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ISSN 1121 – 4171

1 | June 2014 | Vol. 28

GIORNALE ITALIANO DI ENDODONZIA

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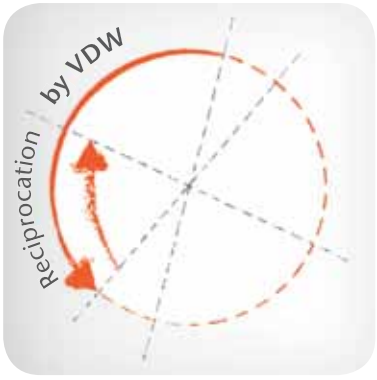
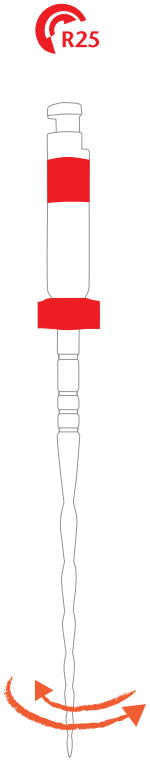
RECIPROC®

one file endo

Efficacia e Semplicità: la preparazione del canale con un solo strumento

Reciproc® one file endo, è il sistema che permette di sagomare il canale radicolare con un solo strumento in Nichel Titanio, azionato da un motore dedicato che utilizza un movimento alternato, e senza l'utilizzo di un file manuale iniziale per creare un glide path.
Il movimento che compiono il micromotore VDW.Silver Reciproc® e il VDW.Gold Reciproc® è un movimento alternato o reciproco, dove lo strumento prima taglia ruotando in una direzione e successivamente ritorna indietro per rilasciare lo strumento. L'angolo della direzione tagliente è più ampio rispetto a quello della direzione contraria, in questo modo lo strumento progredisce con un movimento continuo verso l'apice senza il rischio di impegnarsi e conseguentemente fratturarsi all'interno del canale. Il movimento alternato attenua lo stress sullo strumento e pertanto riduce il rischio di affaticamento ciclico causato dalla tensione e dalla compressione (De-Deus et al. 2010; Varela-Patiño et al. 2010) e allo stesso tempo assicura che lo strumento rimanga centrato all'interno del canale.
Reciproc® è un sistema semplice da usare e da apprendere perché un solo strumento fa il lavoro dei molti strumenti manuali e rotanti necessari fino ad oggi per sagomare il canale radicolare. Il protocollo clinico riduce al minimo le fasi di lavoro e non è più necessario cambiare gli strumenti nel contrangolo durante la preparazione del canale.





Canali molto curvi e stretti possono essere preparati efficacemente con uno strumento R25

Radiografie:
Dott. Ghassan Tared
Ontario, Canada

Test clinici hanno dimostrato che la procedura viene resa molto più veloce perché il tempo di lavoro con un singolo file alternato è **4 volte più breve*** rispetto alla tradizionale tecnica rotante in Ni-Ti.

Il sistema Reciproc® è studiato per essere più **efficace** e **sicuro** rispetto alle tecniche rotanti, perché il rischio di frattura dovuto all'avvitamento e al blocco dello strumento nel canale è stato eliminato. Lo strumento Reciproc® è monouso, utilizzabile al massimo per un molare, e confezionato in blister pre-sterilizzati. Il sistema Reciproc® rende il flusso di lavoro più efficiente, eliminando il bisogno di pulire e sterilizzare lo strumento e riducendo sensibilmente il rischio di contaminazioni da contatto per il personale di studio e totalmente quello di contaminazioni crociate per il paziente.

* G. Yared 2010.

IL DESIGN DELLO STRUMENTO
Uno solo strumento per una preparazione completa

Gli strumenti Reciproc® sono stati studiati con misure e conicità ISO che garantiscono una preparazione apicale ottimale utilizzando un solo strumento.

m-wire® nickel titanium

Sezione a S

Punta non attiva

Foto: Dott. David Sonntag, University of Düsseldorf

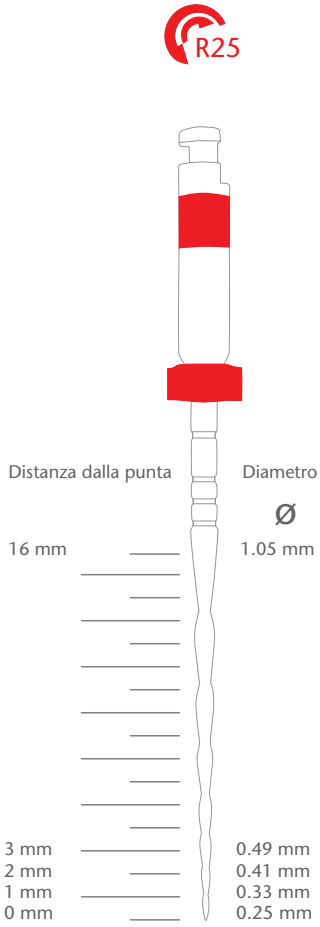
Reciproc® è prodotto con **Nichel-Titanio M-Wire®**. Questa speciale lega brevettata garantisce una straordinaria resistenza alla fatica ciclica grazie all'innovativo processo di trattamento termico, attraverso il quale viene prodotta. La lega M-Wire® possiede sia una maggiore resistenza alla fatica ciclica che una maggiore flessibilità rispetto al Nichel-Titanio tradizionale.

Lo strumento Reciproc® ha la **sezione ad S** che gli conferisce una elevata efficienza di taglio ed una **conicità variabile regressiva** per garantire una preparazione conservativa e senza inutile perdita di sostanza dentaria. Grazie a questa conicità variabile regressiva, gli strumenti Reciproc® sono più sottili nella parte lavorante alta rispetto alla maggior parte degli strumenti conici in Nichel Titanio di misure ISO comparabili. Questo previene una inutile perdita di sostanza dentaria nella sezione coronale durante la preparazione e rende gli strumenti ideali per preparare canali anche molto curvi e stretti.

Tutti gli strumenti Reciproc® hanno la **punta non attiva** e sono stati studiati con misure e conicità ISO che garantiscono una preparazione apicale ottimale utilizzando un solo strumento.

Gli strumenti Reciproc® sono disponibili in 3 misure differenti:

- R25 prepara i canali radicolari ad un diametro ISO 25 e con una conicità 08 nei primi millimetri apicali
- R40 prepara i canali radicolari ad un diametro ISO 40 e con una conicità 06 nei primi millimetri apicali
- R50 prepara i canali radicolari ad un diametro ISO 50 e con una conicità 05 nei primi millimetri apicali



Per completare il trattamento endodontico sono disponibili punte di carta e punte di guttaperca RECIPROC® delle stesse misure dello strumento utilizzato.
Nella maggior parte dei casi non è necessario nessun file manuale iniziale per creare un glide-path

" [...] Durante il movimento alternato, gli angoli che si formano in senso orario ed antiorario determinano l'ampiezza del movimento, rotazioni a destra e a sinistra. Questi angoli sono di ampiezza inferiore rispetto a quelli ai quali lo strumento Reciproc® si fratturerebbe normalmente (se impegnato). Se un file alternato si impegna all'interno del canale, non si frattura perché non arriva a ruotare oltre il suo specifico angolo di frattura. Pertanto, con gli strumenti Reciproc® la creazione di un glide-path per minimizzare i rischi di avvitamento e frattura non è necessaria. Voglio introdurre la nozione di percorso di minima resistenza. La capacità di centratura del canale esclusiva della tecnica alternata associata al design dello strumento Reciproc® e la sua capacità di taglio potenziata, permettono allo strumento Reciproc® di seguire il naturale percorso di minima resistenza già esistente e corrispondente al canale radicolare [...] "

Dott. Ghassan Yared - Ontario, Canada

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GIORNALE ITALIANO DI ENDODONZIA

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Giornale Italiano di Endodonzia was founded in 1987 and is the official journal of the Italian Society of Endodontics (SIE). It is a peer-reviewed journal publishing original articles on clinical research and/or clinical methodology, case reports related to Endodontics. The Journal evaluates also contributes in restorative dentistry, dental traumatology, experimental pathophysiology, pharmacology and microbiology dealing with Endodontics. Giornale Italiano di Endodonzia is indexed in Scopus and Embase and published online only on ScienceDirect. SIE members can access the journal through the website: www.journals.elsevier.com/giornale-italiano-di-endodonzia/

REGISTRATION Court of Milan n° 89, 3 March 2009

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EDITORIAL/EDITORIALE

Periapical activity is needed

Attività periapicale: una necessità

In the last few years, several topics related to endodontic sealers have been examined by researchers, with different degrees of attention; recently the use of MTA-based cements has been proposed and they have been improved for all purposes.

An apical seal of the root canal is desirable and histological and macroscopic observations of the root canal apex have clarified, once again, that a bioactive material should be the final solution for the obturation objectives. A biocompatible sealer with physical, chemical and mechanical properties could be the ideal solution to promote periapical healing, a material we have been looking for a long time. The improvement in material handling and the spread of this knowledge should be strongly supported; it is a common belief that these materials could offer more reliable long-term results in teeth that are otherwise addressed to be extracted and replaced by more suitable osteointegrated implants... until the development of the next perimplantitis.

Nel corso degli anni vari argomenti hanno attirato l'attenzione dei ricercatori a fasi alterne; recentemente i cementi con base uguale o similare al Mineral Trioxide Aggregate (MTA) hanno conquistato un posto preminente.

La necessità di ottenere un sigillo del limite apicale e le riflessioni sulla struttura anatomica macro e microscopica dello stesso hanno, una volta per tutte, spinto a rivalutare i materiali bioattivi come elemento essenziale per ottenere gli obiettivi desiderati.

Un'otturazione ermetica che reca con se anche delle componenti chimiche favorenti l'integrazione con i tessuti periapicali credo sia quello che si ricercava da anni.

Starà a noi diffondere con sempre maggior energia questo messaggio che, se ben utilizzato, potrà fornire risultati a lungo termine favorevoli per elementi dentali altrimenti destinati ad essere tolti per far spazio a più confortevoli impianti osteointegrati...fino alla prossima perimplantite.

Editor-in-Chief
Massimo Gagliani
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Available online 18 June 2014

Peer review under responsibility of Società Italiana di Endodonzia.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.gien.2014.05.005

Giornale Italiano di Endodonzia (2014) **28**, 2—16

Available online at www.sciencedirect.com

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FOCUS

Restoration of the endodontically treated posterior tooth

Il restauro del dente posteriore trattato endodonticamente

Andrea Polesel *

Private Practice in Arenzano (GE), Italy

Received 2 May 2014; accepted 19 May 2014
Available online 23 June 2014

KEYWORDS
Endodontically treated tooth;
Overlay restoration;
Post-endodontic restoration;
Esthetic restoration;
Indirect adhesive restoration.

Abstract
Objectives: To analyse the key factors of the restoration in the posterior endodontically treated teeth, through a literature review and clinical cases presentation. To focus on the clinical advantages of the adhesive indirect restorations, describing the basic principles for long-term success.
Materials and methods: The biomechanical changes due to the root canal therapy and the degree of healthy dental tissue lost because of pathology and iatrogenic factors are the critical points leading the clinician to the restorative treatment planning. The full crown is considered by the literature as the gold standard and is indicated in case of teeth heavily weakened by dental caries, fractures or previous conservative-prosthetic preparations. The improvement of the adhesion and the composite materials, with mechanical properties close to those of dental tissues, offers to the clinician the option of a conservative restoration, able to seal, reinforce and protect the tooth and to delay the execution of a full crown, with the subsequent sacrifice of dental tissue. Although in the presence of small-sized cavity, direct bonded restoration is considered an effective short and medium-term restoration, cuspal coverage with indirect restoration is the treatment of choice in case of mesio-occlusal-distal cavities. Adhesive overlays preserve coronal structure, avoid contamination of the root canal system, reinforce residual dental tissues, guarantee optimal form, function, aesthetics and offer ergonomic and economic undoubted clinical advantages.
Results and conclusions: Direct adhesive restorations, indirect bonded restorations and traditional full crown are three therapeutic options for the single posterior endodontically treated teeth. The amount of remaining sound tooth structure is the most significant factor influencing the therapeutic approach. The clinician's operative skill is a determining aspect for long-term success of adhesive inlays.

