect the endodontic seal.[22] The μCT analysis is a precise, reliable, non-destructive technique for the study of root canal filling components.[23] In the assessment of root canal obturation there is a consistent correspondence between qualitative and quantitative findings of μCT and histologic examination.[23] Several studies have used this technique for the study of root anatomy,[24,25] the effects of various instrumentation techniques on canal shape[26–32] and the effectiveness of root canal filling systems.[18,20,23,33] The aim of the present study on extracted teeth is to assess by micro-computed tomography (μCT) the quality of canal filling and formation of voids in canals shaped with Reciproc files in relation to filling technique (single point technique and continuous wave of condensation technique) and post cementation.

Materials and methods

Samples preparation

Sixty single-rooted caries-free extracted teeth were immersed for 2 h into a 5.25% sodium hypochlorite solution to dissolve the periodontal ligament and then they were cleaned with a periodontal scaler. Fifteen-millimeter long roots were obtained by cutting the crown of each tooth with a diamond bur mounted on a high-speed handpiece. For each root, digital radiographs (RVG 6100, Kodak Dental Systems, Rochester, NY, USA) were acquired in bucco-lingual and mesio-distal projection to verify the presence of a single canal. Apical patency was checked by inserting into the canal a size 10K-file (Dentsply Maillefer, Ballaigues, Switzerland). The working length measurement was carried out according

to Somma and coworkers.[18] The choice of the Reciproc instrument size was done by following the instructions of the manufacturer (VDW GmbH). Based on preoperative radiographs and after the insertion of size 20 and 30K files (Dentsply Maillefer), all canals were instrumented with Reciproc R40. The file was slowly led to working length with back-and-forth movements. Every three movements, the file was extracted, cleaned and the canal was irrigated with 2 ml 2.5% sodium hypochlorite. After the completion of the shaping procedure, the canal was rinsed with 5 ml 17% EDTA (Ogna, Muggiò, Italy), 10 ml sodium hypochlorite and abundant saline solution.[34] Prepared canals were dried with sterile paper points (VDW GmbH).

The roots were randomly divided into four experimental groups (G1—G4, $n = 15$) that were treated as follows:

- G1: single point. A Reciproc gutta-percha master point (VDW GmbH) corresponding to the R40 file was inserted into the canal to check the tug-back. Canal walls were smeared with AH Plus sealer (Dentsply Maillefer) making use of a lentulo paste filler. The apical portion of the gutta-percha point was coated with sealer and the point was inserted to working length. Following the radiographic control, the point was cut at the canal orifice with a heated instrument.
- G2: single point and post cementation. Root canal filling as in G1. The gutta-percha was removed with a heated plugger to depth of 8 mm from the coronal reference point.[35] The post space was prepared with a DT Light Post Illusion X-RO size 2 bur (RST, St Egreve, France), rinsed with sterile water and dried with a gentle air blow and paper points. Canal walls were etched for 15 s with 37% orthophosphoric acid (Totale Etch, Ivoclar Vivadent, Schaan, Liechtenstein); the acid gel was rinsed, reapplied for the same amount of time and rinsed again. After drying the canal walls, the components of the adhesive system (Auto Cure Activator and XP Adhesive, Dentsply Caulk, Milford, DE, USA) were mixed in 1:1 ratio and brushed for 20 s into the root canal with and endodontic microbrush (Endo White Applicator, Bisco, Schaumburg, IL, USA). The CoreXFlow cement (Dentsply Maillefer) was extruded using its self-mixing dispenser into the post space and the posts were immediately inserted. The cement was light-cured for 40 s with a halogen lamp (Elipar 2500, 3M ESPE, St. Paul, MN, USA).
- G3: continuous wave of condensation. A Fine Buchanan plugger (System B; SybronEndo Corp., Orange CA, USA) was bent to adapt at 4 mm from the working length without touching the canal walls. This depth was marked with a rubber stop. A Reciproc R40 gutta-percha point was inserted 0.5 mm short of the working length to assess the presence of tug-back. Its apical portion was trimmed, if needed, and coated with AH Plus sealer. The point was then reinserted to the designed length. The System B unit was set to 200 °C and full power, with the switch in touch mode. The activated plugger was slowly led to 1 mm from the rubber stop, then deactivated and firmly pushed in apical direction for the remaining millimeter. The pressure was maintained for 10 s. The plugger was reactivated for 1 s in order to detach it from the condensed gutta-percha and lastly extracted. When the coronal gutta-percha remnants were removed from canal walls, the back-fill procedure was carried out with the Obtura II syringe (Morita Corporation, Tokyo, Japan).
- G4: continuous wave of condensation and post cementation. Root canal filling as G3 and post cementation as G2.

At the end of the endodontic treatment, the coronal surfaces of the sectioned roots were etched for 15 s with 37% orthophosphoric acid (Total Etch, Ivoclar Vivadent), treated with an adhesive system (Adper Scotchbond, 3M ESPE) and covered with composite resin (Filtek Supreme, 3M ESPE), both of which being light-cured for 20 s. The specimens were stored for 1 week at 100% relative humidity to allow the complete setting of the sealer.

Micro-computed tomography analysis

The specimens underwent μCT scan with SkyScan 1072 (SkyScan, Kartuizersweg, Belgium) set at the following exposure parameters: 10 W, 100 kV, 98 μA, 5.9 s. The samples were positioned onto a 1 mm-thick aluminum tray. Image data were acquired at 15× magnification, performing rotational steps of 0.45° and obtaining a pixel resolution of 19.1 μm × 19.1 μm. A series of two-dimensional lateral projections of the specimens was acquired during a 180° rotation of the tray along the vertical axis. Digital data were elaborated with the aid of the reconstruction software NRecon v1.4.0 (SkyScan). The distance between each slice was 38.0 μm. The final reconstructed slices were 16-bit grayscale images with a resolution of 512 × 512 pixels.

The images underwent a binarization process in order to identify the regions of interest (i.e. the voids) and measure their volumes. This consisted on the segmentation of the grayscale images into material and non-material (void). The μCT analysis quantified (mm^3):

- the entire canal volume;
- the root filling volume, deriving from the sum of the volumes of gutta-percha, sealer and post in groups 2 and 4;
- the volume of the voids within the filling materials (internal voids), along the canal walls (external voids) and inside the filling materials but reaching the canal walls (combined voids).

Percentages of void and root filling relative to the entire canal volume were calculated.

Statistical analysis

Collected data underwent statistical analysis with the Statistical Package for Social Sciences v.15 (SPSS Inc., Chicago, IL, USA). All data sets were tested for the existence of the assumptions for the use of parametric tests by means of Shapiro—Wilk and Levene tests. The homogeneity of the canal volumes and the significance of the differences in terms of void volumes among groups were assessed with a Kruskal—Wallis test, pairwise comparisons were carried out with a Mann—Whitney test with Bonferroni correction. A p value lower than 0.05 was regarded statistically significant.

Results

The statistical analysis did not reveal any significant difference in terms of canal volume among groups. The mean values and the standard deviations of the percentages of filling and voids are reported in Table 1. The mean filling

Table 1 Mean percentages and standard deviations of the volume of root canal filling and voids.

	Root canal filling (%)	Internal voids (%)	External voids (%)	Combined voids (%)
G1	96.775 ± 1.634	0.252 ± 0.162	0.176 ± 0.147	2.797 ± 1.583
G2	97.374 ± 1.587	0.267 ± 0.170	0.178 ± 0.140	2.182 ± 1.672
G3	96.289 ± 2.467	0.642 ± 0.887	0.335 ± 0.240	2.735 ± 2.232
G4	96.336 ± 2.563	0.168 ± 0.126 *	0.136 ± 0.098	3.360 ± 2.558
	NS	$p < 0.005$	NS	NS

Comparison within each column: (*) statistically significant difference from G3; NS, not statistically significant difference.

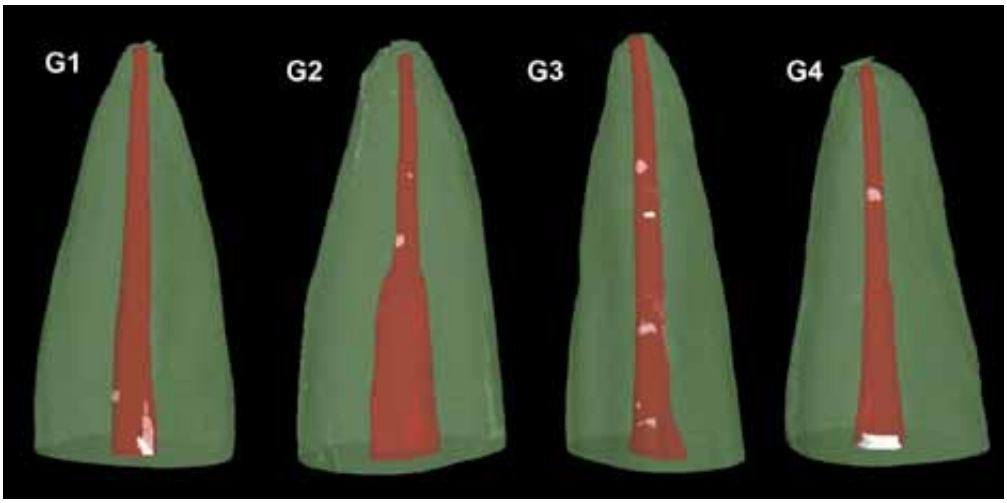

Figure 1 Representative images of three-dimensional reconstructions of μCT scan data: G1, single point; G2; single point and post cementation; G3, continuous wave of condensation technique; G4, continuous wave of condensation technique and post cementation. Color legend: light green, root; red, filling materials (gutta-percha, sealer, post and cement); white, voids.

percentages were high in all groups and never lower than 96%. No statistically significant difference among groups was pointed out in percentages of root filling volume, external and combined voids. A significantly greater percentage of internal voids volume was found in the group in which the root canal was filled with the continuous wave of condensation technique (G3) in comparison to the group with the same filling technique where the post was positioned (G4) ($p < 0.005$). Representative three-dimensional reconstruction images of a specimen belonging to each group are portrayed in Fig. 1. Voids were sporadic and distributed without regular patterns, except from G3, where voids tended to be entrapped between the subsequent gutta-percha masses representing the several steps of the back-fill procedure.

Discussion

The homogeneity of the canal volumes among groups ensures that the randomization process was successful in avoiding differences of canal dimensions. The results of the present study show that both the tested obturation techniques were effective in filling the root canal, with less than 4% of the shaped canal remaining unfilled in all groups. The post cementation did not influence the root canal filling percentage. Despite essential differences in the two filling techniques and the possibility of inducing root filling alterations resulting from the post space preparation, similar external and combined void volumes were observed among groups. On the other hand, a significant greater amount of internal voids was found in G3 (continuous wave of condensation technique) compared to the group with same filling technique and post cementation (G4). This finding can be explained by the fact that the post cementation involves the removal of the coronal part of the filling materials (where voids are more likely to occur) and is effective in avoiding the formation of new voids.

Internal voids can be considered less relevant from a clinical point of view because they represent an unfavorable environment for bacteria that remain in the root canal system despite the cleaning and disinfecting procedures. On the contrary, external and combined voids are caused by unsuccessful adaptation or detachment between filling materials and dentin. In this area, the leakage risk is likely to be increased and potentially pathogenic microorganisms can survive in a confined reservoir.[18]

The single point technique is reasonably simple and requires a lower number of steps than traditional warm vertical compaction techniques. The continuous wave of condensation technique has greater sensibility to the operator and entails proper training and experience to limit the risk of incorporating voids in the filling materials during the back-fill phase.[20] The quality obtained with matched taper

points has been found to be similar to warm compaction techniques by many authors in case of narrow mostly round canals.[18,36–39] In light of this, the single point technique appears to be useful for the obturation of canals with these characteristics, whereas the amount of sealer is likely to be excessive when filling wide irregular canals with the single point technique.