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Peer review under responsibility of Società Italiana di Endodonzia.

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http://dx.doi.org/10.1016/j.gien.2014.05.007

PAROLE CHIAVE
Il dente trattato endodonticamente;
overlay;
restauro post-endodontico;
estetica;
restauro indiretto adesivo;
intarsi adesivi.

Riassunto
Obiettivi: Analizzare i momenti chiave del restauro del dente posteriore trattato endodonticamente, attraverso un'analisi della letteratura e la presentazione di casi clinici. Considerare i vantaggi dei restauri indiretti adesivi, descrivendo i principi determinanti per il successo a lungo termine.
Materiali e metodi: I cambiamenti biomeccanici secondari al trattamento endodontico e la quantità di tessuti dentali sani persi per fattori patologici e iatrogeni, sono i punti cruciali che guidano il clinico nella pianificazione del trattamento restaurativo. La corona completa rappresenta, per la letteratura scientifica, il gold-standard e trova indicazione in elementi gravemente compromessi da carie, fratture e precedenti preparazioni conservativo-protesiche. Il miglioramento delle tecniche adesive e dei materiali compositi, con proprietà meccaniche sempre più simili a quelle dei tessuti dentali, offre al clinico l'opzione del restauro conservativo, in grado di sigillare, rinforzare e proteggere il dente e soprattutto di rimandare l'esecuzione di una corona, con il conseguente sacrificio di ulteriore sostanza dentale. Sebbene in presenza di piccole cavità il restauro diretto in composito sia considerato un efficace restauro a breve e medio termine, il restauro indiretto a copertura cuspidale completa rappresenta il trattamento di scelta in cavità mesio-occluso-distali. Gli overlay adesivi preservano struttura coronale, prevengono la contaminazione del sistema endodontico, rinforzano i tessuti dentali residui, garantiscono forma, funzione ed estetica ed offrono indubbi vantaggi clinici, ergonomici ed economici.
Risultati e conclusioni: i restauri diretti in composito, i restauri indiretti adesivi e le corone complete rappresentano tre valide opzioni terapeutiche per il dente posteriore trattato endodonticamente. La quantità di sostanza dentale sana residua è il fattore più significativo in grado di influenzare l'approccio terapeutico. L'abilità del clinico è un fattore da non sottovalutare per il successo a lungo termine degli intarsi adesivi.

Introduction

A successful clinical outcome of endodontically treated teeth depends on adequate root canal treatment as well as on adequate restorative treatment performed afterwards.[1] The restoration of endodontically treated teeth involves a variety of treatment options and still represents a challenging task for clinicians (Table 1). Restoration of root filled teeth can be challenging due to structural differences between vital and non-vital root filled teeth. Irreversible chemical—physical (dehydration of dentin; reduction of micro-hardness; collagen alteration; effects of irrigants and medicaments) and especially bio-mechanical changes (loss of tooth structure; loss of proprioception), due to the endodontic treatment, increase the propension to dental fracture and condition the restoration options for the clinician. The objectives of a restoration following root canal treatment and re-treatment are: to restore form, function and aesthetics, to prevent bacterial micro-leakage into the root canal system,[2] to ensure periodontal health, to protect the residual tooth structure against fracture, to prevent fracture and wear of the restoration and the abrasion of the antagonistic teeth.[3] The importance of the coronal seal has been demonstrated by literature.[4–7] The final restoration should commence as soon as possible after root canal treatment, better in the same visit of the endodontic treatment, in order to prevent coronal micro-leakage.[8] Delaying definitive restoration and filling temporary obturation for long time enhances the risks of periapical recontamination and future failure.[9] The type of

Table 1 Some of the therapeutic options for the restoration of single posterior endodontically treated teeth. Direct amalgam and indirect gold restorations are being used less and less by clinicians because of the aesthetic features and the demand of bio-economy of dental substance. Adhesive cementation of posterior ceramic full crowns is often a problem to consider.

Therapeutic options for the restoration of single posterior treated teeth	
• Amalgam restoration	Direct
• Composite resin restoration	Restoration
• Composite resin onlay/overlay	
• Composite resin onlay/overlay (cad-cam)	
• Ceramic onlay/overlay — lithium disilicate (pressed)	Inlay
• Ceramic onlay/overlay — lithium disilicate (cad-cam)	
• Gold overlay	
• Metal—ceramic crown	
• Zirconia—ceramic crown	
• Monolithic zirconia crown	Full
• Ceramic crown — lithium disilicate (pressed and layered)	Crown
• Ceramic crown — lithium disilicate (pressed)	
• Ceramic crown — lithium disilicate (cad-cam)	
• Gold crown	

restoration chosen for a root filled tooth depends on the amount of remaining hard tooth structure available and may influence long-term survival and cost. Full crown is indicated in case of teeth heavily weakened by pathology with extensive involvement of the cervical enamel or in the presence of previous prosthetic preparations. Overlay adhesive restoration is preferable in case of adequate healthy dental substance when a previous crown is not present (Figs. 1—27). The aim of this paper is to analyse the therapeutic options for the post-endodontic restorations, describing the clinical advantages of the conservative adhesive techniques and the basic principles fundamental for long-term success.

The recent changes in the methods available for restoring endodontically treated teeth depend on the improvement of the adhesive techniques, composite resin materials, fiber posts, and indirect ceramic materials. Focusing on the relevant advantages (bioeconomy of dental tissues, bioeconomy of periodontal tissues, reinforcing of healthy residual dental tissues, aesthetic, ergonomic and economic advantages) of the conservative bonded techniques helps the clinician to choose the proper restoration.

(1) Bioeconomy of dental tissues

There is a direct relationship between remaining tooth structure and fracture resistance. According to Nagasiri and

Figure 1 Mandibular first molar showing mesial deep decay.

Figure 2 After caries removal, pretreatment and reconstruction of the mesial wall with composite resin, a mini-invasive access cavity was prepared.

Figure 3 Post-operative radiograph. Note the conservative shaping respecting the original anatomy performed with M-wire rotary files of the latest generation.

Figure 4 After the build-up restoration the colour was taken and sent to the laboratory.

Figure 5 Cavity preparation. Detail of the proximal box preparation with coarse diamond burs.

Chitmongkolsuk's study, greater remaining tooth structure means greater longevity for the teeth.[10] Scientific literature on the post-endodontic restoration is unanimous: the prognosis of root-filled teeth depends not only on the success of the endodontic treatment but also on the amount of remaining

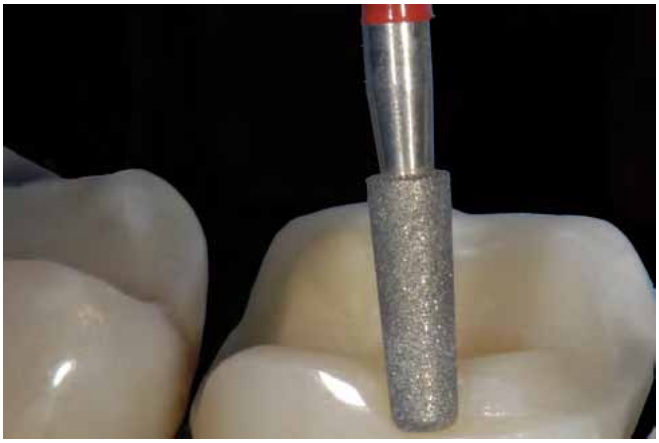

Figure 6 Finishing of the cavity margins with fine-grained burs.

Figure 7 Proximal separation and finishing of the cervical margins with fine-grained diamond strips.

Figure 8 After impression a ceramic overlay (lithium disilicate) for the first molar and a composite overlay for the second premolar were prepared by the dental technician.

Figure 9 Luting appointment. The try-in and shade control of the laboratory-made restoration (proximal contacts, marginal adaption, passive fit) after rubber dam placement.

Figure 10 Application of the hydrofluoric acid to etch the inner aspect of the ceramic overlay.

Figure 11 Application of the silane to the inner surface of the ceramic overlay.

dentine tissue, and the nature of final restoration.[11,12] A mini-invasive approach should be performed during all the steps of the treatment. It is important to reduce the removal of healthy dental tissues during the endodontic therapy (preparation of access cavity (Fig. 2), root canal instrumentation (Fig. 3) and during the restoration procedures (post-space preparation, final cavity preparation, selection of the type of the restoration). It is also important to use conservative techniques during irrigation and canal obturation.[13] The lengthening life expectancy and the increasing numbers of elderly persons want to retain their remaining dentitions for as long as possible, lead the clinician to prefer a conservative restoration, in order to

Figure 12 Application of a thin layer of bonding resin protecting the overlay to avoid accidental curing by ambient light.

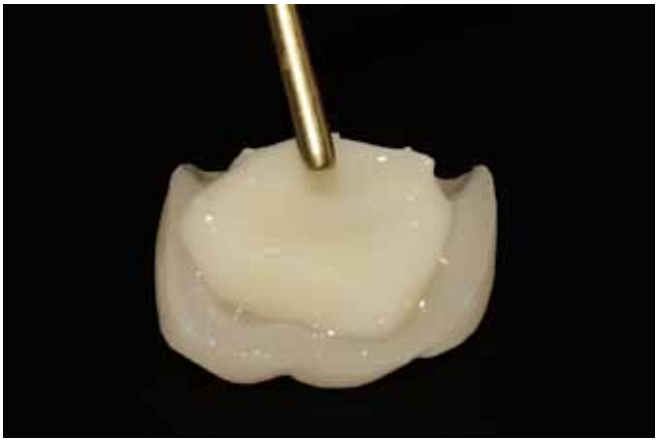

Figure 13 The resin composite is placed on the inner surface of the overlay.

Figure 14 After protecting the proximal teeth, the cavity of the first mandibular molar is conditioned with orthophosphoric acid.

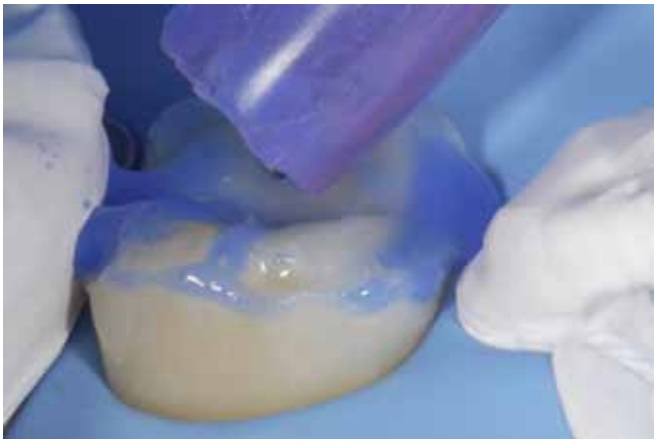

Figure 15 After aspirating the acid, the cavity is rinsed abundantly with water and dried with compressed air.

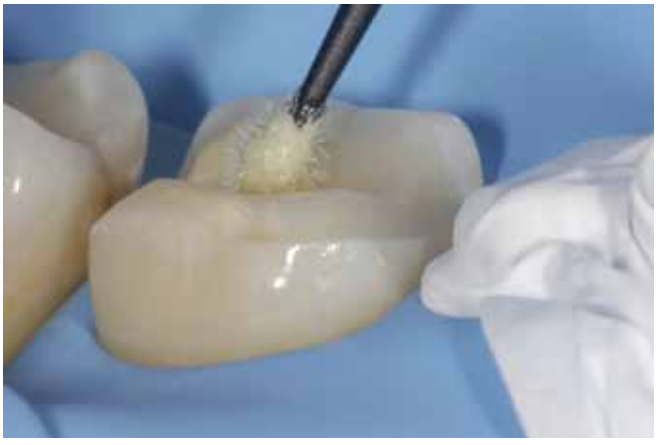

Figure 16 Application of primer.

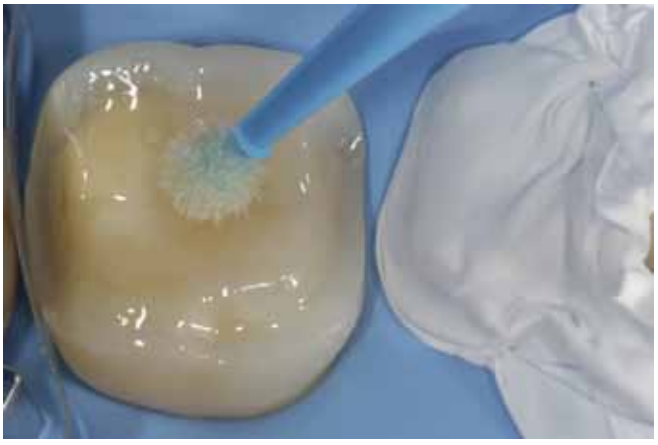

Figure 17 A thin layer of light-cured bonding resin is applied on the entire cavity without being pre-cured.

extend the "molar life cycle" and limit the use of osteointegrated implants.[14]

(2) Bioeconomy of periodontal tissues

Preserving intact coronal and radicular tooth structure and maintaining cervical tissue to create a ferrule effect are considered to be crucial to optimize the biomechanical behavior of the restored tooth.[15–17] A conservative approach in cavity preparation and restoration often means mini-invasive surgical crown lengthening, and sometimes, no periodontal surgery.

Figure 18 The ceramic overlay placed and seated manually.

Figure 19 After dimming the dental chair light, the composite is removed carefully with a thin probe.

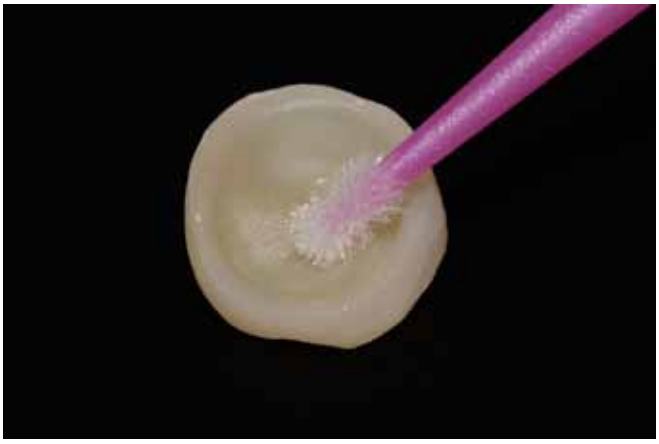

Figure 20 Application of the silane to the inner surface of the composite overlay.

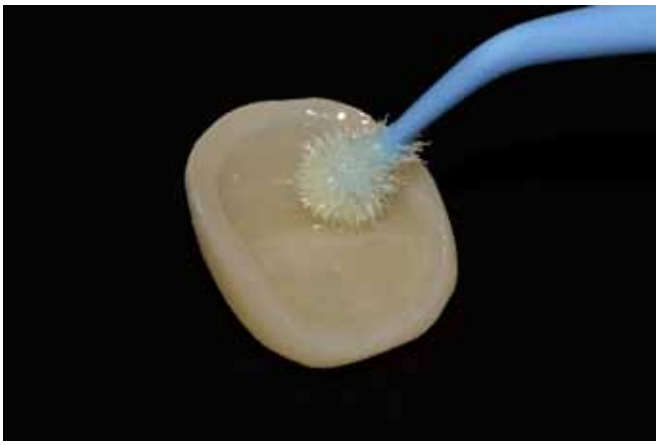

Figure 21 Application of a thin layer of bonding resin.

Figure 22 Placement of the resins composite.

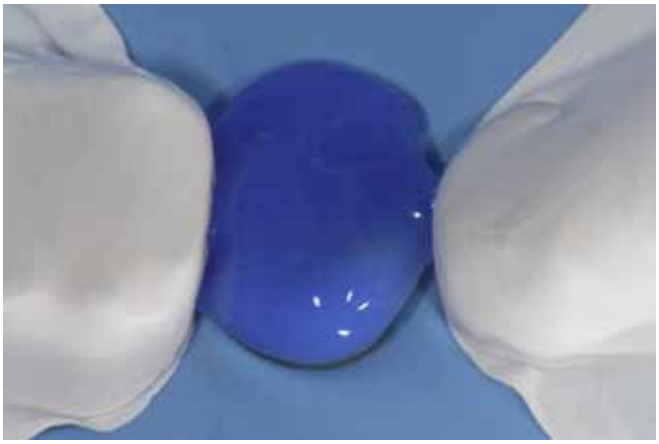

Figure 23 After protecting the proximal teeth, the cavity of the second premolar is conditioned with orthophosphoric acid.

(3) Reinforcing of healthy residual dental tissues

Reinforcing effect of adhesive restorations have long been known.[18,19] Conservative bonded restorations are more and more preferred to traditional metal full crowns.[20] The best current approach for restoring endodontically treated teeth seems to: minimize tissue sacrifice, especially in the cervical area so that a ferrule effect can be created, use adhesive procedures to strengthen remaining tooth structure and optimize restoration stability and retention, use post and core materials with physical properties close to those of natural dentin.[15]

(4) Esthetic, ergonomic and economic advantages

The chromatic integration of the adhesive restorations offers an immediate appreciable aesthetic result. The

Figure 24 After maintaining in place the restoration with a composite plugger, the composite is removed carefully with a thin probe.

Figure 25 Luting composite is polymerized with a curing device at least 60 s per surface and finally through a glycerine gel for 5 s per surface to avoid an oxygen-inhibition layer.

Figure 26 Post-operative radiograph at the end of the cementation.

"chameleon effect" is excellent in posterior teeth, also in maxillary premolars. In upper posterior elements with aesthetic implications, bleaching techniques and paramarginal preparations (veneerlay preparations) could be necessary in order to guarantee an aesthetic restoration with minimally invasive performances.[20] The supragengival margins of the partial adhesive restorations result in healthy periodontal tissues and simplify oral hygiene techniques (brushing and flossing) and professional inspection. It is easier to diagnose marginal leakage and to perform early treatment. Indirect composite restoration permits repair and replacement: it is an interim stage before placement of a full crown, with the advantage of preserving the residual tissues for subsequent prosthetic treatment.[21] Composite overlay is a restoration that allows for future retreatment of the root canal system[22] and is a treatment option in clinical cases with dubious prognosis. The use of one single material for the direct restoration, for the build-up and for the production of the overlay is another ergonomic advantage. Dental technician procedure for inlay execution is simpler if compared to a full crown. These ergonomic advantages result in economic benefits for patients and dental office.

Figure 27 Follow-up periapical radiograph.

Direct adhesive restorations

Direct restoration involves placement of a restorative material directly into the tooth. On one hand the bonded composite direct restoration is a conservative option that is possible to achieve, technically, by means of sectional matrix bands and separation rings (Figs. 28 and 29). Today the clinicians are

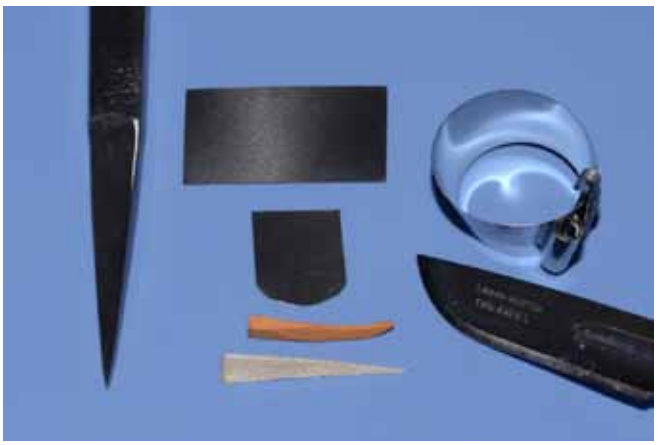

Figure 28 Matrices and wedges used for direct restorations.

Figure 29 Recent systems used for direct composite restorations: separation rings and sectional matrix bands.

able to perform anatomy and function of the proximal area (contacts, contour, cervical seal and emergence profile) in many clinical cases (Figs. 30—35). On the other hand, in line with the current international literature, this procedure is practicable only in the presence of small loss of healthy dental substance. Posterior teeth with an endodontic access preparation and no other structural loss may succeed with a conservative bonded restoration.[23,24] The marginal ridge is an anatomical structure of reinforcement and it should be preserved.[25,26] In posterior teeth with one marginal ridge lost, an adhesive direct composite restoration could be considered if other key factors (tooth involved, occlusion, cuspal thickness and so on) are favorable.[27,39]

Indirect adhesive restorations (onlay—overlay)

Partial indirect adhesive restorations are more conservative than prosthetic restorations and should be preferred, when possible. The full crown is considered the gold standard by the literature, with a six times greater rate of success in endodontically treated teeth,[28] but in medium-sized cavity, bonded indirect restorations (onlay, but mostly overlay) allow to delay the execution of a full crown, with the subsequent sacrifice of healthy dental tissue. Adhesive overlays preserve coronal

Figure 30 Periapical pre-operative radiograph showing a deep distal caries in a second premolar of a young patient.

Figure 31 After isolating the operative field with rubber dam, preparing a mini-invasive access cavity and completing a conservative endodontic treatment, using nickel—titanium rotary files, the cavity is ready to be filled.

Figure 32 The use of a plastic wedge, a sectional matrix and a separation ring during the adhesive composite restoration.

Figure 33 Anatomical layering of composite posterior restoration, with small increments in order to reduce shrinkage stress occurring during polymerization. The restorative hybrid composite resin is stratified into the cavity, starting from the interproximal distal wall in order to transform the Class II cavity into a Class I cavity.

Figure 34 The restoration after the last occlusal increment.

Figure 35 Periapical radiograph showing an endodontic-restorative treatment with a mini-invasive approach. The direct composite restoration will be used as a build-up for an indirect adhesive restoration.

structure, avoid contamination of the root canal system, reinforce residual dental tissues, guarantee optimal form, function, aesthetics and offer ergonomic and economic undoubted clinical advantages. There is no clear evidence to favour ceramic or composite resin inlays, but composite resin onlays—overlays are, in general, less expensive and easier to prepare and repair.

Onlay

In the presence of one marginal ridge lost and the two adjacent cusps compromised (OM — OD cavities) an onlay indirect restoration could be performed if the other marginal ridge and cusps are healthy (Figs. 36—38). This restorative option is not frequent in endodontically treated teeth that are, usually, heavily compromised; molars damaged by one deep single decay with interproximal extension represent the typical indication.

Overlay

In mesio-occlusal-distal cavities (Fig. 39) the risk of fracture is higher[19]; in endodontically treated posterior teeth with

Figure 36 In the presence of a marginal ridge preserved, the measurement of the thickness of the residual cusps is essential to decide the restorative plan of treatment.