Single-file systems have been introduced on the market only recently; consequently, few studies on their performance are available. To the best of our knowledge, no previous μCT work has been published on the fillings in canal shaped with the Reciproc files, so that a direct comparison of our findings with other works is not feasible. Only a recent study compared the quality of obturation in canals shaped with single-file reciprocating systems (Reciproc and WaveOne) or conventional rotary files (Mtwo, Sweden & Martina, Due Carrare, Italy; FlexMaster, VDV GmbH; ProTaper, Dentsply Maillefer) and filled with laterally compacted matching single points.[40] Making use of several cross-sections, the authors stated that constant tapered matching points (FlexMaster, Mtwo) yielded significantly higher gutta-percha filling areas than variable tapered points (Reciproc, WaveOne, ProTaper).[40]

The single point obturation technique was effective in filling a considerable portion of the root canal and allowed for similar filling percentages to the continuous wave of condensation technique, which represents the evolution of the classic warm vertical compaction. This is in accordance with the findings of a previous work that highlighted no differences between the single point and two warm gutta-percha techniques.[18,19] The results of the present study corroborate the evidence supporting the use of simplified technique in specific cases, such as narrow mostly round canals.

Conclusions

Within the limitations of the present study, all the examined techniques exhibited high root canal filling rates and similar configuration of voids formation. The post cementation reduced the internal voids of the continuous wave of condensation group. Further clinical studies are needed to confirm the laboratory findings.

Clinical relevance

The clinical practice can be facilitated by the use of simplified, even single-file, systems (e.g. Reciproc). The single point technique can be a valid alternative to conventional warm compaction techniques, also when a post cementation is planned.

Conflict of interest

The authors declare no conflict of interest.

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ORIGINAL ARTICLE/ARTICOLO ORIGINALE

Endodontic and periodontal treatment of dens invaginatus: Report of 2 clinical cases

Trattamento endodontico e parodontale di dens invaginatus: rapporto di 2 casi clinici

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KEYWORDS
Dens invaginatus;
Classification of Oehlers;
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Abnormal tooth development;
Pro-Root MTA.

Abstract
Objectives, materials and methods: The purpose of this work is to describe the treatment of two lateral incisors affected by developmental abnormalities (Oehlers, types I and II) treated respectively through periodontal regenerative therapy associated with conservative correction of shape anomaly, and orthograde retreatment.
Results: Both therapies used resulted in complete remission of the initial symptoms and total healing of the lesions present.
Conclusions: "Dens invaginatus" is a dental development malformation that can predispose to the onset of caries, pulpal involvement and periodontal lesions, the treatment of which may require a specialized and often multidisciplinary approach. This malformation should therefore be recognized in time in order to establish effective prevention protocols, when possible, or prevent related consequences generating non-recoverable endodontic, periodontal or combined disease.

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PAROLE CHIAVE
Dens invaginatus;
Classificazione di Oehlers;
Incisivo laterale superiore;
Anomalie sviluppo dentale;
MTA-Pro root.

Riassunto
Obiettivi e materiali e metodi: Scopo del lavoro è descrivere il trattamento di due incisivi laterali superiori affetti da anomalie di sviluppo (Oehlers, tipo I e II) trattati rispettivamente mediante terapia rigenerativa parodontale associata a correzione conservativa dell'anomalia di forma, e ritrattamento ortogrado.
Risultati: Entrambe le terapie praticate hanno determinato la completa remissione dei sintomi iniziali e la totale guarigione delle lesioni presenti.
Conclusioni: Il ''dens invaginatus'' e' una malformazione dello sviluppo dentale che puo' predisporre all'insorgenza di carie, coinvolgimento pulpare e lesioni parodontali, il cui trattamento può richiedere un approccio specialistico e talvolta multidisciplinare. Tale malformazione dovrebbe essere quindi riconosciuta per tempo per poter instaurare efficaci protocolli di prevenzione, quando possibili, o evitare che le conseguenze correlate generino una patologia endodontica, parodontale o combinata non recuperabile.

Introduction

During the physical examination of the oral cavity the observation of dental anomalies is a very frequent clinical event. Within these anomalies dens invaginatus constitutes one of the most commonly encountered. According to the literature, in fact, its prevalence is between 0.3% and 10%.[1] This is an alteration of odontogenesis that results in invagination of the enamel organ into the dental papilla.[2] Salter was the first to describe in 1855 these anatomical abnormalities defining them as a ''tooth in a tooth.'' The subsequent discovery of X-rays allowed Bush in 1897 to describe the radiographic appearance of such pathologic findings, confirming the presence of a dysmorphic dental element inside a tooth proper.[3]

The permanent teeth more frequently affected by this anomaly are the upper lateral incisors (90% versus 6.5% of posterior teeth), often bilaterally (in 43% of cases according to the study by Grahnen et al.), also in the literature cases have been reported of dens invaginatus, also borne by the second deciduous molars.[2,4,5] The etiology of this particular clinical picture remains very controversial, as evidenced in the work.[6,7]

The purpose of this work is the description of two clinical cases that came to our attention relating to the above-mentioned dental anomaly, attributable to periodontal preservation and endodontic treatment, respectively.

Materials and methods

Case 1

In May 2010, patient I.D. was presented to our attention, of Asian descent and 36 years old, reporting pain symptoms in the palatine region at element 2.2. The proximate and remote medical history were negative, as well as was the extra-oral examination. The intra-oral examination of that area however allowed the observation of invagination of the enamel which distorted the Carabelli cuspid ancillary of palatal element 2.2. There was also a brown vertical groove in the region of convergence of the invagination of the enamel, and the periodontal probing of that groove measured 9 mm. An X-ray (radiograph performed with Rinn centering) showed the presence of an infrabony, mesial and distal defect in which the peaks were normo-maintained (''bowl-like'' infrabony defect). Detailed mapping of the periodontal defect for the mentioned diagnosis was also set out.

The vitality test of element 2.2 was normo-positive, there was no occurrence of pain caused to the vertical and lateral percussion, and mobility was 1°. After the initial site preparation consisting of ultrasonic decontamination and manual classical instrumentation (curettage), we opted for a periodontal regeneration of the defect, with the intent also at the same time to correct the open dental anatomy invaginated above and subgingivally, responsible for the pathology described. In pursuing this objective, we proceeded as follows. After performing plexus anesthesia 1:100,000 (Ubistesin 40 mg/ml, 3M-Espe, Seefeld, Germany), vestibularly and palatally to element 2.2, we performed a palatal intrasulcular incision from mesial 1.3 to distal 1.1. Into the periosteum a full thickness flap was low-cut carved to guarantee access to the surgical defect and optimal vision. We therefore proceeded to clean up and decontaminate the infra-formed bone pocket further, using both hand tools (Gracey curettes 3/4 and 7/8) and mechanical (long shank burs, 40 micron particle size mounted on counter-angle to blue ring, Perioset cutter CA 440 Intensiv, Montagnola, Switzerland) and antiseptic agents (washing with 12 volumes hydrogen peroxide and chlorhexidine 0.12%). By the use of cutters mounted on the red ring counter-angle handpiece we smoothed and flattened the brown groove throughout its length in correspondence to the entire invagination, and we filled with Mineral Aggregate Trioxid white color. This according to a rationale for use for which please refer to that section of the discussion. Before completing the operation dedicating ourselves to the regeneration of the periodontal defect in a manner to be described below, we assembled an open flap rubber dam, and ran coronally to the cemento-enamel line reconstruction in a small composite ''bridge'', above the MTA, (ProRoot MTA Root Canal Repair Material, Dentsply Tulsa Dental Specialties, Tulsa, Oklahoma, USA) to improve the anatomy of invagination corresponding to the dental track, which was thus transformed into a convexity. At this point, apically to the cemento-enamel junction, we filled the infra-bone defect with deproteinized bovine bone (Bioss, Geistlich Pharma, Wolhusen Switzerland) positioned at the cemento-enamel junction, and the grafting of biocompatible

material was covered with a collagen membrane (Bio-Gide, Geistlich Pharma, Wolhusen Switzerland), suitably trimmed and shaped. Finally we replaced the flap to its original position, by applying a suture at detached points with the vertical mattress stitch and simple detached points on the apex of the papillae between the elements involved (Goretex CV5, Gore-Tex sutures, WL Gore & Associates, Flagstaff, Arizona, USA).[8,9]

We prescribed antibiotic medication to the patient (Augmentin cp. 1 g, 2 cp./day for 5 days) and an analgesic/anti-inflammatory (Synflex strong 550 mg, 1 cp as needed), also suggesting the use of local mouthwashes for the entire stay in situ of the suture (10—2 volume hydrogen peroxide, diluted to 50%, 1 rinse per day, Chlorhexidine 0.12% with Anti-Discoloration System 2/day, chlorhexidine gel applications 4 times/day), which was removed on day 8. The patient's clinical course was good, with no complications, and marked by little postoperative pain. In particular, the patient has not materialized short or long-distance exposure of portions of the membrane, proving the tissue seal was reached via the suturing applied and the subsequent primary closure healing, or reported the presence of micro-granules of bio-material within the oral cavity. This case is described iconographically in Figs. 1—4.

Case 2

S.I., 14 years old, is referred as a patient by a colleague after the repeated occurrence of abscesses borne by the upper right lateral incisor (item 1.2). The necrotic element is treated by orthograding but without success. Two months ago a first reprocessing was undertaken but acute symptoms persist, with the further emergence of a fistula on the vestibular fornix. Radiographically three areas of radiolucency were shown, one at apical level and two on the mesial profile of the root. Within 4 months of the last operation a second reprocessing was carried out that temporarily resolved the abscess condition. The reappearance of the fistula after 6 months argues in favor of sending the patient for a new reprocessing to be performed by microscopy.

The re-opening of the pulp chamber and a more accurate view of the complex root system highlights the presence of

Figure 1 Case 1. The initial case: note the presence of a brown groove corresponding to the track.