Figure 37 In this maxillary first molar the mesial marginal ridge is lost and the mesial cusps are too thin to perform a direct restoration.

Figure 38 With healthy distal cusps and distal ridge preserved, an onlay indirect composite restoration is planned, covering the two mesial cusps. Build-up phase: the "white" composite in the pulp chamber facilitates the detection of the root canals in case of endodontic re-intervention.

both marginal ridges lost, a direct restoration is unacceptable and an overlay preparation with cusp coverage increases fracture resistance. Overlay adhesive preparations require removal of tooth structure about 50% lower than complete crown preparation.[29] Adhesive techniques allow the clinician to preserve rather than remove dentine; the precision during the single phases of the procedure (build-up, cavity preparation, impression, luting, finishing and polishing) and the attention to many fine details can provide the basis of long-lasting, aesthetic restorations.

Cavity preparation and impression

The onlay preparation for composite resin or ceramic materials requires a minimum reduction of 1.5—2 mm. The margins recommended for these preparations are normally a 90° shoulder finish (without bevels), and the internal line angles of the cavity should be rounded. Complete proximal separation (cervical, lingual-palatal and buccal side) is necessary. Proximal boxes should be extended gingival to the contact points and internal walls should be divergent (about 15°—18°) to avoid undercuts in the preparation. A 2—3 mm wide preparation at the occlusal isthmus is usually recommended.[30] A similar preparation for occlusal veneers[31] has become increasingly more conservative with softer lines and, in many cases, with butt joint preparations just in the proximal boxes.[32] The cavities are prepared using coarse diamond burs (100 μm) (Fig. 5) and finished with fine-grained burs (40 μm) (Fig. 6) of the same shape. For finishing assial cavity walls it is possible to use fine-grained diamond flame burs. For proximal separation and finishing of the cervical margins it is possible to use fine-grained diamond strips, sonic tips or reciprocating tips. Diamond strip is a very conservative and easy method, especially for regularization of the distal margins (Fig. 7). The management of the mesial margins requires manual skill; in these cases it could be convenient to use proximal fine sonic tips (Fig. 40) or reciprocating tips (Fig. 41). The advantage of the reciprocating handpiece is the rotation of the tip along the axis in order to adapt to all shapes and inclinations of the teeth. On the other hand, with the sonic handpiece just one position of the tip is possible.

Figure 39 Mesio-occlusal-distal cavity. In endodontically treated posterior teeth with both marginal ridges lost, a direct restoration is unacceptable and an overlay preparation with cusp coverage increases fracture resistance.

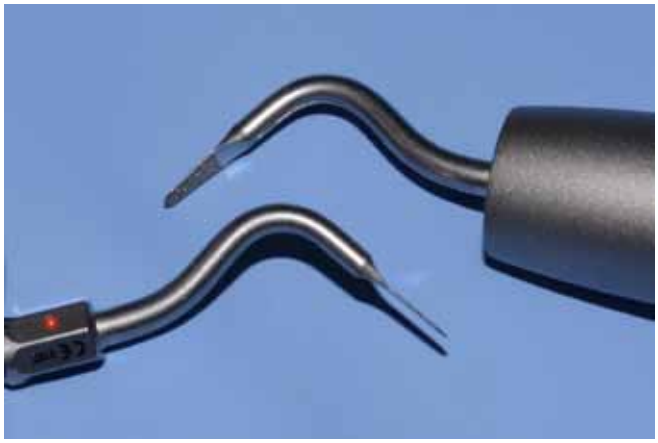

Figure 40 Proximal fine sonic tips used for finishing assial cavity walls, for proximal separation and finishing of the cervical margins and during the finishing after cementation.

The preparation of a tooth isolated with the rubber dam is able to simplify the procedure and increase the precision and the quality of the final result. Supragingival margins preparation and impression are simpler than paramarginal or intrasulcural full-crown preparation especially in posterior teeth (first molar and above all second molar). A gingival retraction cord to obtain hemostasis and displacement of gingival tissues in order to expose finishing lines of the preparation often is not necessary.

Luting, finishing and polishing

The luting appointment is performed after rubber dam isolation and it is a determinant for the long-term success. After the try-in and shade control of the laboratory-made restoration (proximal contacts, marginal adaption, passive fit) (Fig. 9), the inner surface of the indirect resin composite restoration is abraded with 30—50 μm Al_3O_2 particles, primed for 60 s with an organic silane (Figs. 11 and 20), dried with a gentle blow of warmed air, covered with a thin layer of bonding resin (Figs. 12 and 21) and finally protected from

Figure 41 Reciprocating tips, used with the same purpose of the sonic tips. The advantage of the reciprocating handpiece is the rotation of the tip along the axis in order to adapt to all shapes and inclinations of the teeth. On the other hand, with the sonic handpiece just one position of the tip is possible.

light to avoid accidental curing by ambient light.[33] The cavity surface is prepared for luting: after protecting the proximal teeth, the cavity is conditioned with orthophosphoric acid (Figs. 14 and 23), rinsed abundantly with water, dried with compressed air; a thin layer of light-cured bonding resin is applied on the entire cavity without being pre-cured (Fig. 17). The pre-heated light-cured restorative resin composite is filled in the cavity and the restoration is placed manually (Figs. 18 and 24) and seated with ultrasonic energy (optional). Removal of resin composite excess is a determinant step. After dimming the dental chair light and maintaining in place the restoration with a composite plugger, the composite is removed carefully with a thin probe. Luting composite is polymerized with a curing device at least 60 s per surface and finally through a glycerine gel (Fig. 25) for 5 s per surface to avoid an oxygen-inhibition layer. If the previous steps have been correct, finish and polish restoration's margins are often a fine and delicate procedure requiring a couple of minutes and few instruments (fine plastic strips, flexible fine disks, silicone points with slight pressure). The removal of small composite residues, accidentally trapped in the proximal spaces, but not bonded to the enamel, can be performed in a simple, conservative and quick way, by moving a small, thin metallic matrix through the contact point in a coronal—apical direction. Thanks to this simple trick, the clinician is able to mechanically remove the small amounts of materials, with a method more effective than the traditional flossing. After removing rubber dam, occlusion is checked and, if necessary, adjust.

Amalgam restorations

Amalgam has been used as a direct restoration because of many clinical, practical and ergonomic advantages: optimal marginal seal, wear resistance and compression strength, good polishability, excellent costs-benefits ratio.[34] Amalgam was an economical material able to ensure a stable coronal seal and to allow the retreatment; it was particularly suitable as a medium-term restoration in young patients, especially in the presence of uncertain prognosis. Onlay amalgam restoration with intraradicular retentions[35] was an effective procedure and more conservative than a full crown. Cuspal coverage ensured protection against bio-mechanical stress, preventing vertical fractures.[36] The amalgam posed several limitations: the intrinsic rigidity of the material, but most importantly the change in size, caused by the thermal expansion coefficient and expansion during the hardening phase, more extreme in moist environments, could increase the stress on dental tissues leading to micro-cracking. With the introduction of composite materials silver amalgam was quickly replaced, not necessarily for toxicity problems, which have never been proven, or for its other limitations (corrosion, oxidation, gum tattoos, and galvanic currents), but for the advantages of the adhesive techniques that enable aesthetic, conservative and strengthening restorations on the residual healthy tissue.

Gold restorations

Gold was the "noble" and high-quality alternative to the amalgam. Cast gold partial crowns (onlays, three-quarters, seven eights) ensured conservative preparations, protection against bio-mechanical stress and optimal long-term reliability.[37] Despite their renowned durability, the use of gold restorations has decreased because of aesthetic limits. Today gold is still the material of choice for posterior teeth but this tends to be where aesthetics are not a major concern. Second molars are good candidates for these types of restoration especially in case of limited interocclusal space or in bruxist patients.[38]

Full crowns

Covering the cuspids improves the long-term prognosis of endodontically treated teeth. The development of adhesive techniques limited the use of full crowns in favor of partial procedures that guarantee the same protection with more conservative procedures. Today full crowns have fewer indications than in the past and, more specifically, are used for three clinical conditions; (1) for severe loss of coronal material from disease (decay or fractures) or iatrogenisis (pre-existing full procedures (Figs. 42—44) with the involvement of dental tissues extending to the cervical third; (2) as a bridge component in a fixed prosthesis (when implants are contraindicated); (3) for perio-prosthetics. The development of the materials for manufacturing crowns today allows clinicians to choose between more treatment options than in the past (Table 1). If on one hand aesthetic materials (ceramic zirconia-supported crowns, crowns in monolithic zirconia crowns, and lithium disilicate crowns) have been shown to offer optimal aesthetic and functional qualities over the short- and medium-term, we should not forget that only traditional metal—ceramic crowns have been scientifically shown to offer long-term reliability and thus represent the first choice, particularly in sectors and for patients with few aesthetic requirements. The greater invasiveness of procedures used for metal—ceramic crowns, often emphasized by certain authors as a fault, is in fact only a partial limitation, considering the fact that full crowns are indicated for severely compromised components. Regardless of the nature of the material used in the manufacturing of the crown, two aspects play a decisive role in the long-term

Figure 42 The full crown is indicated in severely destroyed endodontically treated teeth and in replacing pre-existing ones. Pre-operative photograph, showing a direct amalgam restoration, a metal-ceramic and a gold full crown.

Figure 43 Try-in-phase of the structures of the two crowns.

Figure 44 A modern restorative approach: an indirect adhesive composite onlay, a metal-ceramic (in a tooth without aesthetic demand) and a monolithic zirconia in the presence of reduced occlusal space.

success of the prosthetic tooth: the placement of an endodontic post and the detection of a cerclage or splint.

Endodontic posts

The systematic use of endodontic posts and full crowns in endodontically treated teeth represents the modus operandi for the dentistry of the past, when the general consensus was that the post strengthened the root. If sufficient healthy coronal dental tissue is present, post-endodontic restoration can be achieved with a conservative technique (direct, but more often indirect) and does not require the use of endodontic posts. The scientific literature today is generally in agreement on the key points of this issue.

- When to use an endodontic post.

  When a large portion of the clinical crown has been lost to damage, it is often impossible to achieve sufficient anchorage of a restoration in the remaining dentin. In such situations, a root canal-retained restoration is proposed to be required. Endodontic posts should only be used in cases with severe loss of healthy coronal dental tissue caused by decay, fractures or iatrogenic damage that indicates the need for a full crown. Although in some cases endodontic posts are necessary, their use should be carefully assessed and avoided where possible[39] for a series of reasons:

  (1) The preparation for an endodontic post requires the removal of healthy dental tissue at the root and causes a potential risk of stripping, particularly if inserted in thin and curved roots.
  (2) As a consequence of the above point, they increase the risk of root fracture.[40]
  (3) The presence of a post is associated with an increased incidence of endodontic lesions.[41]
  (4) In case of repeat treatment, the post is an obstacle that may lead to greater removal of radicular dentin and the risk of perforation.[42]
  (5) Its use increases surgery times and costs.[43]
  (6) Adhesion to the root canal dentin remains a "challenge" for the clinician due to the negative impact of irrigants and disinfectants, the unfavorable cavitary configuration[16] and the technical/practical difficulties (removal of the gutta-percha, adhesive phases).

  The use of posts should be avoided in all cases allowing for adhesion to the pulp chamber, which offers an anatomical structure with naturally sufficient retention, particularly in the molars. In the premolars the endodontic posts are more frequently used, since these dental components have a lesser quantity of dental structure and a smaller pulp chamber.[44]

- Why use an endodontic post.