Figure 2 Initial radiography. Periodontal lesion infra-bone and presence of tooth shape anomaly concerning item 2.2.

multiple inter-canal septa, which prevented, in the previous treatments, the performance of adequate action by irrigating solutions and, consequently, obtaining an effective three-dimensional seal in the final stage of filling. Through the use of the operating microscope and special ultrasonic tips (Start X no. 3, Dentsply Maillefer, Tulsa, Oklahoma, USA), the septa, and necrotic and infected material contained therein was removed. High magnification vision together with effective coaxial illumination made it possible to detect the presence of three independent output exits, two at the level of the apical portion and one on the buccal surface in correspondence with the middle third of the root. It was not necessary to use the rotating tools. The focus was on deep irrigation action, alternating the use of heated sodium hypochlorite (5% Niclor, OGNA Lab S.r.l., Muggiò MB, ITALY) and EDTA (Tubuliclean, OGNA Lab S.r.l., Muggiò MB, ITALY), activated by ultrasound (Endo Activator, Dentsply Tulsa Specialties, Tulsa, Oklahoma, USA) and left to act for about 45 min. The abnormal morphology of the root canal system and persistent apical moisture made us opt for the execution of an obturation MTA filling (MTA ProRoot Root Canal Repair Material, Dentsply Tulsa Dental Specialties, Tulsa, Oklahoma, USA) in white commercial form. The material was made with the MAP-SYSTEM dedicated tip (Dentsply Maillefer, Tulsa, Oklahoma, USA) system with increments starting at 3 independent exits until it reached a thickness of 8 mm. Compaction was favored by the use of a dedicated plugger. The 4 mm upper portion has remained in contact with the damp apical interface, the lower one with wet cotton placed in the chamber. The provisional filling was made with a 5 mm layer of Cavit (3M-Espe, Seefeld, Germany). After 72 h the correct hardening of the MTA was verified and the final filling proceeded, performed using composite materials (Filtek Supreme, 3M-Espe, Seefeld, Germany). Case 2 is also illustrated iconographically in Figs. 5—13. This study was undertaken by consent of the patients involved and in accordance with ethical standards established by the

Figure 3 The patient shows at the initial physical examination almost perfect teeth. (a) The brown groove on the track of item 2.2 shows a very deep periodontal probing. (b) The palatal infra-bone lesion with flap open. It is clear that the dental anomaly, which promotes bacterial penetration, has contributed to the formation of the lesion. (c) After the ''smoothing'' of the brown groove and preparation of the infra-bone defect, Mineral Trioxide Aggregate (MTA Pro Root) was positioned and then the grafting of biocompatible material executed. (d) The defect is adequately protected by contouring a resorbable membrane. (e) The flap suture, palatine view. The small composite reconstruction performed open-flap, following isolation with rubber dam, which covers a portion of Pro-Root MTA coronally at the track, is evident.

Figure 4 Final radiograph at 18 months, with illustration of the steps performed and the apparent resolution of the original infra-bone defect (compare with Fig. 2).

Helsinki Declaration. Informed consent was freely and fully expressed by the patients involved before their recruitment.

Results

Case I. As shown in the clinical description of the case, the course of action had good results, the patient did not report particular pain, beyond the slight inconvenience post-surgery. The wound always seemed healthy and with rosy complexion, not denoting redness with clinical signs of inflammation or worse of re-infection of the site. We ran clinical and radiographic inspections by means of intra-oral radiographs every 15 days, 1 month, 2 months, 4 months, 6 months, 1 year. In each of the aforementioned controls the dental element appeared normal-vital in tests, stable, and non-tender to percussion. The radiographic appearance of the filled defect was gradually acquiring greater mineralization. The periodontal probing, not executed before a year after intervention, was less than 4 mm.

Figure 5 Case 2. Initial radiograph of the first treatment of item 1.2.

Case II. The acute symptoms, along with vestibular fistula, were resolved after 48 h from the operation. Radiographic controls after 6 and 12 months indicate the return of integrity of the cortical bone and the complete resolution of the case.

Figures 6 and 7 Intra-oral radiographs at 2 months (Figure 6) and 4 months (Figure 7) after the first reprocessing of the element. Note the presence of radio-transparent lesions evident clinically, associated with the appearance of a vestibular fistula.

Figure 8 Intra-oral X-ray 6 months after the second reprocessing.

Figure 10 New working lengths; we highlight: removal of septa, finding exits, deep cleansing obtained (checked with the operating microscope).

Discussion

Various etiology hypotheses were formulated in relation to dens invaginatus. According to a study by Rushton this condition would indicate a faulty cell stimulation of the enamel organ that would migrate to all the dental papilla.[10,11] Atkinson in 1943 suggested that behind this anomaly in tooth development there might be an outside force coming from the adjacent teeth or by traumatic or phlogistic events.[12] Subsequent discoveries in DNA research led to analyzing the genetic and hereditary aspect of the disease. In fact, there is some familial predisposition to the disorder. According to a study conducted on a population of 3020 Swedish children, about 2.7% present with dens invaginatus, 43% of whom have parents and 32% brothers or sisters with the same issue.[4]

In the literature there are many possibilities for the classification of the malformation considered.[13–16] The one that has experienced the most success due to its simplicity, but especially its prognostic value, is that of Oehlers.[17] He proposed as criteria for classification of invagination depth from the crown to the root by radiographic analysis:

- Type I: The invagination coated with enamel does not exceed the cemento-enamel junction.

Figure 9 Working lengths of the third retreatment (early care by Dr. Castro, 1 year after the second reprocessing previously performed by third parties).

Figure 11 MTA apical plug, with direct seal of output ports, direct wet cement apical contact, and compaction of the material performed by ultrasonic processes.

Figure 12 Three days after inserting a wet cotton-pellet in the chamber, the temporary filling is replaced with a final restoration in composite resin. Radiograph at 6 months after completion of therapy.

Figure 13 The final radiograph at 12 months shows the complete healing of the originally present lesions.

- Type II: The invagination coated with glaze, enters into the pulpal chamber but remains confined to the root canals without interaction with the periodontium.
- Type IIIA: The invagination extends to the roots and interacts with the periodontal ligament laterally through a pseudo-foramen. Generally there are no interactions with the pulp that is compressed in the root.
- Type IIIB: The invagination extends into the roots and interacts with the periodontal ligament through the apical foramen. There are usually no interactions with the pulp.

While inheriting all the limits of conventional radiography (two-dimensional representation of three-dimensional reality), this classification makes it possible to distinguish the incomplete invaginations (type I—II) from complete (type III) with its prognostic and therapeutic implications. The inflammatory processes borne by the invagination of an Oehlers type III have inevitable repercussions at the periodontal level, creating a lesion difficult to clinically manage. Fortunately, this type of problem is also the most rare, being only 5% of dentes invaginati, compared to 79% and 15% respectively of the Oehlers types I and II. Sometimes, the beginning of invagination is difficult to identify for which you may need the use of chemical detection systems like methylene blue or radiopaque, used in conjunction with magnification systems. But when should you suspect you are facing this type of problem? Often the Salter invaginations are accompanied by evident alterations in dental anatomy such as an increase in the mesial-distal diameter or lingual-labial element, the presence of a notch at the incisal level in association with a labial sulcus, a conical or triangular morphology, the presence of a girdle or a very prominent ''cusp heel''.[17—19] Obviously before these concerning clinical aspects, we cannot be exempt from conducting a careful radiographic examination, using not only the parallel rays technique, but by integrating this data with that of one or more intra-oral radiographs exposed by an X-ray tube inclined at 15° with respect to the film (unprojected radiography). Also in this case the dens invaginatus presents a possible wide range of radiographic representations: From the ''crosshair'' appearance, that of a pulp chamber of difficult definition, by the presence of a ''pseudo-channel'' that opens sideways to the periodontal ligament, in the presence of an abnormal lesion and irregular contours. All this portends the difficulties which the clinician may encounter should endodontic treatment of the element be required.

Regarding the histological appearance of the disease, it is noted that while the enamel and dentin of the ''external tooth'' are normal, on the contrary the tissues that cover the invagination appear dysplastic and sometimes may also present gaps and fenestrations, which constitute an easy access route for bacteria to the pulp. The SEM analysis of the invagination enamel reveals a different chemical composition, rich in phosphates and calcium ions and magnesium deficient. This is in clear contrast to the Beynon studies of 1982 according to which the tissues of the invagination would be hypo-mineralized.[1,3] The early interception of type I Oehlers, more than of other anomalies, turns out to be a discriminant in determining the prognosis of the dental element concerned. In fact, if you do not see pulpal pathology, the clinical intervention should be limited to a simple prophylactic sealing of the invagination. If, instead, the endodontic treatment is required, the therapeutic protocol can

vary depending on the case: from a simple pulpotomia of the immature tooth in pulpitis, necrotic tooth orthograde treatment, with or without endodontic surgery.[20]

Endodontic treatment of these teeth is a complex procedure because they have a difficult root canal anatomy and possible non-formation of the root apex, and in addition, the morphology of the main channel can be irregular and invaginated tissue could occupy and block the channel at different levels. These conditions often do not allow us to fully orchestrate the root canal walls.[21,22] For this reason you must often treat these teeth with a combined approach, i.e. with both an orthograde endodontic and endodontic-surgical treatment. Non-surgical treatment should be the first choice, and the surgical phase should occur only in cases where the orthograde canal treatment has not been successful, or in severe cases of dens invaginatus in which there are serious periapical lesions or if the teeth have anatomical variations that do not allow access and cleaning of all parts of the same channel.[23]

The work shown in case 1 is an upper lateral incisor with normo-positive vitality in which it was surgically addressed as a first choice, as endodontic treatment was not indicated, but rather the resolution of periodontal intra-bone defects generated as a result of the dental malformation present. Obtaining that resolution was due to proceeding with the decontamination of the site and the correction of the anatomy, to then be able to seal the invagination defect with white color Trioxid Mineral Aggregate. It was decided to use this material because of its affinity with a moist environment, such as the sub-crestal root surface, but especially because it allows the periodontal ligament that you want to regenerate to "find new attack," or better, provides a valid adhesion surface and thus promotes creeping, a phenomenon which does not occur with the composite material. In fact, according to a recent study in vitro on the roots of perforated elements, the amount of fibroblasts migrating from periodontal ligament is statistically higher in the vicinity of the perforations repaired with MTA than perforations not repaired or repaired with other materials (amalgam, composites, compomers and zinc oxide eugenol cement).[24]

Case 2 however refers to an upper right lateral necrotic incisor, clinically characterized by repeated abscess phenomena, by the presence of a vestibular fistula and 3 zones of radiolucency appreciable radiographically at an apical level and two on the profile of the mesial root. In this type of problem, you may experience an indirect interaction in this case between the pulp, the periodontal ligament and the oral cavity, so that bacteria from saliva could indirectly infect the endodontium, and subsequent necrosis led to the formation of the periapical lesion and periradicular lesions. Usually the patient does not notice the presence of an anomaly of the dens invaginatus until the onset of symptoms and clinical features like acute dento-alveolar abscess. In case 2, the more conservative solution was chosen given the difficulty of the case. In fact, using dedicated ultrasonic tips, it was decided to attack the unfavorable anatomy of the tooth coronal level only at, while in the third and apical middle one has totally abstained from orchestrating the channel, therefore making use of the instrumentation of the previous treatment and the use of root canal irrigating. Please note that the case in question, beyond the anatomical difficulties, remains a clinical case of "endodontic retreatment," whose prognosis requires maximum atraumaticity. Regarding the recommended systems of root canal obturation, root canal filling with calcium hydroxide for a limited period of time to attempt apexification of the element could be indicated: the abnormal morphology of the root canal system and the presence of persistent apical humidity made for opting for a filling with MTA (PRO-ROOT, Maillefer).[25] This material formed hard tissue with consistency significantly higher than the gutta-percha and to a high degree of biocompatibility. Therefore, it has become an excellent alternative to conventional long-term therapy with calcium hydroxide.

Conclusions

In the literature there are few studies that test the incidence of pulpal pathology in dens invaginati. According to a study by Ridell in 2004, 11.3% of teeth that have had preventive sealing of invagination practiced have, however, subsequently manifested pulpal pathology.[26] It is of paramount importance in every way to recognize this type of dimorphism in time and to learn to manage the possible complications which, as shown, may possibly not be only as a result of endodontic nature, but unfortunately sometimes can also have a clear and eventual likely periodontal evolution.

This study proposes a rational and effective approach to address the difficulties that underlie this anatomical type of malformation. In both cases, in the first through regenerative periodontal therapy, in the second through orthograde endodontic therapy, we have tried to by-pass the anatomic problem seeking to treat the dimorphism, thereby returning the element to an anatomical simplicity that would make it easier for management of clinical complications.

Clinical relevance

The upper lateral incisor can sometimes be a difficult element to treat endodontically, as it often has a narrow apical and pronounced curvature. Just as often, however, it can also be characterized by abnormalities of form, of embryological basis, which can determine the need for endodontic, periodontal, or combined treatment (endodontic and periodontal). The formulation of a proper diagnosis is therefore required in these cases, always unique, specific to which may be sometimes multi-disciplinary and specialist operational strategies.

Conflict of interest

The authors state that there is no conflict of interest economic or otherwise by any of the authors themselves involved in the work presented.

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CASE REPORT/CASO CLINICO

Cyst-like periapical lesion healing in an orthodontic patient: a case report with five-year follow-up

Guarigione di una lesione periapicale simil-cistica in un paziente ortodontico: case report con follow-up di 5 anni

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Root canal treatment;
Root resorption.

PAROLE CHIAVE
Lesione simil-cistica;
Incisivi centrali superiori;

Abstract
Aim: To report the orthodontic movement of two central incisors through the healing site of a maxillary cyst-like lesion of endodontic origin after nonsurgical treatment.
Case summary: This report shows the treatment of a 18-year old patient, male, with a Class II division 2 malocclusion. He came to our attention seeking for orthodontic treatment.

Radiographic examinations revealed a large cyst-like lesion in the maxillary anterior area, extending from the mesial surface of tooth 12 to the distal surface of tooth 21. The two upper incisors were nonresponsive to pulp sensitivity tests. Endodontic treatment was performed first. One week after root canal treatment had been completed with gutta-percha fillings, orthodontic treatment was started while the bone lesion healing was still underway. At the end of the orthodontic treatment, incisor retroclination was corrected, periapical lesion healing was completed and there were no signs of root resorption. The five-year follow-up revealed that

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Trattamento ortodontico;
Trattamento endodontico;
Riassorbimento radicolare.

occlusal relationship and dental alignment were kept stable and excellent radiographic resolution of the periapical lesion was obtained.

Riassunto

Scopo: Riportare il movimento ortodontico di due incisivi centrali attraverso il sito di guarigione di una lesion simil-cistica di origine endodontica dopo trattamento non chirurgico.

Riassunto del caso clinico: Questo articolo riporta il trattamento di un paziente di 18 anni, affetto da malocclusione di Classe II divisione 2, venuto alla nostra osservazione con la richiesta di trattamento ortodontico.

Gli esami radiografici hanno messo in evidenza un larga lesione simil-cistica nella regione mascellare anteriore, che si estendeva dalla superficie mesiale 12 alla superficie distale del 21. I due incisivi centrali superiori rispondevano negativamente ai test di sensibilità pulpare. Una settimana dopo il completamento del trattamento endodontico con otturazione canalare con guttaperca, è stato iniziato il trattamento ortodontico mentre la guarigione della lesione ossea era ancora in corso. Al completamento del trattamento ortodontico, la retroclinazione incisiva risultava corretta e la guarigione della lesione periapicale era completa; inoltre, non erano visibili segni di riassorbimento radicolare. Il follow-up a 5 anni, ha mostrato che i rapporti occlusali e l'allineamento dentale erano stati mantenuti stabili; al controllo radiografico si era evidenziata una restituito ad integrum della lesione ossea periapicale.

Introduction

Changes in pulp blood supply, mainly due to dental trauma, may induce several pulp responses, leading to necrosis. Tissue necrosis and anaerobic conditions are the ideal environment for root canal colonization on the part of opportunistic microorganisms. Inflammatory reactions, including abscesses, granulomas and apical cysts, may develop in the periodontal tissue in response to intracanal antigenic content through immunopathological mechanisms.[1]

In order to differentiate radicular inflammatory periapical lesions, an accurate histopathological analysis of lesions is required.[2] Nair et al.,[3] after histological analysis, found that 15% of a sample of 256 periapical lesions were cysts, whilst 52% of the lesions were found to be epithelialized. Suspected cystic periapical lesions may undergo asymptomatic evolution and can became quite large.[4] Extensive periapical lesions may heal after conventional endodontic therapy, contrary to which periapical surgery may be necessary to allow nonresponsive lesions to heal.[5]

Orthodontic treatment has been considered as a major factor involved in root resorption.[6] While a well cleaned and shaped endodontically treated tooth is known to exhibit less propensity for apical root resorption during orthodontic tooth movement,[7–10] less is known about the effects of orthodontic movement during the healing phase of periapical lesions. Relevant literature has always suggested to wait for

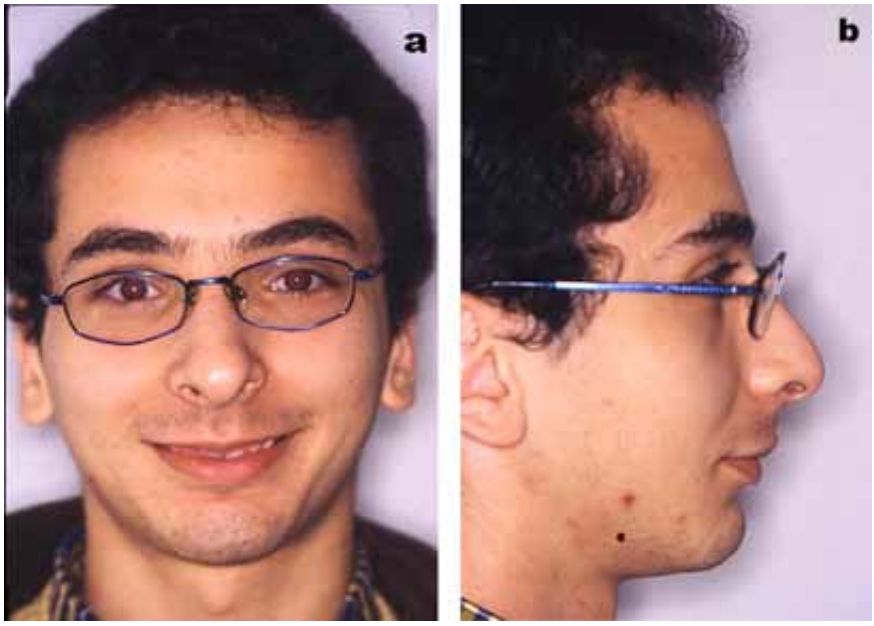

Figure 1 Pre-treatment frontal (a) and profile (b) view of the 18-year-old patient.

the complete healing of the apical lesion before applying an orthodontic force, because of the high risk of root resorption.[11]

This case report illustrates a combined endodontic—orthodontic treatment in a patient with a severe deep bite and traumatic necrosis of upper incisor and radiographic signs of cyst-like lesion.

Case report

An 18-year-old male, with a non-contributory medical history, was brought to our attention for orthodontic treatment. The patient's main complaint was an unpleasant smile. Profile and frontal photographs showed an increased lower height. The facial profile was convex. Labial competence was reached physiologically while a slight gummy smile was observed (Fig. 1a and b). The intraoral examination (Fig. 2a—f) revealed that oral hygiene was acceptable. First molars and the right lower second molar had amalgam fillings. A complete permanent dentition was present (the four third molars were asymptomatically included). Facial and both arch midlines corresponded. Intraoral frontal and lateral views showed a severe deep bite. The incisor margin of both central incisiors traumatized the vestibular lower incisor gingiva. The patient resulted having a bilateral Class I molar relationship. The maxillary central incisor crowns were displaced palatally to the arch, thus requiring considerable apexes movement during orthodontic therapy.

Evaluation of the panoramic radiography revealed signs of bony pathosis. A large radiolucent lesion extended from the

Figure 2 Pre-treatment intraoral views. (a) Frontal view shows the severe deep bite. (b) Overjet view. (c) Right and (d) left side views show a bilateral class I molar relationship (e) Occlusal upper and (f) lower arch views, note the palatally displaced central incisors.

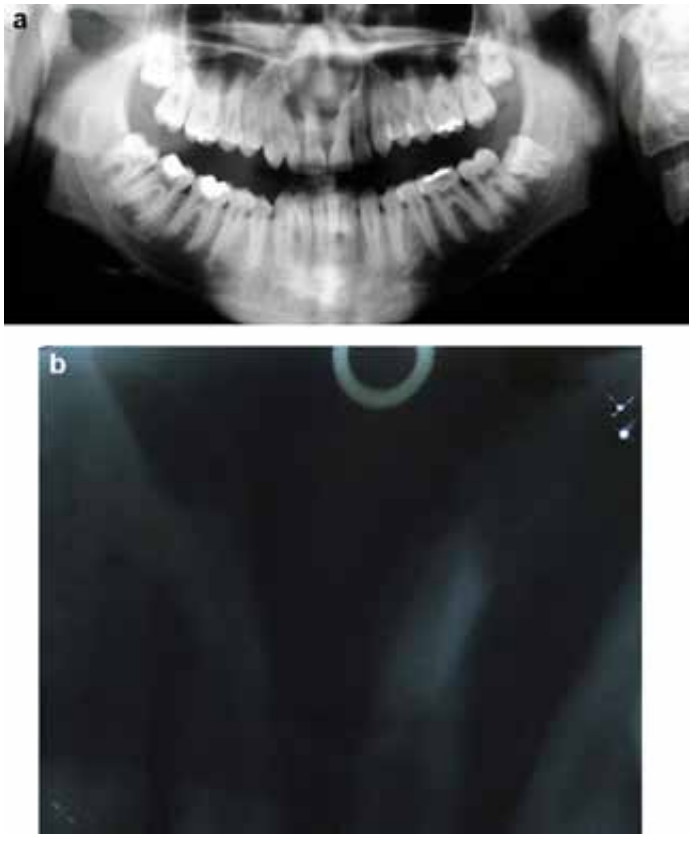

Figure 3 Inizial panoramic radiograph (a) and preoperative intraoral radiograph (b) showing the large radiolucent lesion.

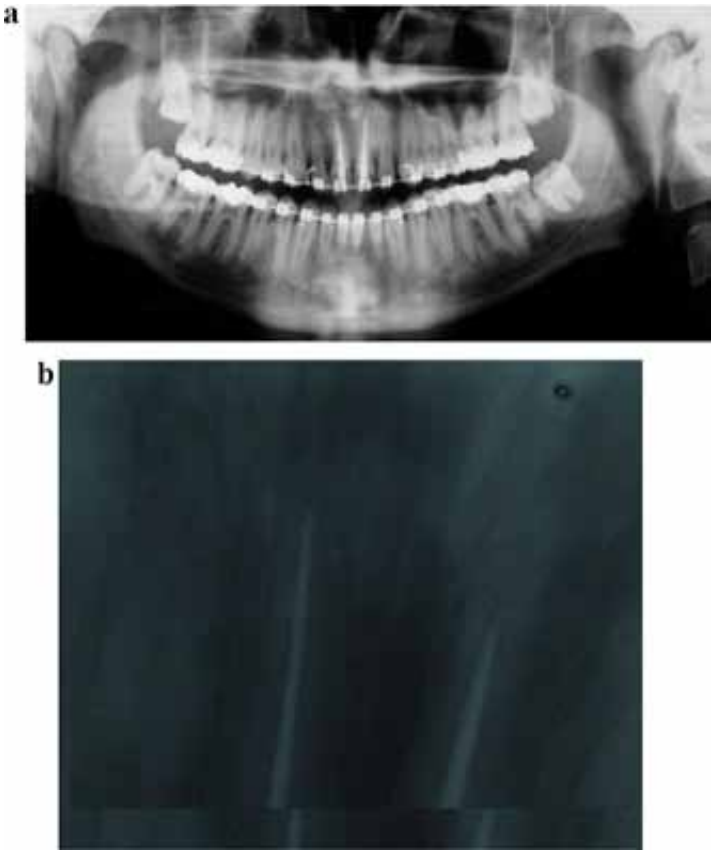

Figure 4 Two years post-treatment panoramic and intraoral radiograph showing the complete healing of the periapical lesions and healthy root apexes.