  The endodontic post is a device for retaining materials in a coronal restoration through radicular anchoring. This is the principal reason for the use of a post. The second reason why posts are used is to strengthen the restoration complex/coronal dentin, which is subjected to tangential stress.[43] Other studies[45] have not confirmed the strengthening effect on the residual coronal portion and the post can thus be seen as an additional system for coronal—radicular retention, but not necessarily for strengthening.

- Which material is preferred when selecting the post.

  For many years cast-gold posts were considered the gold standard for the restoration of endodontically treated teeth. More recently all posts manufactured in rigid materials (gold, silver, titanium, zirconium) have been reassessed because, since they are very resistant with an elevated elastic modulus, they cause stress on dental tissues, increasing the risk of fracture. More recently posts with a more favorable elastic modulus have been preferred. Fiber posts provide an elastic modulus (20 GPa) very close to that of dentin (18 GPa) and enable a more uniform absorption and distribution of stress across the residual radicular structure. Carbon fiber posts,[46] and more recently glass and quartz-fiber posts, have been used for over 20 years in the post-endodontic restoration of severely compromised components, with the goal of creating as uniform as possible a monoblock between the post, reconstructive material, cement and tooth, with each component having physical characteristics (elastic modulus) as similar as possible to the others. The biomechanical stress and consequential deformation under load of the tooth-restoration complex over time can result in microflexions causing weakness in the adhesive bond and potential de-cementation. De-cementation, by preventing catastrophic

consequences such as radicular fracture, can be considered a ''safety system'' for the dental component.

- How large should the post be.

  The size of the post depends on the size of the canal where it will be inserted. A larger post is selected when it can be inserted in the canal without sacrificing excessive healthy dental tissue. It is preferable to insert the post in the widest and straightest canal,[42] possibly in the strongest root (typically the palatal root of the upper molars and the distal root of the lower molars) avoiding particularly curved canals (mesio-vestibular canal of the lower molars and mesio-vestibular and mesiopalatal canal of the upper molars). The shape of the post is also important: ''anatomical'' posts are preferred, as they allow for minimally invasive procedures. Very often the preparation of the space for the post is limited to a careful cleaning of the endodontic walls, under strong magnification, without the removal residual healthy dental tissue.
- How deep the post should be inserted.

  The depth of post insertion depends on residual healthy dental tissue. The greater the loss of coronal material, the greater the depth of post cementation. The same is true for the number of posts: with severely compromised components, it may be necessary to use more than one post, cemented in different canals. Long posts distribute the load over larger areas and increase the adhesion surface. A ratio of 2:3 between the crown and the post is excellent, within an extension of 2/3 of the root.[21] Regardless, the apical seal must be preserved, preventing microinfiltration and remaining within a range between 3 and, preferably, 6 mm.[47] Some authors[48] maintain that it is sufficient to insert the post to a depth corresponding to the height of the crown without penetrating the more apical 4—5 mm. It should be noted that the deeper the post is inserted, the greater the surgical difficulties in cementation and the worse the adhesion.
- Technical/surgical strategies

  The cementation of a fiber post is successful when adhesion protocols are followed meticulously, when the field is fully isolated with a rubber dam and a suitable armamentarium is used (magnification first and foremost). The surgeon also plays a determining role, however, having to work inside a dark environment and within a limited space. The preparation of the cavity that will hold the post is the first critical phase and consists in the removal of the gutta-percha and the endodontic cement of the canal walls, a procedure that is achieved with low-speed rotary tools (small Gates burs), alternating cooling with air and water. The purpose is to meticulously clean the endodontic walls and create the ideal foundation for adhesion, removing all residual material that could contaminate the surface. Then the small areas of contaminating undercut are cleaned using ultrasonic tools, always under magnification and with dedicated coaxial lighting. Endodontic brushes can simplify the final cleaning phase. After testing and possibly shortening and adjusting the post to the prepared space, cementation is completed. Regardless of the type of cement chosen, it is important to use paper cones to remove any excess material prior to etching, after the removal of acid and the irrigation of the radicular dentin after the application of the primer. In order to apply the primer and ensure bonding (if required by the adhesive system) at the maximum depth, a handle free microbrush is preferred. The insertion of cement is another delicate phase, which should be performed using long, thin and adjustable plastic connectors with metal nozzles (for centrix syringe) in order to enable the penetration of the base of the post-space, preventing the formation of bubbles that would limit adhesion. The post is positioned and the reconstruction of the stump can then be completed with composite material.

Ferrule effect

The presence of a 1.5- to 2-mm ferrule has a positive effect on fracture resistance of endodontically treated teeth. A ferrule effect is defined as a 360° metal collar of the crown surrounding the parallel walls of the dentine extending coronal to the shoulder of the preparation. The result is an elevation in resistance form of the crown from the extension of dentinal tooth structure.[49,50] If the clinical situation does not permit a circumferential ferrule, an incomplete ferrule is considered a better option than a complete lack of ferrule. Including a ferrule in preparation design could lead to more favorable fracture patters.[51] Ideally, the ferrule of dentin should be continuous around the entire circumference of the tooth. However, there may be instances where this is not achievable, and so any ferrule should be considered in the context of the individual case being treated. The restoration of severely damaged teeth, with no clinical crown present, represents a particularly important issue. In teeth with no coronal structure, in order to provide a ferrule, the clinician may consider two options: surgical crown lengthening or orthodontic extrusion. In such a clinical situation, an adequate ''biologic width'' and distance between crown margin and alveolar crest should be ensured. Biological width was defined as ''the dimension of the junctional epithelial and connective tissue attachment to the root above the alveolar crest''.[52] Gargiulo et al. found the dimensions of the attachment apparatus to range from 1.77 mm to 2.43 mm. This means that there should be an absolute minimum of 2.5 mm between the restoration margin and the crest of bone.[53] Other authors recommended that at least 3 mm between the crown margin and the alveolar crest should be left to avoid impingement on the coronal attachment of the periodontal connective tissue.[54,55] Therefore, if a 1.5-mm ferrule is to be achieved, at least 4.5 mm of supra-alveolar tooth structure is required.[56]

Conclusions

The restoration of endodontically treated teeth is one of the topics more studied and controversial in dentistry.[57] The long-term success is influenced by operative choices selected by the clinician in function of the individual clinical case: direct or indirect restorations, overlays or full crown, using or not posts, the better material and the principles used in the design preparation. The treatment planning depends on remaining coronal tooth structure and functional requirement, once load received depends on tooth position in the arch, occlusion, missing teeth, parafunctions and rehabilitation planning. On one side the full crown is the first condition able to improve tooth survival after endodontic treatment.[58] On the other side new materials, instrumentation and

techniques have enhanced the performance of current posterior composite restorations over their predecessors.[59] However, it is a clinician's operative skill that ultimately determines the quality of a restorative option.[60] Optimal application of the clinical protocols, the attention to many fine details and, above all, dental dam requirement are the key points for long-term clinical success.[61] The proper placement of the rubber dam is an essential step for the composite-resin build-up and the luting of inlays, onlays and overlays. It is important the size of the holes, the correct distance between the single ones and the shape, that must be round and well-defined, in order to prevent any moisture seepage coming from saliva, intraoral humidity, blood and crevicular fluid. Contamination of the enamel and dentin can reduce bond strengths and adhesion to the tooth, compromising the longevity of the adhesive restorations. An isolation of a large field including one or more teeth mesially and distally to the interested tooth, simplify the phases of the restoration and of the cementation. The choice of heavy or extra-heavy weight rubber sheets is recommended to provide gingival tissues retraction in order to enhance visibility of deep margins and simplify the removal of all residues of adhesive and cement.

Conflict of interest

The authors have no conflict of interests to declare.

Acknowledgements

The author would like to thank dental technicians of the laboratory Giacometti & Zeppegno (Genoa — Italy) for the laboratory works. The author also thanks Silvia and Roberta, assistants of the dental office and Professor Massimo Gagliani.

References

1. Gillen BM, et al. Impact of the quality of coronal restoration versus the quality of root canal fillings on success of root canal treatment: a systematic review and meta-analysis. *J Endod* 2011;**37**:895—902.
2. Ray HA, Trope M. Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and the coronal restoration. *Int Endod J* 1995;**28**:12—8.
3. Mannocci F, Bhuva B, Stern S. Restoring teeth following root canal re-treatment. *Endod Topics* 2011;**19**:125—52.
4. Torabinejad M, Borasmy U, Kettring JD. In vitro bacterial penetration of coronally unsealed endodontically treated teeth. *J Endod* 1990;**16**:556—9.
5. Khayat A, Lee SJ, Torabinejad M. Human saliva penetration of coronally unsealed obturated root canals. *J Endod* 1993;**19**: 458—61.
6. Cerruti A, Venturi G, Azzini A, Savoldi E. Valutazione in vitro della resistenza alla penetrazione batterica in elementi trattati endodonticamente. *Giornale Italiano Endo* 1998;**6**:76—83.
7. Berutti E. Microleakage of human saliva through dentinal tubules exposed at the cervical level in teeth treated endodontically. *J Endod* 1996;**11**:579—82.
8. Heling I, Gorfil C, Slutzky H, Kopolovic K, Zalkind M, Slutzky Goldberg I. Endodontic failure caused by inadequate restorative procedures: review and treatment recommendations. *J Prosthet Dent* 2002;**87**:674—8.
9. Coronal leakage: clinical and biological implications in endodontic success. AAE Fall-Winter; 2002.
10. Nagasiri R, Chitmongkolsuk S. Long-term survival of endodontically treated molars without crown coverage: a retrospective cohort study. *J Prosthet Dent* 2005;**93**:164—70.
11. Kishen A. Mechanisms and risk factors for fracture predilection in endodontically treated teeth. *Endod Topics* 2006;**13**:57—83.
12. Assif D, Gorfil C. Biomechanical considerations in restoring endodontically treated teeth. *J Prosthet Dent* 1994;**71**:565.
13. Tang W, Younong W, Smales R. Identifying and reducing risks for potential fractures in endodontically treated teeth. *J Endod* 2010;**4**:609—10.
14. Simonsen RJ. New materials on the horizon. *J Am Dental Assoc* 1991;**122**:24—31.
15. Dietschi D, Duc O, Krejci I, Sadan A. Biomechanical considerations for the restoration of endodontically treated teeth: a systematic review of the literature: Part 1. Composition and micro- and macrostructure alterations. *Quintessence Int* 2007; **38**:733—43.
16. Dietschi D, Duc O, Krejci I, Sadan A. Biomechanical considerations for the restoration of endodontically treated teeth: a systematic review of the literature: Part II (evaluation of fatigue behavior, interfaces, and in vivo studies). *Quintessence Int* 2008;**39**:117—29.
17. McLean A. Predictably restoring endodontically treated teeth. *J Canadian Dental Assoc* 1998;**64**:782—7.
18. Sheth JJ, Fuller JL, Jensen ME. Cuspal deformation and fracture resistance of teeth with dentin adhesives and composites. *J Prostheth Dent* 1988;**60**:56—569.
19. Hansen EK, Asmussen E, Christiansen NC. In vivo fractures of endodontically treated posterior teeth restored with amalgam. *Endod Dental Traumatol* 1990;**6**:49—55.
20. Magne P. No post, no crown: biomimetic restorative dentistry; 2008.
21. Cavalli G. Cap 12: Il restauro del dente trattato endodonticamente. Odontoiatria Conservativa procedure di trattamento e prospettive future. Milano: Elsevier Masson; 2009.
22. Schwartz R, Jordan R. Restoration of endodontically treated teeth: the endodontist's perspective: Part 1. AAE Spring-Summer; 2004.
23. Reeh ES, Messer HH, Douglas WH. Reduction in tooth stiffness as a result of endodontic and restorative procedures. *J Endod* 1989;**15**:512—6.
24. Steele A, Johnson BR. In vitro fracture strength of endodontically treated premolars. *J Endod* 1999;**25**:6—8.
25. Sakaguchi RL, Brust EW, Cross M, Cross DeLong R, Douglas WH. Independent movement of cusps during occlusal loading. *Dent Mater* 1991;**7**:186—90.
26. Panitvisai P, Messer H. Cuspal deflection in molars in relation to endodontic and restorative procedures. *J Endod* 1995;**21**:57—61.
27. Becciani R, Castellucci A. La biomeccanica del dente trattato endodonticamente. Implicazioni cliniche. *Dental Cadmos* 2002; **70**:15—32.
28. Aquilino SA, Caplan DJ. Relationship between crown placement and the survival of endodontically treated teeth. *J Prosthet Dent* 2002;**87**:256—63.
29. Edelhoff D, Sorensen JA. Tooth structure removal associated with various preparation designs for posterior teeth. *Int J Period Restorative Dent* 2002;**22**:241—9.
30. Dietschi D, Spreafico R. Restauri adesivi non metallici: attuali concetti per il trattamento estetico dei denti posteriori. *In: Scienza e Tecnica dentistica*. Milano: Edizioni Internazionali; 1997.
31. Magne P, Belser U. Cap 8: Prove in bocca e procedure di cementazione adesiva. *In: Restauri adesivi in ceramica dei denti anteriori*. Milano: Quintessenza edizioni; 2005: 172.
32. Veneziani M. Riabilitazioni conservative con restauri adesivi estetici. *Rivista degli Amici di Brugg* 2014;**1**:23—41.