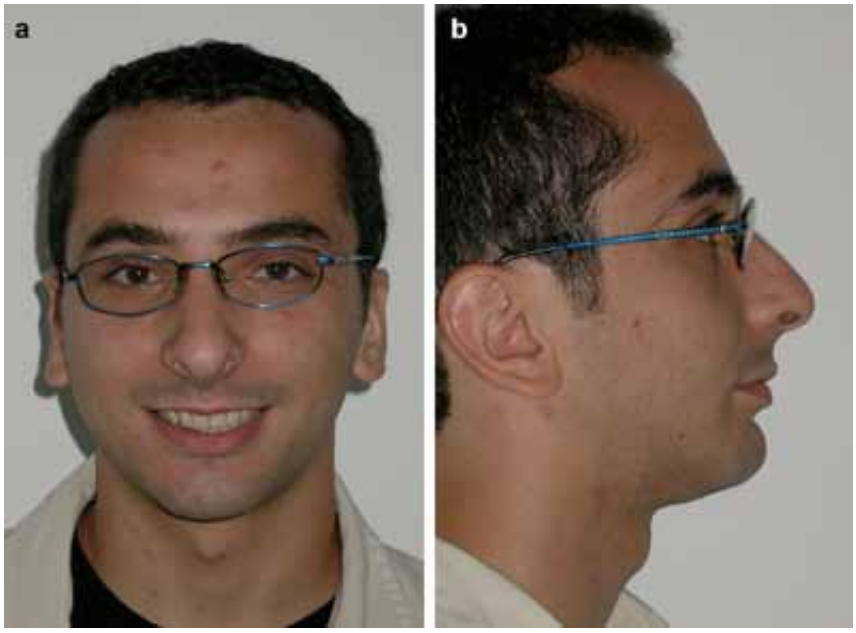

Figure 5 Post-orthodontic treatment (a) frontal and (b) profile views. Note smile characteristic and profile improvements as compared with Fig. 1.

Figure 6 Post-orthodontic treatment intraoral views. (a) Frontal and (b) overjet views indicate that overjet and overbite are in the norm. (c) Right and (d) left side views show a good functional occlusion. (e) Occlusal upper and (f) lower arch views reveal the correction of the incisor inclinations. A lower canine-to-canine fixed retainer has been applied for retention.

mesial surface of tooth 12 to the distal surface of tooth 21 measuring 27 mm in diameter (Fig. 3a and b). The patient referred to have had whiplash in the past, and to present a sporadic click in the right temporomandibular joint.

Before starting orthodontic treatment, an endodontic consultation was required. The patient was also examined according to the Research Diagnostic Criteria for Temporomandibular disorders (RDC/TMD)[12] because of the higher frequency of disc displacement in individuals suffering from whiplash syndrome.[13]

The endodontic examination revealed that the upper central incisors were nonresponsive to electronic and thermal pulp testing whilst adjacent teeth presented physiological responses. Pulp necrosis was diagnosed. Neither decay nor periodontal pockets were present. It is possible that the occlusal trauma derived from the severe anterior deep bite which had most likely triggered off the incisor necrosis, or from the trauma of the year before.

A diagnosis of pulp necrosis of traumatic origin with extensive apical periodontitis was established and root canal treatment on both incisors was performed. Upon access to the pulp chamber, a yellow serous exudate was evident in the canals. They were debrided with K-type files and irrigated with 5% sodium hypochlorite solution. The working length was assessed by apex locator and periapical radiographic analysis. Five days later, when active drainage ceased, we were able to perform the step back technique of canal preparation under rubber dam isolation: canals were instrumented using Ni-Ti rotary files accompanied by irrigation with 5% sodium hypochlorite.[43] To avoid possible fractures, a single patient use of a set of rotary file was preferred.[14] A temporary dressing of calcium hydroxide was then applied and changed every 3 weeks for 2 months. After removal of the dressing using K-type file and irrigation with 5% NaOCl, root canals were filled with gutta-percha cones and Sealapex cement (Kerr/Sybron Dental Specialities Inc., Glendora, CA, USA) using cold lateral condensation technique.

One week later, orthodontic treatment was started. The patient's upper arch was bonded from tooth 16 to tooth 26 using straightwire self-ligating appliance to reduce initial orthodontic forces and chairside time.[15] Two months later the lower arch was completely bonded, thanks to correction of the incisor inclinations. The use of heat activated archwires was preferred to reduce initial orthodontic forces and patient pain complaint.[16] Torque of maxillary incisors was controlled using translation arch.[17] Two years after completion of the endodontic treatment, no radiographic signs of bony defect nor root resorption were observed in the maxillary incisor area (Fig. 4a and b). After 26 months of active orthodontic therapy, profile improved (Fig. 5a and b), correct molar and canine relationships were achieved, overjet and overbite were within the norm and maxillary and mandibular arches were coordinated (Fig. 6a–f).

Comparison between pre- and post-orthodontic treatment lateral cephalograms showed evident correction of incisor inclination and torque, demonstrating the wide movememnt of incisor roots (Fig. 7a and b).

The patient was most satisfied with the final result. The five-year follow-up demonstrates that facial profile and smile characteristic improvements have been maintained (Fig. 8a and b) and the teeth have settled into a good functional occlusion with excellent facial aesthetics (Fig. 9a–f). The panoramic radiograph revealed no signs of pathologic root resorption and periapical tissues were healthy (Fig. 10).

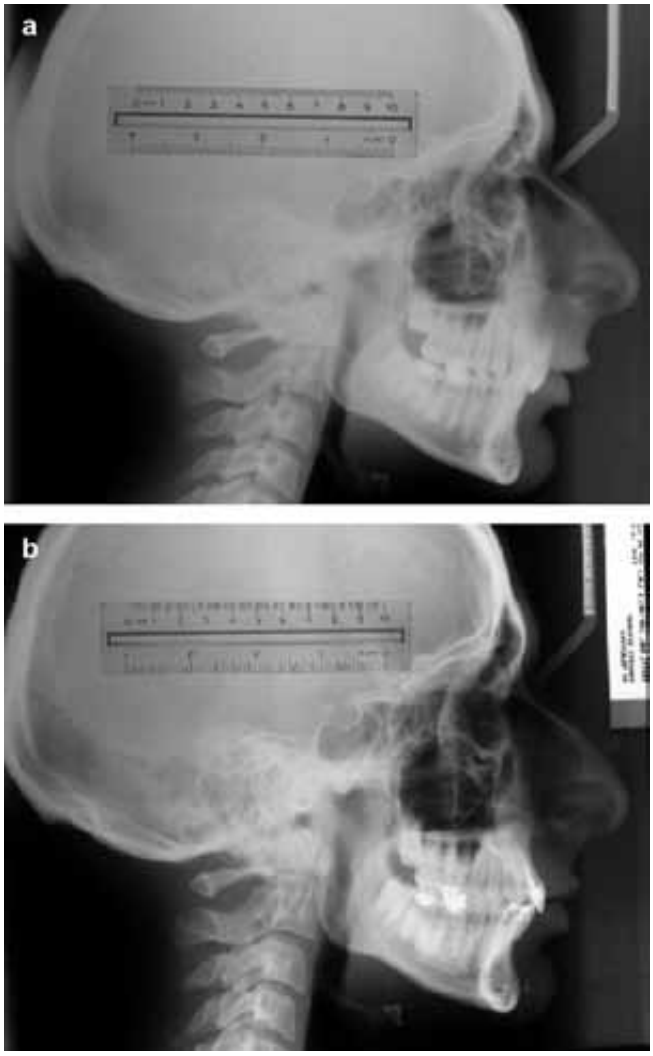

Figure 7 Pre- (a) and post- (b) orthodontic treatment lateral cephalograms. Note the correction of upper incisor inclination and torque, thanks to wide movement of incisor root.

Discussion

Dental trauma, when associated with the disruption of pulp blood supply, can lead to necrosis. Circulatory breakdown causes tissue necrosis and anaerobic conditions for opportunistic microorganisms growth, favouring the development of inflammatory periapical lesions.[1,18] When the inflammatory periapical process involves the epithelial islands of Malassez, these cells can proliferate and lead to the development of periapical cysts.[3] Cysts are reported to be more frequent in males than females[19,20] and the maxillary anterior teeth are more vulnerable than mandibular teeth.[21] Traditionally, periapical lesions larger than 10 mm were considered as apical cysts whilst smaller ones were considered as granulomas.[22,23] The reported incidence of cysts among periapical lesions varies from 6 to 55%. However, an accurate histopathological analysis of the lesions removed *in toto* is necessary in order to

Figure 8 Follow-up five years after completion of orthodontic treatment. (a) Frontal and (b) profile views show that good facial aesthetics is maintained.

differentially diagnose either radicular cysts or apical granulomas.[2]

A study, based on meticulous serial sectioning of periapical lesions, has shown that the incidence of radicular cysts is approximately 15% of all periapical lesions.[3] The same author, according to a previous study,[24] differentiates ''apical true cysts'' from ''apical pocket cysts'' on the basis of their histological characteristics and connection to the tooth apex. The latter type, also known as ''bay cysts'', is not completely enclosed in the epithelial lining, but is open to the root canals.[2] From a clinical and radiographic standpoint, it is impossible to differentiate granulomas and cysts or ''apical cysts'' and ''bay cysts''.[25] As concern our specific patient, a clinical diagnosis of periapical cyst, based on epidemiological data, clinical and radiographic results, was possible, as previously reported by Çalişkan.[26] While a ''pocket'' or ''bay'' cyst is likely to heal after conventional nonsurgical therapy due to the removal of antigen intra-canal source, true cysts are less likely to respond successfully to conventional root canal therapy.[27] Root canal treatment using calcium hydroxide has resulted in more than 70% complete healing of large periapical lesions[28,29] and many authors have previously supported the conservative nonsurgical approach to treatment.[30,31]

In this case report, the endodontic treatment was performed according to the nonsurgical root canal treatment using calcium hydroxide proposed by Çalişkan.[26] The decompression of the cyst, demonstrated by the conspicuous drainage through the canals, associated with the accurate removal of intracanal irritants and with the renewal of calcium hydroxide dressing, led to significant periapical lesion resolution. The use of calcium hydroxide is effective in improving histological responses thanks to its anti-inflammatory action, neutralization of acids products, activation of alkaline phosphatase, and anti-bacterial action.[32,33] These effects seem to depend on the release of calcium and hydroxyl ions involved in several cellular and molecular mechanisms leading to the regeneration of periapical connective tissue.[4] Endodontically treated teeth are reported to move as readily and for the same distances as teeth with vital pulps.[34–37] Even if orthodontic movement is the main cause of external apical root resorption,[6] some authors report that teeth with previous successful root canal treatment are less inclined to apical root resorption.[10] Although this outcome cannot be considered conclusive,[11] it has been suggested that, owing to pulp removal, there may be loss in release of neuropeptides which are usually triggered off by orthodontic treatment.[7–9]

Baranowskyj[38] investigated the healing rate of periradicular tissues in dogs after early application of an orthodontic intrusive force on teeth that had undergone periradicular surgery and retrograde root fillings. After comparison with non-orthodontically-treated group, the author concluded that the early application of orthodontic forces after surgical endodontic treatment greatly delayed the healing process and the specific cause was identified in tooth mobility. Whatever the case, no comparison could be made with this study, because of different species and protocol design, and, to our knowledge, no previous article deals with orthodontic movement performed during the healing phase of a cystic like lesion after conventional endodontic treatment in humans. Nonetheless, it has been reported that if endodontic treatment is needed, orthodontic treatment should be postponed until completion of endodontic treatment and clinical and radiographic evidence of healing.[39]

In this case report, two months and two weeks after incisor pulp chambers were opened, and one week after the endodontic treatment with gutta-percha canals filling was completed, the upper arch was bonded and the active orthodontic treatment commenced. Moreover, in order to

Figure 9 Five-year follow-up intraoral views. (a) Frontal, (b) overjet, and (c, d) lateral photographs display that post-treatment results have been maintained. (e) Occlusal upper and (f) lower views show good teeth alignment.

complete lower arch bonding, impeded by the severe deep bite, the first active orthodontic movements were performed on the maxillary incisors. A 0.016 inches NiTi heat activated wire was used to obtain the vestibular inclination of incisor crowns that corresponded to palatal movement of root apexes. Light forces, like those exerted by a thin NiTi heat activated wire, with its peculiar surface characteristics,[40] are necessary to avoid the risk of root resorption.[41,42]

Figure 10 Follow-up five years after completion of orthodontic treatment. Panoramic radiograph revealing healthy periapical tissues.