33. Rocca GT, Krejci I. Bonded indirect restorations for posterior teeth: the luting appointment. *Quintessence Int* 2007;**38**:543—53.
34. Anderlini G. Moderni orientamenti per la restaurazione dentale. Bologna: Edizioni Martina; 1995.
35. Nayar A, Walton RE, Leonard LA. An amalgam coronal-radicular dowel and core technique for endodontically treated posterior teeth. *J Prosthet Dent* 1980;**43**:511—5.
36. Mangani F. Gli onlays in amalgama a sole ritenzioni naturali per il restauro degli elementi posteriori trattati endodonticamente. *Giornale Italiano Endo* 1993;**3**:123—7.
37. Mangani F. Corone parziali in oro per il restauro degli elementi posteriori trattati endodonticamente. *Giornale Italiano Endo* 1988;**2**:37—45.
38. Mannocci F, Cowie J. Restoration of endodontically treated teeth. *Br Dental J* 2014;**6**:341—6.
39. Polesel A. Il restauro conservativo del dente singolo posteriore trattato endodonticamente. *Giornale Italiano Endo* 2011;**25**: 3—21.
40. Heydecke G, Butz F, Strub JR. Fracture strength and survival rate of endodontically treated maxillary incisors with approximal cavities after restoration with different post and core systems: an in-vitro study. *J Dent* 2001;**29**:427—33.
41. Sorensen JA, Martinoff JT. Endodontically treated teeth as abutments. *J Prosthet Dent* 1985;**53**:631—6.
42. Schwartz R, Robbins JW. Post placement and restoration of endodontically treated teeth: a literature review. *J Endod* 2004;**30**:289—301.
43. Fichera G, Dinapoli C, Ferrari P, Re D. Restaurativa post-endodontica con perni in fibra. Indicazioni e tecnica operativa. *Il Dentista Moderno* 2005;**9**:23—55.
44. Fokkinga WA, Le Bell AM, Kreulen CM, Lassila LVJ, Valittu PK, Creugers NHJ. Ex vivo fracture resistance of direct resin composite complete crowns with and without posts on maxillary premolars. *Internat Endod J* 2005;**38**:230—7.
45. Fokkinga. et al. Ex vivo fracture resistance of direct resin composite complete crowns with and without posts on maxillary premolars. *Int Endod J* 2005;**38**:230—7.
46. Duret B, Reynaud M, Duret F. Un nouveau concept de reconstitution coronradiculare: le Composipost. *Le Chir Dent Fr* 1990; **54**:131—41.
47. DeCleen MJ. The relationship between the root canal filling and post space preparation. *Int Endod J* 1993;**26**:53—8.
48. Abramovitz L, Lev R, Fuss Z, Metzger Z. The unpredictability of seal after post space preparation: a fluid transport study. *J Endod* 2001;**27**:292—5.
49. Sorensen JA, Engelman MJ. Ferrule design and fracture resistance of endodontically treated teeth. *J Prosthet Dent* 1990; **63**:529—36.
50. Stankiewicz N, Wilson P. The ferrule effect. *Dent Update* 2008; **35**:222—4.
51. Juloski J, Radovic I, Goracci C, Vulicevic ZR, Ferrari M. Ferrule effect: a literature review. *J Endod* 2012;**38**:11—9.
52. Sivers JE, Johnson GK. Periodontal and restorative considerations for crown lengthening. *Quintessence Int* 1985;**16**: 833—6.
53. Gargiulo AW, Wentz F, Orbun R. Dimensions and relations of the dentogingival junction in humans. *J Periodontol* 1961;**32**: 261.
54. Fugazzotto PA, Parma-Benfenati S. Pre-prosthetic periodontal considerations. Crown length and biologic width. *Quintessence Int* 1984;**12**:1247—56.
55. Freeman B. The biologic width periodontal — restorative considerations. *Univ Tor Dent J* 1990;**3**:32—3.
56. Stankiewicz NR, Wilson PR. The ferrule effect: a literature review. *Int Endod J* 2002;**35**:575—81.
57. Faria. et al. Endodontically treated teeth: characteristics and considerations to restore them. *J Prosthodontic Res* 2011;**55**: 69—74.
58. Faria ACL, Rodrigues RCS, Antunes RP, Chiarello de Mattos MG, Faria Ribeiro R. Endodontically treated teeth: characteristics and considerations to restore them. *J Prosthodontic Res* 2011; **55**:69—74.
59. Rocca GT, Krejci I. Crown and post-free adhesive restorations for endodontically treated posterior teeth: from direct composite to endocrowns. *Eur J Esthetic Dent* 2013;**8**:156—79.
60. Liebenberg WH. Posterior composite resin restorations: operative innovations. *Pract Proc Aesthet Dent* 1996;**8**:769—78.
61. Heintze SD, Rousson V. Clinical effectiveness of direct class II restorations — a meta-analysis. *J Adhes Dentistry* 2012;**14**: 407—31.

Giornale Italiano di Endodonzia (2014) **28**, 17—22

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CASE REPORT/CASO CLINICO

Endodontic retreatment of a lower canine associated with a periapical lesion: case report of an unusual anatomy

Ritrattamento canalare di un canino inferiore affetto da lesione periapicale: caso clinico relativo ad una anatomia inusuale

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Received 28 February 2014; accepted 24 April 2014
Available online 28 May 2014

KEYWORDS
Root canal anatomy;
Two roots;
Lower canine;
Retreatment;
Periapical lesion;
Operating microscope.

Abstract
Objectives: To describe the endodontic orthograde retreatment of a lower canine with a rare anatomy, affected by a symptomatic periapical lesion.
Materials and methods: A 30-year-old Caucasian woman came to our office reporting severe pain and swelling located at the right mandible. A two-roots/two-canals configuration was discovered for the lower canine which sustained the periapical infection; a missed lingual canal was not recognized and treated at the previous primary endodontic therapy.

A full pre-operative examination and diagnosis, the application of modern endodontic strategies along with the use of magnification technologies (like the Surgical Operating Microscope - SOM) and proper disinfection protocols were employed for endodontic re-treatment.
Result and conclusions: Healing of the periapical infection was clinically and radiographically confirmed at a 9-month follow-up. Endodontists should know the anatomical variations of human teeth and be vigilant about them when approaching treatments. More than a single radiographic projection is recommended in the diagnostic phase.

Careful procedures related to instrumentation, cleaning and filling of the entire root canal system enhance the potential for healing of apical lesions.

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Peer review under responsibility of Società Italiana di Endodonzia.

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http://dx.doi.org/10.1016/j.gien.2014.04.001

PAROLE CHIAVE
Anatomia canalare radicolare;
Canino inferiore;
Due radici;
Ritrattamento;
Lesione periapicale;
Microscopio operatorio.

Riassunto
Obiettivi: Descrivere il ritrattamento endodontico ortogrado di un canino mandibolare caratterizzato da una anatomia inusuale, affetto da lesione periapicale sintomatica.
Materiali e metodi: Una donna caucasica di 30 anni si è presentata all'osservazione a causa di un dolore severo, associato a gonfiore, localizzato all'emimandibola destra. Il canino inferiore (n.43) è stato individuato quale dente responsabile dell'infezione apicale; per lo stesso elemento è stata riscontrata una anatomia rara caratterizzata da due radici e due canali. Le procedure diagnostiche hanno evidenziato la presenza del canale linguale non trattato nella precedente terapia endodontica primaria. Il ritrattamento per via ortograda è stato intrapreso attenendosi ai protocolli dell'endodonzia contemporanea, per mezzo di strumenti ingranditori (microscopio operatorio) ed accurate procedure di disinfezione del sistema canalare.
Risultati e Conclusioni: E' stata ottenuta la completa risoluzione della lesione apicale, confermata dalle indagini cliniche e radiografiche del follow-up a 9 mesi. Gli endodonzisti dovrebbero conoscere le possibili variazioni anatomiche del sistema canalare dei denti umani, e vigilare sulla loro eventuale presenza al momento del trattamento. Molteplici proiezioni radiografiche sono raccomandate e possono agevolare la fase diagnostica.
Procedure endodontiche attente relative alla strumentazione, disinfezione ed otturazione del sistema canalare possono favorire la guarigione delle lesione periapicali.

Introduction

The aim of the root canal treatment is to achieve a correct shaping, cleaning and three-dimensional filling of the root canal system.[1,2] The ultimate goal is to eliminate the infected tissue, bacteria and to fill the complex anatomy of the root canal system, in order to allow the healing of a periapical lesion or to prevent the infection of periradicular tissues.[3,4]

Rare or complex anatomical variations may lead to inappropriate endodontic treatment, often associated with an incomplete elimination of the infected tissue, resulting in a treatment failure.[5,6] Moreover, some unusual root canal systems may be undetected at all by the clinician. In order to minimize the above-mentioned challenges, a careful clinical and radiological examination of the tooth to be treated is recommended. It is not advisable to approach a root canal treatment giving as granted that a specific tooth has a predetermined number of roots or canals. The lower canine anatomy usually presents just one wide canal associated with a single root[7]; a variation in such a morphological pattern might complicate the treatment. In a sample of 830 extracted human mandibular canines studied using a clearing technique, 98.3% of these teeth exhibited a single root, with 92.2% presenting one canal and one foramen.[7] According to Vertucci, in single-rooted mandibular canines, type II and type III configurations may be found in 14% and 3% of the cases, respectively.[8] The type II Vertucci configuration identifies two canals which start with independent orifices and then merge together (usually at or near the apical third of the root) into a single canal with its unique foramen; in the type III configuration a single main canal is split by a dentinal island, along its way to the apex, into two canals; finally, these two canals merge together at or near the apex forming just one foramen. Other researchers have performed in-vitro studies using sectioning[9] or radiographic[10] techniques: they also reported that about 15% of single-rooted lower canines show two canals with one or two foramina.

The presence of two-roots and two-canals in mandibular canines is a more unusual condition. In a study conducted by Ouellet,[11] the presence of the second root appeared in proportion of 5% of all teeth included; other authors have reported a considerably lower percentage, with a rate of 1.7% of mandibular canines with two roots featuring two canals.[7] A recent study assessed the anatomy of two-rooted mandibular canines by using high-resolution micro-computed tomography[12]: the findings revealed that root bifurcation occurred in the apical and middle thirds; moreover, lateral and furcation canals were observed in 29% and 65% of the samples, respectively.

From a clinical point of view, periapical radiographs performed at different angulations may be of great help to discover anatomical variations of teeth.

The objective of this article is to describe a case report about the endodontic retreatment of a lower canine with a rare two-roots/two-canals configuration. The previous primary therapy didn't detect the entire canal system: a symptomatic periapical lesion developed and led patient to our dental office.

Case report

A 30-year-old woman came to our hospital reporting severe pain and swelling located at the right mandible. After taking proper medical and dental history, the intra-oral examination was performed and a mucosal edema corresponding to the apex of teeth 4.2 and 4.3 was discovered. However, clinical tests highlighted the absence of endodontic disease on the lower lateral incisor: vitality tests were normal, no pain at percussion was discovered and physiological periodontal probing was present. On the other hand, tooth 4.3 showed a post-endodontic restoration carried out with a metallic screw-type post associated with a secondary decay and marginal leakage. The canine was painful at vertical and bucco-lingual percussion tests. The first orthogonal X-ray examination of the right lower canine showed an apparently correct endodontic treatment: despite the filling of the canal seemed adequate in relation to the root length, a wide periapical bone rarefaction was present (Fig. 1a).

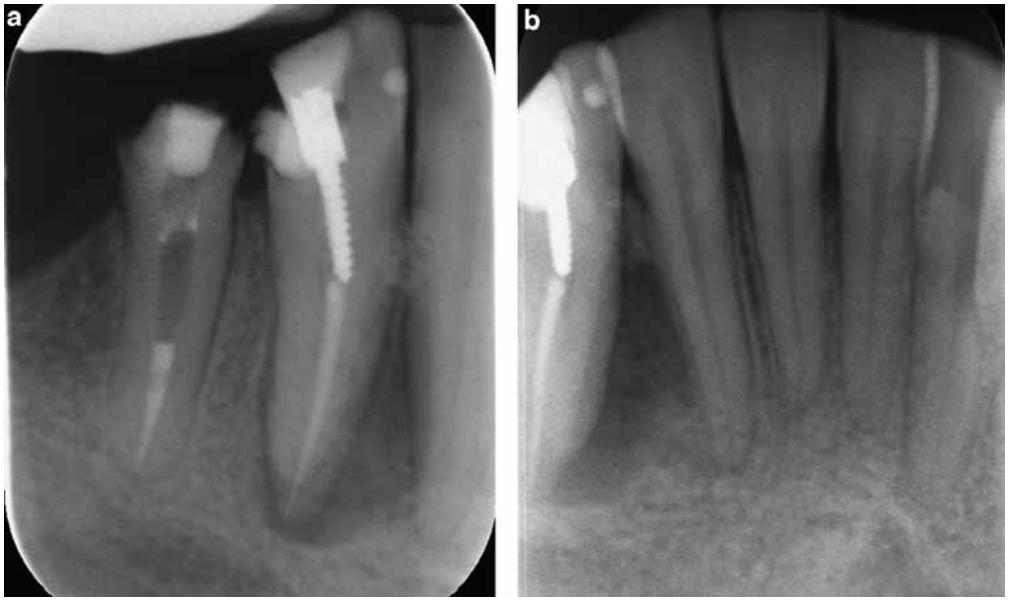

Figure 1 (a) Orthogonal pre-operative X-ray of the previous root canal therapy of tooth 4.3: secondary decay, marginal leakage of the post-and-core restoration and a large periapical lesion are clearly visible. (b) Mesio-distal pre-operative X-ray of the previous root canal therapy: the full extent of the periapical lesion is shown. The profile of a second root is discovered; the lower incisors are not involved.

A second X-ray, obtained according to Clark's rule from a mesio-distal projection, clearly showed a second lingual root remained unshaped and filled during the previous therapy: probably, this was the main problem sustaining the apical lesion (Fig. 1b). A further periodontal evaluation led to the exclusion of a vertical root fracture and/or other issues at the attachment apparatus. Finally a diagnosis of acute, symptomatic periapical periodontits on tooth 4.3 was formulated. After informed consent was obtained from the patient, the endodontic retreatment was scheduled. Following local anesthesia and rubber dam placement, the post-retained restoration and all decayed dentinal tissue were removed (Fig. 2). The access cavity was enlarged, extending the opening of the pulp chamber a bit more in the lingual direction: with the help of an operating microscope (Surgical Operating Microscope — SOM 32, KAPS International) the second, lingual orifice was found. The usage of magnification and powerful illumination is considered of key importance for many endodontic procedures: in this particular case it helped the exploration of the pulp chamber, orifice location and prevention of further tissue weakening in a previously root canal treated tooth. Residual necrotic pulp tissue and debris were present in the lingual canal; however a 08 manual k-file (Dentsply, Maillefer) easily reached the apex and patency was confirmed. Working length (WL) was determined with apex locator (Root ZX®, J. Morita Europe). After the initial instrumentation with hand files, shaping of the lingual canal was performed using Ni—Ti rotary files (Protaper Universal, Dentsply, Maillefer); disinfection was accomplished irrigating with 5,25% sodium hypochlorite (Niclor® 5, Ogna, Milan, Italy) alternated with 10% EDTA (Tubuliclean®, Ogna, Milan, Italy). The vestibular canal was retreated: after the removal of the previous canal filling (hand instrumentation with the aid of gutta-percha solvent, followed by dedicated Ni—Ti rotary files for retreatment (Protaper Retreatment, Dentsply, Maillefer)), the same shaping and cleaning protocols used for the lingual canal were applied. (Dentsply Maillefer). An intra-operative view of the pulp chamber, during disinfection procedures and showing instrumented canals, is provided in Fig. 3.

Subsequently, an X-ray was taken with guttapercha points in order to confirm the presence of a proper tug-back of the

Figure 2 Rubber dam isolation: intra-oral operative view.

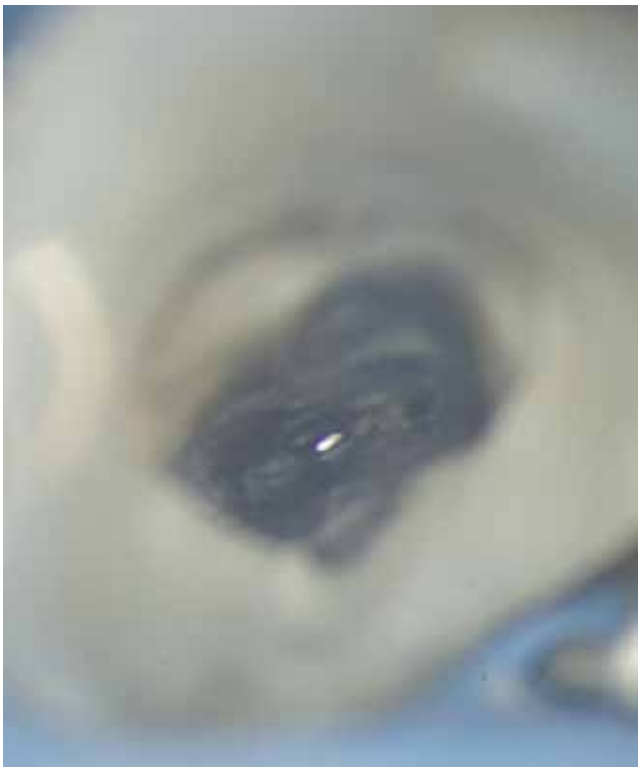

Figure 3 View of the pulp chamber during instrumentation steps showing vestibular and lingual canal orifices.

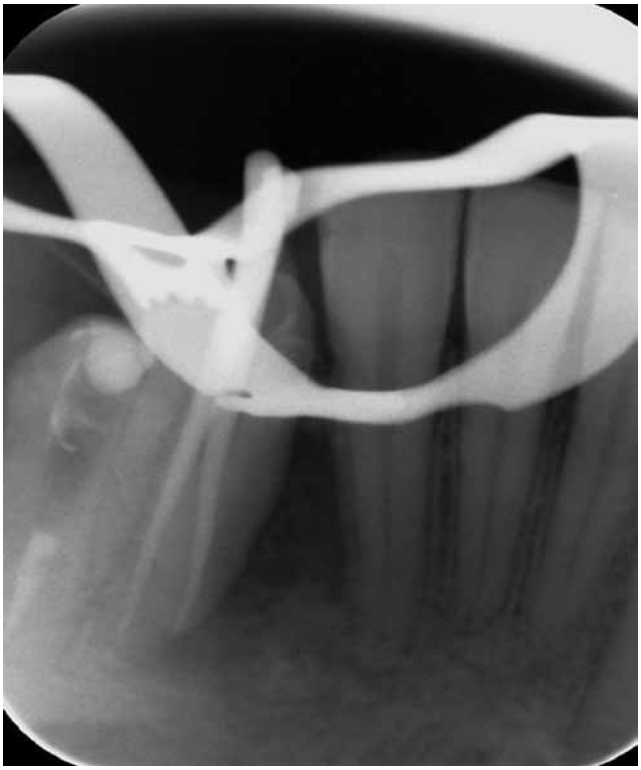

Figure 4 Intra-operative periapical radiograph showing the guttapercha master cones selected for filling: the two-canals-two roots configuration can be appreciated; working length and appropriate tug-back were confirmed.

Figure 5 Post-operative periapical radiograph showing completed endodontic filling of the lower canine.

cones at the appropriate WL (Fig. 4). Canals were dried with paper points and obturated with a warm vertical condensation technique: SystemB® (SybronEndo Corporation) was used as the heat source, in association with proper manual

Figure 6 Nine-months radiographic follow-up.

pluggers (Dr. Machtou Pluggers n. 1-2 and 3-4, Dentsply, Maillefer). The immediate post-operative radiograph, taken at rubber dam removal, is reported in Fig. 5.

The orifices of the canals were also protected by placing flowable composite in association with an etch-and-rinse adhesive technique, in order to avoid leakage/bacteria contamination of the root canal system, while waiting for the final restoration. A temporary filling sealed the access cavity.

The patient was finally discharged with a pharmacological prescription including NSAIDs and a broad spectrum, penicillin-based antibiotic to control both potential post operative pain and flare-up. A second appointment was scheduled for the subsequent week; the clinical examination confirmed that symptoms and swelling had disappeared; the tooth was restored with a fiberglass post and resin composite. The radiographic follow up after 9 months showed the complete healing of the periradicular lesion (Fig. 6); from a clinical perspective, the patient reported absence of pain, and the tooth was correctly responding to percussion (absence of pathological inflammation involving the periodontal ligament).

Discussion

The present case report described a successful non surgical retreatment of a lower canine with a two-roots/two-canals configuration; the follow-up X-ray showed healing of the periapical tissues (associated with lamina dura formation) at 9 months after therapy. Beside the identification of the missed lingual canal, vestibular canal of the lower canine was retreated due to potential leakage from the previous coronal restoration.

We may speculate that the primary endodontic intervention on the lower canine failed due to unsystematic radiographic examination[13]; inadequate access cavities or improper observation of the pulp chamber may also lead to untreated portions of the canal system.