Conclusions

This article presented a combined endodontic—orthodontic treatment performed in an adult patient with Class II divison 2 malocclusion and a large periapical lesion in the maxilla anterior region. A large periapical cyst-like lesion may respond to nonsurgical root canal treatment. In this case report, the orthodontic movement of incisor roots was successfully performed during the healing phase and through the healing site of the cyst-like lesion.

Clinical relevance

The long-term successful outcome of the present study suggests that clinicians could perform an orthodontic tooth

movement without awaiting the complete healing of periapical cyst-like lesions, if appropriate root canal treatment has been previously completed. Further studies are needed to demonstrate the clinical suggestions of this report on large scale.

Conflict of interest

The authors declare no conflict of interest.

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LETTERA DEL PRESIDENTE

Cari colleghi,

è con grande piacere e onore che mi appresto a scrivere la mia ultima lettera a Voi tutti, come Presidente in carica della SIE, una Società Scientifica forte e florida che lascio non con poco dispiacere.
Sono stati anni duri, a causa del periodo storico in cui per forza di cose ci troviamo a vivere, ma caratterizzati da enormi successi: il Congresso ESE e il MiEndo nel 2011, il Congresso di Bologna nel 2012 e ora, quello torinese nel 2013, che si apre con i migliori auspici.
Auguro all'amico Pio Bertani, che mi succederà per il prossimo triennio e a tutto il nuovo Consiglio Direttivo, buona fortuna e buon lavoro!
Come preannunciato, dal 7 al 9 Novembre avrà luogo, a Torino, il 33° Congresso Nazionale SIE, nella famosa sede congressuale del "Lingotto", oramai ultra-collaudata, polo attrattivo per grandi eventi e manifestazioni e sinonimo di grande affluenza da parte dei partecipanti.
Il titolo "Endodonzia: problemi e soluzioni" parla da se: si affronteranno i più moderni approcci in tema di endodonzia chirurgica, di ritrattamenti, di adesione post-endodontica e anche in tema di diagnosi strumentale.
Nel programma spiccano, inoltre, i nomi dei più grandi endodontisti italiani che illustreranno tutte le novità riguardanti la sagomatura, la detersione e la otturazione canalare.
Il Corso Pre-Congresso, che si terrà Giovedì 7, sarà condotto dal 2 relatori d'eccezione: Jean Yves Cochet e Shanon Patel; avrà come titolo "Esami radiografici 3D in endodonzia: impatto sulla diagnosi e sul piano di cura".
Sarà un momento di grande apprendimento per quanto riguarda non solo le novità in tema di diagnosi strumentale ma anche delle diverse opzioni adottabili in un piano di trattamento moderno
Ricordo che, dopo il Corso Pre-Congresso, si terrà la consueta Assemblea dei Soci e le Elezioni del Nuovo Consiglio Direttivo: a seguire verrà organizzato il Welcome Cocktail per dare il benvenuto ufficiale a tutti Voi e per prepararci alle due intense giornate congressuali di Venerdì e Sabato, con un po' di spensieratezza.
Non voglio dimenticare, Venerdì 9, la Cena Sociale che coronerà il momento di aggregazione.
Quest'anno, come l'anno passato, l'iscrizione alla SIE offre l'opportunità di accumulare più di 30 crediti ECM, grazie al progetto FAD (Formazione a distanza) promosso dal CIC, nostro provider.

Certo di potervi incontrare al Nostro 33° Congresso Nazionale, Vi saluto calorosamente!
Arrivederci a Torino!

Il presidente SIE
Marco Martignoni

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La domanda di ammissione allo "status" di Socio Aggregato/Attivo, rivolta al Presidente della SIE, **dovrà pervenire,** insieme alla documentazione di seguito elencata, **alla Segretaria della SIE con un anticipo di 20 giorni sulle date di riunione della CAS,** sufficiente per poter organizzare il materiale dei candidati. Le date di scadenza saranno rese note sul sito.
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PRESENTAZIONE DEI CASI ALLA COMMISSIONE ACCETTAZIONE SOCI

La presenza del candidato è obbligatoria durante la riunione della CAS; è altresì consigliabile la presenza del Socio presentatore.

LA COMMISSIONE ACCETTAZIONE SOCI

La CAS (Commissione Accettazione Soci), eletta ad ogni scadenza elettorale dall'Assemblea dei Soci Attivi ed Onorari, è formata da 5 Soci Attivi, con almeno 5 anni di anzianità in questo ruolo e di indiscussa esperienza clinica. Compito della CAS è quello di esaminare e valutare i Casi Clinici presentati dagli aspiranti Soci Aggregati e Soci Attivi. Per rispetto del lavoro dei Candidati e per omogeneità di giudizio, in ogni riunione verranno valutati non più di 5 candidati a Socio Attivo. Resta libero, invece, il numero dei candidati a Socio Aggregato valutabili in una singola riunione della CAS. Il Consiglio Direttivo (CD) incaricando la Commissione Accettazione Soci (CAS) la rende responsabile dell' applicazione delle regole descritte nell' articolo 2 del regolamento. Il giudizio della CAS è insindacabile.

MEMBRI DELLA COMMISSIONE ACCETTAZIONE SOCI 2013

- **Dott. Davide Fabio Castro**
- **Dott. Franco Ongaro**
- **Dott. Mauro Rigolone**
- **Dott. Umberto Uccioli**

Aziende Informano

SIMIT DENTAL

PROGLIDER™ Dentsply Maillefer

Un solo file per un glide path semplice e veloce

Una fase importante della procedura endodontica è la creazione di un glide path per assicurare il percorso nel canale radicolare prima di procedere con la sagomatura.

PROGLIDER™ è realizzato in lega NiTi M-Wire con conicità progressiva variabile ed offre diversi vantaggi:

- è sufficiente un solo file **PROGLIDER™** *per creare un glide path nel pieno rispetto dell'anatomia radicolare; in questo modo il clinico potrà lavorare più velocemente rispetto all'uso di strumenti manuali o con soluzioni rotanti alternative per glide path.*

- è adatto alla maggior parte dei canali radicolari, compresi quelli particolarmente curvi.

- preserva maggiormente l'anatomia del canale rispetto agli strumenti manuali per glide path.

PROGLIDER™ è il sistema meccanico in NiTi per glide path d'elezione per tutti i clinici che desiderino la soluzione più avanzata in termini di efficienza, semplicità e sicurezza.

E' disponibile in blister presterilizzati nelle misure 21 – 25 – 31 mm.

PROPEX PIXI™ Dentsply Maillefer

Piccole dimensioni, grandi vantaggi

PROPEX PIXI™ è il localizzatore apicale miniature di Dentsply Maillefer adatto al professionista che cerca la convenienza e la praticità di un dispositivo tascabile, ultraleggero, da portare ovunque.

Le misurazioni sono accurate ed affidabili.

PROPEX PIXI™ consente controllo e comfort grazie alla tecnologia a multifrequenza.

Lavora in canali asciutti e umidi:

− la precisione non è influenzata dall'assenza nel canale radicolare di diversi liquidi o soluzioni irriganti;

− non sono necessarie calibrazioni o regolazioni.

Può essere posizionato sul tray oppure agganciato al bavaglino tramite l'apposita clip.

Controllo visivo e controllo sonoro con 4 livelli di volume per poter lavorare in massima sicurezza.
Oltre ad occupare il minimo spazio indispensabile durante il trattamento, **PROPEX PIXI™** è estremamente facile da usare.

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Aziende Informano

DENTSPLY ITALIA

GUTTAFUSION®

Sistema di otturazione a caldo con carrier

Innovativo, senza compromessi!

GUTTAFUSION® è il nuovo sistema di otturazione a caldo della VDW DENTSPLY, si tratta di un carrier costituito interamente da guttaperca per un'otturazione termoplastica in 3D dei canali radicolari.

Gli otturatori **GUTTAFUSION®** hanno, infatti, un corpo in guttaperca cross-linked che rimane stabile quando riscaldato. All'esterno l'otturatore è ricoperto da guttaperca scorrevole che, grazie al suo adattamento tridimensionale nei canali laterali e negli istmi, riempie efficacemente tutto il canale radicolare in maniera omogenea e compatta.

Il nuovo otturatore **GUTTAFUSION®** è particolarmente indicato in caso di posizionamento di perni, è inoltre indicato nei casi particolarmente delicati in cui potrebbe essere necessario un ritrattamento, in quanto, essendo interamente costituito da guttaperca, nessun corpo in plastica rimane nel canale radicolare.

Il manico dell'otturatore, specificatamente sviluppato per un utilizzo sicuro con le pinzette, consente di posizionare l'otturatore in maniera rapida e precisa anche nei molari, inoltre il manico può essere rimosso con semplicità senza bisogno di nessuno strumento aggiuntivo. Ovviamente, tutti gli otturatori **GUTTAFUSION®** presentano un'elevata radiopacità.

GUTTAFUSION® è compatibile con tutti i sistemi rotanti in NiTi, la giusta misura dell'otturatore è facilmente determinata grazie ai verificatori **GUTTAFUSION®** inclusi nel sistema. Sia gli otturatori che i verificatori **GUTTAFUSION®** sono disponibili dalla misura 20 alla misura 55.

Per un pratico e veloce riscaldamento degli otturatori è disponibile il fornetto **GUTTAFUSION®**, con il quale è possibile riscaldare gli otturatori in meno di un minuto.

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E-mail: infoweb.italia@dentsply.com

SWEDEN & MARTINA

MicroHeat

Sistema di otturazione tridimensionale con tecnica di condensazione laterale

Sweden & Martina ha sviluppato un nuovo sistema di otturazione laterale, **MicroHeat,** che propone l'uso di coni di guttaperca e cartucce di guttaperca preriscaldata - entrambi con altissima capacità di adattamento alla morfologia canalare - e di spreader e condensatori termomeccanici in Nichel Titanio capaci di lavorare in tutte le traiettorie canalari.

Il sistema è di semplice apprendimento e garantisce un sigillo tridimensionale dello spazio endodontico, in modo ermetico e stabile nel tempo, nonché il controllo pressoché assoluto della profondità dell'otturazione e la ripetibilità dei risultati in qualunque tipo di anatomia canalare.

Il sistema **MicroHeat** è dotato di:

***- fornelletto**: riscalda la guttaperca rapidamente ed in modo efficace; è dotato di un termostato che mantiene costante la temperatura della cartuccia per tutto il trattamento;*

***- dispenser per cartucce,** autoclavabile;*

***- spreader meccanici in Nichel Titanio**: permettono una distribuzione uniforme delle forze di condensazione sul cono Master, anche in presenza di accentuate curvature;*

***- condenser in NiTi** che introducono la guttaperca fino ai canali laterali e contemporaneamente la condensano;*

***- coni Master:** contengono guttaperca a bassa temperatura di fusione e con considerevole capacità di scorrimento; sono sufficientemente rigidi per raggiungere la lunghezza di lavoro e al contempo sufficientemente flessibili per riuscire ad adattarsi ad eventuali curvature del canale;*

***- cartucce MicroHeat:** preriempite con guttaperca a bassa temperatura di fusione, si riscaldano in modo uniforme in poco tempo e si fondono con i coni Master, garantendo una massa dalle proprietà omogenee. Nel riscaldarsi, la guttaperca presente nelle cartucce MicroHeat diventa lievemente appiccicosa, per cui aderisce bene alle pareti del canale e riduce la quantità di cemento necessaria.*

MicroHeat SYSTEM

sweden & martina

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Via Veneto, 10 35020 Due Carrare (PD)
Tel. +39.049.91.24.300
www.sweden-martina.com

SYBRONENDO

Adaptive Motion Technology

Adaptive Motion Technology si basa su un brevetto di un algoritmo intelligente, progettato per lavorare con Twisted Files Adaptive System.

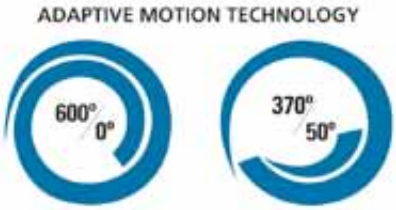
Questa tecnologia permette di regolare il movimento del motore in base alle resistenze torsionali che il TF file incontra all'interno del canale e che dipendono dalla pressione esercitata sullo stesso.

Questo comporta che il TF file può ruotare in senso normale o reciprocante a seconda della situazione. Il risultato è una rimozione eccezionale dei detriti grazie alla comprovata affidabilità del design dei Twisted Files, la migliore resistenza alla frattura e un minore rischio di effetto risucchio grazie ad **Adaptive Motion Technology.**

Il design del TF Adaptive si basa su una tecnologia clinicamente testata, che ritorce il file in NiTi su se stesso senza farlo passare all'interno di una mola, rendendo così una capacità di taglio migliore e costante nel tempo.

La tecnologia R-Phase aumenta la flessibilità e permette la rimozione eccezionale dei detriti.

Con TF Adaptive e Adaptive Motion raggiungi il meglio per la strumentazione del canale.



Rotary when you want it
Reciprocation when you need it

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CLOSED MEETING SIE

Pesaro, 21/23 Giugno 2013

Nell'incantevole, suggestiva ed originalissima sede alberghiera marchigiana dell'Alexander Museum Palace Hotel di Pesaro, nelle giornate del 21, 22 e 23 Giugno scorse, si è svolto l'annuale Closed Meeting della SIE.

Come di consueto, l'evento è stato caratterizzato da un programma fitto di incontri ed assemblee societarie "istituzionali", ma anche di condivisione di momenti ludici ed informali che caratterizzano da tempo ogni Closed Meeting e che favoriscono le relazioni ed i rapporti fra i soci appartenenti alla Società. Il Closed Meeting rappresenta davvero "IL" momento di incontro societario, insieme al Congresso Nazionale.

Quest'anno la scelta della riviera Marchigiana come sede si è rivelata vincente: ben 85 presenze in totale fra cui 56 soci attivi.

Il programma del venerdì ha visto la riunione della Commissione Accettazione Soci (CAS) che ha conferito la carica di nuovo Socio Attivo SIE al Dr. Roberto Strafella di Matera, cui va il plauso di tutti i colleghi della Società. Nel pomeriggio si sono svolte le riunioni della Commissione Culturale e della Commissione WEB, mentre da un punto di vista scientifico il pomeriggio è stato animato dalla relazione del Socio Attivo Dr. Mario Mancini che, presentato ed introdotto dal Presidente in carica Dr. Marco Martignoni, ha ottimamente tenuto una relazione ai presenti inerente gli sbiancamenti dentali, condotti sia su denti vitali, sia su denti trattati endodonticamente, illustrandone indicazioni e limiti.

La prima giornata si è quindi conclusa con il consueto momento di relax e mare, con l'aperitivo a bordo piscina di saluto della prima giornata e la cena svoltasi presso la stessa sede alberghiera.

VITA SOCIETARIA

Il sabato mattina è stata fatta la presentazione di un testo d'eccezione, da tempo atteso: il Prof. Massimo Gagliani ed il Dr. Tiziano Strambini di LSWR Srl, hanno infatti presentato il testo "Manuale di Endodonzia", alla cui stesura hanno contribuito svariati Soci Attivi, e sulla cui diffusione la stessa LSWR Srl conta molto.

Certamente di quest'ennesima quanto splendida opera editoriale targata "SIE" sentiremo parlare per molto tempo. Alla presentazione del testo è seguita una tavola rotonda riservata ai Soci Attivi, sul tema "La SIE nell'epoca di internet, della nuova normativa ECM e della crisi economica europea", nella quale non sono mancati momenti di profonda riflessione e spunti sulle programmazioni, sulle attività scientifico-formative e sulle future iniziative che la Società saprà prendere.

Si è successivamente svolta la riunione dei Segretari Regionali, alla presenza del Segretario Nazionale Dr. Vittorio Franco, del Coordinatore dei Segretari Regionali Dr. Mario Badino, del Presidente eletto Dr. Pio Bertani e del Segretario Culturale Dr. Mario Lendini.

Il pomeriggio del sabato si è concluso in modo duplice: relax e mare per chi desiderava rilassarsi al sole, fortunatamente mai mancato nelle giornate dei lavori, mentre per tutti gli altri la consueta, avvincente ed agguerritissima sfida calcistica fra le squadre del nord e del sud, svoltasi presso il Circolo Tennis Pesaro, per l'ennesima volta terminata con la vittoria di misura ottenuta dalla squadra del sud.

La serata del sabato si è conclusa con la cena, tenutasi sul mare nell'incantevole ristorante Calamara, sul molo di Ponente di Fano, resa ancora più gradevole dalle immancabili note musicali finali.

La domenica ha visto infine i partecipanti intervenuti godersi gli ultimi scampoli di relax, dandosi appuntamento al prossimo incontro collettivo immancabile per i soci della SIE e gli appassionati tutti all'endodonzia, cioè il prossimo Congresso Nazionale che si svolgerà a Torino in Novembre.

Resoconto a cura di Cristian Coraini

GIORNALE ITALIANO DI ENDODONZIA

INSTRUCTION AUTHOR

CONTENT OF AUTHOR GUIDELINES:

The journal to which you are submitting your manuscript employs a plagiarism detection system. By submitting your manuscript to this journal you accept that your manuscript may be screened for plagiarism against previously published works.

1. GENERAL

Giornale Italiano di Endodonzia publishes original scientific articles, reviews, clinical articles and case reports in the field of Endodontology. Scientific contributions dealing with health, injuries to and diseases of the pulp and periradicular region, and their relationship with systemic well-being and health. Original scientific articles are published in the areas of biomedical science, applied materials science, bioengineering, epidemiology and social science relevant to endodontic disease and its management, and to the restoration of root-treated teeth. In addition, review articles, reports of clinical cases, book reviews, summaries and abstracts of scientific meetings and news items are accepted.

Please read the instructions below carefully for details on the submission of manuscripts, the journal's requirements and standards as well as information concerning the procedure after a manuscript has been accepted for publication in *Giornale Italiano di Endodonzia*. Authors are encouraged to visit GIE web site **gi-endodonzia.com** for further information on the preparation and submission of articles and figures.

2. ETHICAL GUIDELINES

Giornale Italiano di Endodonzia adheres to the below ethical guidelines for publication and research.

2.1. Authorship and Acknowledgements

Authors submitting a paper do so on the understanding that the manuscript has been read and approved by all authors and that all authors agree to the submission of the manuscript to the *Giornale Italiano di Endodonzia.*

Giornale Italiano di Endodonzia adheres to the definition of authorship set up by The International Committee of Medical Journal Editors (ICMJE). According to the ICMJE, authorship criteria should be based on 1) substantial contributions to conception and design of, or acquisiation of data or analysis and interpretation of data, 2) drafting the article or revising it critically for important intellectual content and 3) final approval of the version to be published. Authors should meet conditions 1, 2 and 3.

It is a requirement that all authors have been accredited as appropriate upon submission of the manuscript. Contributors who do not qualify as authors should be mentioned under Acknowledgements.

Acknowledgements:

Under acknowledgements please specify contributors to the article other than the authors accredited. Please also include specifications of the source of funding for the study and any potential conflict of interests if appropriate.

2.2. Ethical Approvals

Experimentation involving human subjects will only be published if such research has been conducted in full accordance with ethical principles, including the World Medical Association Declaration of Helsinki (version 2008) and the additional requirements, if any, of the country where the research has been carried out.

Manuscripts must be accompanied by a statement that the experiments were undertaken with the understanding and written consent of each subject and according to the above mentioned principles. A statement regarding the fact that the study has been independently reviewed and approved by an ethical board should also be included. Editors reserve the right to reject papers if there are doubts as to whether appropriate procedures have been used.

When experimental animals are used the methods section must clearly indicate that adequate measures were taken to minimize pain or discomfort. Experiments should be carried out in accordance with the Guidelines laid down by the National Institute of Health (NIH) in the USA regarding the care and use of animals for experimental procedures or with the European Communities Council Directive of 24 November 1986 (86/609/EEC) and in accordance with local laws and regulations.

All studies using human or animal subjects should include an explicit statement in the Material and Methods section identifying the review and ethics committee approval for each study, if applicable. Editors reserve the right to reject papers if there is doubt as to whether appropriate procedures have been used.

2.3 Clinical Trials

Clinical trials should be reported using the guidelines available at www.consort-statement.org.

A CONSORT checklist and flow diagram (as a Figure) should also be included in the submission material.

The *Giornale Italiano di Endodonzia* encourages authors submitting manuscripts reporting from a clinical trial to register the trials in any of the following free, public clinical trials registries: www.clinicaltrials.gov, http://clinicaltrials.ifpma.org/clinicaltrials/, http://isrctn.org/. The clinical trial registration number and name of the trial register will then be published with the paper.

2.4 Systematic Reviews

Systematic reviews should be reported using the PRISMA guidelines available at http://prisma-statement.org/. A PRISMA checklist and flow diagram (as a Figure) should also be included in the submission material.

2.5 Conflict of Interest and Source of Funding

Giornale Italiano di Endodonzia requires that all sources of institutional, private and corporate financial support for the work within the manuscript must be fully acknowledged, and any potential conflicts of interest noted. Grant or contribution numbers may be acknowledged, and principal grant holders should be listed. Please include the information under Acknowledgements.

2.6 Appeal of Decision

The decision on a paper is final and cannot be appealed.

2.7 Permissions

If all or parts of previously published illustrations are used, permission must be obtained from the copyright holder concerned. It is the author's responsibility to obtain these in writing and provide copies to the Publishers.

2.8 Copyright Assignment

If your paper is accepted, the author identified as the formal corresponding author for the paper will receive an email by editor's address,editor.giornale@endodonzia.it, to complete the license agreement on behalf of all authors on the paper.

3. MANUSCRIPT SUBMISSION PROCEDURE

Manuscripts should be submitted electronically by e-mail:
editor.giornale@endodonzia.it

3.1. Manuscript Files Accepted

Manuscripts should be uploaded as Word (.doc) or Rich Text Format (.rft) files (not write-protected) plus separate figure files. GIF, JPEG, PICT or Bitmap files are acceptable for submission, but only high-resolution TIF or EPS files are suitable for printing.

The text file must contain the abstract, main text, references, tables, and figure legends, but no embedded figures or Title page. The Title page should be provided as a separate file.

In the main text, please reference figures as for instance 'Figure 1', 'Figure 2' etc to match the tag name you choose for the individual figure files uploaded. Manuscripts should be formatted as described in the Author Guidelines below.

3.2. Blinded Review

Manuscript that do not conform to the general aims and scope of the journal will be returned immediately without review.

All other manuscripts will be reviewed by experts in the field (generally two referees).

Giornale Italiano di Endodonzia aims to forward referees´ comments and to inform the corresponding author of the result of the review process.

Manuscripts will be considered for fast-track publication under special circumstances after consultation with the Editor.

Giornale Italiano di Endodonzia uses double blinded review. The names of the reviewers will thus not be disclosed to the author submitting a paper and the name(s) of the author(s) will not be disclosed to the reviewers.

To allow double blinded review, please submit your main manuscript and title page as separate files.

3.3. E-mail Confirmation of Submission

After submission you will receive an e-mail to confirm receipt of your manuscript. If you do not receive the confirmation e-mail after 24 hours, please send an e-mail once again to editor.giornale@endodonzia.it or contact segreteria.sie@me.com.

3.4. Submission of Revised Manuscripts

All the revised manuscripts will be sent to the author; to submit a revised masucript please re-contact the e-mail address of the journal: editor.giornale@endodonzia.it.

4. MANUSCRIPT TYPES ACCEPTED

Original Scientific Articles: must describe significant and original experimental observations and provide sufficient detail so that the observations can be critically evaluated and, if necessary, repeated. Original Scientific Articles must conform to the highest international standards in the field.

Review Articles: are accepted for their broad general interest; all are refereed by experts in the field who are asked to comment on issues such as timeliness, general interest and balanced treatment of controversies, as well as on scientific accuracy. Reviews should generally include a clearly defined search strategy and take a broad view of the field rather than merely summarizing the authors´ own previous work. Extensive or unbalanced citation of the authors´ own publications is discouraged.

Mini Review Articles: are accepted to address current evidence on well-defined clinical, research or methodological topics. All are refereed by experts in the field who are asked to comment on timeliness, general interest, balanced treatment of controversies, and scientific rigor. A clear research question, search strategy and balanced synthesis of the evidence is expected. Manuscripts are limited in terms of word-length and number of figures.

Clinical Articles: are suited to describe significant improvements in clinical practice such as the report of a novel technique, a breakthrough in technology or practical approaches to recognised clinical challenges. They should conform to the highest scientific and clinical practice standards.

Case Reports: illustrating unusual and clinically relevant observations are acceptable but they must be of sufficiently high quality to be considered worthy of publication in the Journal. On rare occasions, completed cases displaying non-obvious solutions to significant clinical challenges will be considered. Illustrative material must be of the highest quality and healing outcomes, if appropriate, should be demonstrated.

5. MANUSCRIPT FORMAT AND STRUCTURE

5.1. Format

Language: The language of publication is English. It is preferred that manuscript is professionally edited. All services are paid for and arranged by the author, and use of one of these services does not guarantee acceptance or preference for publication

Presentation: Authors should pay special attention to the presentation of their research findings or clinical reports so that they may be communicated clearly. Technical jargon should be avoided as much as possible and clearly explained where its use is unavoidable. Abbreviations should also be kept to a minimum, particularly those that are not standard. The background and hypotheses underlying the study, as well as its main conclusions, should be clearly explained. Titles and abstracts especially should be written in language that will be readily intelligible to any scientist.

Abbreviations: Giornale Italiano di Endodonzia adheres to the conventions outlined in Units, Symbols and Abbreviations: A Guide for Medical and Scientific Editors and Authors. When non-standard terms appearing 3 or more times in the manuscript are to be abbreviated, they should be written out completely in the text when first used with the abbreviation in parenthesis.

5.2. Structure

All manuscripts submitted to Giornale Italiano di Endodonzia should include Title Page, Abstract, Main Text, References and Acknowledgements, Tables, Figures and Figure Legends as appropriate

Title Page: The title page should bear: (i) Title, which should be concise as well as descriptive; (ii) Initial(s) and last (family) name of each author; (iii) Name and address of department, hospital or institution to which work should be attributed; (iv) Running title (no more than 30 letters and spaces); (v) No more than six keywords (in alphabetical order); (vi) Name, full postal address, telephone, fax number and e-mail address of author responsible for correspondence.

Abstract for Original Scientific Articles should be no more than 250 words giving details of what was done using the following structure:

- **Aim:** Give a clear statement of the main aim of the study and the main hypothesis tested, if any.
- **Methodology:** Describe the methods adopted including, as appropriate, the design of the study, the setting, entry requirements for subjects, use of materials, outcome measures and statistical tests.
- **Results:** Give the main results of the study, including the outcome of any statistical analysis.
- **Conclusions:** State the primary conclusions of the study and their implications. Suggest areas for further research, if appropriate.

Abstract for Review Articles should be non-structured of no more than 250 words giving details of what was done including the literature search strategy.

Abstract for Mini Review Articles should be non-structured of no more than 250 words, including a clear research question, details of the literature search strategy and clear conclusions.

Abstract for Case Reports should be no more than 250 words using the following structure:

- **Aim:** Give a clear statement of the main aim of the report and the clinical problem which is addressed.
- **Summary:** Describe the methods adopted including, as appropriate, the design of the study, the setting, entry requirements for subjects, use of materials, outcome measures and analysis if any.
- **Key learning points:** Provide up to 5 short, bullet-pointed statements to highlight the key messages of the report. All points must be fully justified by material presented in the report.

Abstract for Clinical Articles should be no more than 250 words using the following structure:

- **Aim:** Give a clear statement of the main aim of the report and the clinical problem which is addressed.
- **Methodology:** Describe the methods adopted.
- **Results:** Give the main results of the study.
- **Conclusions:** State the primary conclusions of the study.

Main Text of Original Scientific Article should include Introduction, Materials and Methods, Results, Discussion and Conclusion.

Introduction: should be focused, outlining the historical or logical origins of the study and gaps in knowledge. Exhaustive literature reviews are not appropriate. It should close with the explicit statement of the specific aims of the investigation, or hypothesis to be tested.
Material and Methods: must contain sufficient detail such that, in combination with the references cited, all clinical trials and experiments reported can be fully reproduced.

(i) Clinical Trials should be reported using the CONSORT guidelines available at www.consort-statement.org. A CONSORT checklist and flow diagram (as a Figure) should also be included in the submission material.

(ii) Experimental Subjects: experimentation involving human subjects will only be published if such research has been conducted in full accordance with ethical principles, including the World Medical Association Declaration of Helsinki (version 2008) and the additional requirements, if any, of the country where the research has been carried out. Manuscripts must be accompanied by a statement that the experiments were undertaken with the understanding and written consent of each subject and according to the above mentioned principles. A statement regarding the fact that the study has been independently reviewed and approved by an ethical board should also be included. Editors reserve the right to reject papers if there are doubts as to whether appropriate procedures have been used.

When experimental animals are used the methods section must clearly indicate that adequate measures were taken to minimize pain or discomfort. Experiments should be carried out in accordance with the Guidelines laid down by the National Institute of Health (NIH) in the USA regarding the care and use of animals for experimental procedures or with the European Communities Council Directive of 24 November 1986 (86/609/EEC) and in accordance with local laws and regulations.
All studies using human or animal subjects should include an explicit statement in the Material and Methods section identifying the review and ethics committee approval for each study, if applicable.
Editors reserve the right to reject papers if there is doubt as to

whether appropriate procedures have been used.

(iii) Suppliers: Suppliers of materials should be named and their location (Company, town/city, state, country) included.

Results: should present the observations with minimal reference to earlier literature or to possible interpretations. Data should not be duplicated in Tables and Figures.

Discussion: may usefully start with a brief summary of the major findings, but repetition of parts of the abstract or of the results section should be avoided. The Discussion section should progress with a review of the methodology before discussing the results in light of previous work in the field. The Discussion should end with a brief conclusion and a comment on the potential clinical relevance of the findings. Statements and interpretation of the data should be appropriately supported by original references.

Conclusion: should contain a summary of the findings.

Main Text of Review Articles should be divided into Introduction, Review and Conclusions. The Introduction section should be focused to place the subject matter in context and to justify the need for the review. The Review section should be divided into logical subsections in order to improve readability and enhance understanding. Search strategies must be described and the use of state-of-the-art evidence-based systematic approaches is expected. The use of tabulated and illustrative material is encouraged. The Conclusion section should reach clear conclusions and/or recommendations on the basis of the evidence presented.

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- Names and initials of up to six authors. When there are seven or more, list the first three and add et al.
- Full title of paper followed by a full stop (.)
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- Volume number
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Standard journal article

(1) Somma F, Cammarota G, Plotino G, Grande NM, Pameijer CH. The effectiveness of manual and mechanical instrumentation for the retreatment of three different root canal filling materials. J Endod 2008;34(4):466—9.

Corporate author

British Endodontic Society - Guidelines for root canal treatment. Giornale Italiano di Endodonzia 1979 ; 16: 192-5.

Journal supplement

Frumin AM, Nussbaum J, Esposito M () Functional asplenia: demonstration of splenic activity by bone marrow scan (Abstract). Blood 1979; 54 (Suppl. 1): 26a.

Books and other monographs

Personal author(s)

Gutmann J, Harrison JW Surgical Endodontics, 1st edn Boston, MA, USA: Blackwell Scientific Publications, 1991.

Chapter in a book

Wesselink P Conventional root-canal therapy III: root filling. In: Harty FJ, ed. Endodontics in Clinical Practice, (1990) , 3rd edn; pp. 186-223. London, UK: Butterworth.

Published proceedings paper

DuPont B Bone marrow transplantation in severe combined immunodeficiency with an unrelated MLC compatible donor. In: White HJ, Smith R, eds. Proceedings of the Third Annual Meeting of the International Society for Experimental Rematology; (1974), pp. 44-46. Houston, TX, USA: International Society for Experimental Hematology.

Agency publication

Ranofsky AL Surgical Operations in Short-Stay Hospitals: United States-1975 (1978). DHEW publication no. (PHS) 78-1785 (Vital and Health Statistics; Series 13; no. 34.) Hyattsville, MD, USA: National Centre for Health Statistics.8

Dissertation or thesis

Saunders EM In vitro and in vivo investigations into root-canal obturation using thermally softened gutta-percha techniques (PhD Thesis) (1988). Dundee, UK: University of Dundee.

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