Endodontic treatment failure has been associated to persistent infection of canals: unsatisfactory shaping or cleaning procedures, incomplete root canal filling, iatrogenic errors or leakage of temporary/post-endodontic restorations[14] are common factors that may impair an acceptable micro-organisms eradication.[5,15] Moreover, in case of one or more undetected/untreated root canals, large areas of necrotic pulp tissue are available for bacteria proliferation and their by-products accumulation.[16] Apical periodontitis, both acute or chronic in nature, has been associated to really limited, unreached endodontic infected spaces (i.e: apical ramifications, lateral canals, etc.).[14,17] For this reason, it is not surprising to discover a periapical infection in case of a completely uninstrumented main root canal (as the lingual one, in the present report).

Upper and lower canines are considered strategically important teeth in the arch; they usually have long, stable roots that make them favorite abutments for prosthetic purposes in case of partial edentulisms[18]; moreover, canines have a functional impact on occlusion (guidance on eccentric movements and posterior disclusion).[19] For the above-mentioned reasons, many efforts should be addressed toward the preservation of canines (i.e: avoiding extractions) even if anatomic variations or other morphological challenges may be encountered.

Few previous published data focusing on primary endodontic treatment of canines with two roots-two canals configuration has also suggested that this particular anatomy might be found across several populations of patients or ethnic groups.[20,21]

Traditional eccentric periapical radiographs are clinically useful during diagnostic examination of the tooth to be treated (in particular when accessory roots are present)[13]: this way, the clinician can imagine a three-dimensional picture of the root canal system prior to instrumentation. Overall, new modern imaging technologies (like CBCT or micro-computed tomography) might also be used to clarify the morphology of complex root canal systems.[22]

Conclusions

Mandibular canines might present two distinct roots with their respective canals; a deep knowledge of anatomical variations should help clinicians to enhance the success of endodontic therapy.

Conflict of interest

The authors have no conflict of interests to declare.

References

1. Schilder H. Filling root canals in three dimensions. *Dent Clin North Am* 1967;723—44.
2. Schilder H. Cleaning and shaping the root canal. *Dent Clin North Am* 1974;**18**(2):269—96.
3. Mounce R. The biologic objectives of root canal therapy: meeting the standard. *Compend Contin Educ Dent* 2004;**25**(8). 576, 8-81.
4. Sjogren U, Hagglund B, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment. *J Endod* 1990;**16**(10):498—504.
5. Nair PN. Pathogenesis of apical periodontitis and the causes of endodontic failures. *Crit Rev Oral Biol Med* 2004;**15**(6): 348—81.
6. Witherspoon DE, Small JC, Regan JD. Missed canal systems are the most likely basis for endodontic retreatment of molars. *Tex Dent J* 2013;**130**(2):127—39.
7. Pecora JD, Sousa Neto MD, Saquy PC. Internal anatomy, direction and number of roots and size of human mandibular canines. *Braz Dent J* 1993;**4**(1):53—7.
8. Vertucci FJ. Root canal anatomy of the human permanent teeth. *Oral Surg Oral Med Oral Pathol* 1984;**58**(5):589—99.
9. Green D. Double canals in single roots. *Oral Surg Oral Med Oral Pathol* 1973;**35**(5):689—96.
10. Pineda F, Kuttler Y. Mesiodistal and buccolingual roentgenographic investigation of 7,275 root canals. *Oral Surg Oral Med Oral Pathol* 1972;**33**(1):101—10.
11. Ouellet R. Mandibular permanent cuspids with two roots. *J Can Dent Assoc* 1995;**61**(2):159—61.
12. Versiani MA, Pecora JD, Sousa-Neto MD. The anatomy of two-rooted mandibular canines determined using micro-computed tomography. *Int Endod J* 2011;**44**(7):682—7.
13. Segura-Egea JJ, Alonso-Ezpeleta O, Martin-Gonzalez J, Martin-Jimenez M. Endodontic treatment failure consecutive to

unsystematic radiographic examination. *Oral Health Dent Manage* 2013;**12**(4):300—4.
14. Ricucci D, Siqueira Jr JF. Recurrent apical periodontitis and late endodontic treatment failure related to coronal leakage: a case report. *J Endod* 2011;**37**(8):1171—5.
15. Nair PN. On the causes of persistent apical periodontitis: a review. *Int Endod J* 2006;**39**(4):249—81.
16. Graunaite I, Lodiene G, Maciulskiene V. Pathogenesis of apical periodontitis: a literature review. *J Oral Maxillofac Res* 2012;**2**(4):e1.
17. Arnold M, Ricucci D, Siqueira Jr JF. Infection in a complex network of apical ramifications as the cause of persistent apical periodontitis: a case report. *J Endod* 2013;**39**(9): 1179—84.
18. Andrei OC, Margarit R, Daguci L. Treatment of a mandibular canine abutment with two canals. *Rom J Morphol Embryol* 2010;**51**(3):565—8.
19. Sreekumar AV, Rupesh PL, Pradeep N. Nature of occlusion during eccentric mandibular movements in young adults. *J Contemp Dent Pract* 2012;**13**(5):612—7.
20. Andrei OC, Margarit R, Gheorghiu IM. Endodontic treatment of a mandibular canine with two roots. *Rom J Morphol Embryol* 2011;**52**(3):923—6.
21. D'Arcangelo C, Varvara G, De Fazio P. Root canal treatment in mandibular canines with two roots: a report of two cases. *Int Endod J* 2001;**34**(4):331—4.
22. Durack C, Patel S. Cone beam computed tomography in endodontics. *Braz Dent J* 2012;**23**(3):179—91.

Giornale Italiano di Endodonzia (2014) **28**, 23—28

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CASE REPORT/CASO CLINICO

Endodontic treatment of a mandibular second molar with four roots — A case report and literature review

Trattamento endodontico di un secondo molare mandibolare con quattro radici - Caso clinico e revisione della letteratura

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Received 28 October 2013; accepted 19 May 2014
Available online 18 June 2014

KEYWORDS
Second molar anatomy;
Cone beam computed tomography;
Radix entomolaris.

Abstract
Objectives: The most common configuration of the mandibular second molar is the presence of two roots, although the presence of one and three roots has also been reported. The objective of this work was to present a rare anatomic configuration with four roots diagnosed during an endodontic therapy.
Materials and methods: Endodontic treatment was performed using a dental operating microscope. The anatomic configuration was confirmed with a cone beam computed tomography image analysis. An electronic database search was conducted to identify all the published reported cases of mandibular second molars with four roots.

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Peer review under responsibility of Società Italiana di Endodonzia.

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1121-4171/$ — see front matter
http://dx.doi.org/10.1016/j.gien.2014.05.004

Results: The cone beam computed tomography analysis showed the presence of three mature normal length roots plus a smaller and conical radix entomolaris. The authors were unable to identify a single case in population's characterization researches with large samples by search in the available literature. Only one *in vivo* case report was available in the literature.
Conclusions: A configuration with four roots is rare for the mandibular molars. This configuration has an incidence of 0.04% in the first lower molar with only three *in vivo* case reports available. For the second lower molar, no incidence ratio was found.

PAROLE CHIAVE
Anatomia secondo molare mandibolare;
Tomografia computerizzata cone beam;
Radix entomolaris.

Riassunto
Obiettivi: La configurazione anatomica più comune nel secondo molare mandibolare é la presenza di due radici, anche se la presenza di una o tre radici è stata giá documentata. L'obiettivo del lavoro é presentare una rara configurazione anatomica, con quattro radici, diagnosticata durante il trattamento endodontico.
Materiali e metodi: Il trattamento endodontico su questo particolare molare é stato realizzato con il microscopio operatorio. La configurazione anatomica é stata confermata con il ricorso alle immagini della tomografia computorizzata tipo cone beam. É stata realizzata una ricerca, su banca dati elettronica, per identificare tutti i casi pubblicati in cui il secondo molare mandibolare presentava quattro radici.
Risultati: Le analisi delle immagini della tomografia computorizzata tipo ''cone beam'' mostrano chiaramente la presenza di tre radici di misura normale e una ''radix entomolaris'' piú piccola e conica. Nella revisione della letteratura disponibile, non è stato possibile reperire alcun caso documentato come il presente.
Conclusioni: La configurazione con quattro radici é rara per i molari mandibolari. Questo aspetto ha una incidenza dello 0,04% nei primi molari inferiori, solo tre casi sono stati documentati *in vivo*. Non esiste un valore di incidenza disponibile per il secondo molare, essendo stato descritto un único caso in letteratura.

Introduction

Anatomic variations may be present in any tooth. Knowing the typical morphology and their variations may help to detect these variations during root canal therapy, enhancing the chance for a successful treatment. The most typical anatomy of a mandibular second molar is the presence of two roots and three root canals,[1,2] but other root configurations have been described in the literature. One root with a single root canal has been reported,[3] and radix entomolaris[4] and Radix Paramolaris[5] in a three-root configuration have also been reported.

The clinical relevance and the main purpose of this paper are to report an uncommon four-rooted mandibular second molar, with two independent mesial roots, a normal distobuccal root and one smaller radix entomolaris.

Case report

A 33-year-old Caucasian female was referred to the endodontic department of a private clinic in Lisbon for evaluation. The patient had a chief complaint of spontaneous pain in the mandibular left side, irradiating from the left mandibular incisors to the left ear. Her medical history had no relevant contribution. The patient had a previous unsuccessful treatment for a possible trigeminal neuralgia but the pain was still present. A panoramic radiographic examination revealed a previous endodontic treatment on tooth 36 (mandibular left first molar) and restorative fillings in the mesial and occlusal faces of the crown of tooth 37 (mandibular left second molar) (Fig. 1). The reaction to the cold sensibility test was an intense pain that remained present for more than one minute

Figure 1 Initial panoramic radiograph.

Figure 2 Pulp chamber view after full root canal instrumentation. The developmental lines draw an X on the pulp chamber floor.

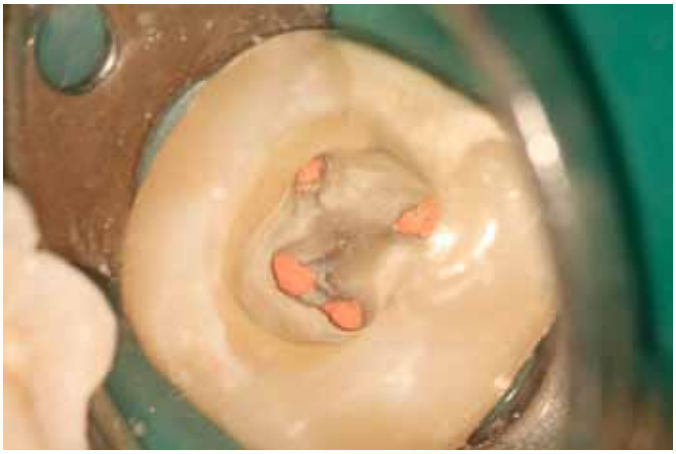

Figure 3 Pulp chamber view after root canal obturation.

on tooth 37. The other teeth on the lower left side, except for tooth 36, had a normal response to this test and all had a negative percussion test. The diagnosis was an irreversible pulpitis on tooth 37. The clinical condition was explained to the patient. Endodontic treatment was proposed and accepted.

The tooth was anaesthetized with a mandibular block infiltration using 1.8 ml of 4% articaine with 1:200,000 epinephrine (Artinibsa, Inibsa, Spain), proper rubber dam isolation was obtained, and the access cavity was achieved. Upon first inspection of the pulp chamber one peculiar feature was noted; the development lines were drawing an X on the pulp chamber floor, quite different from the typical T connecting the two mesial root canals and the distal root canal. Four root canals were identified at the end of each extremity of the X (Fig. 2). After canal identification and negotiation, the working length was determined by an electronic apex locator (Root Zx II, Morita, USA). Mechanical instrumentation of the root canals was performed with ProTaper NiTi rotary files (ProTaper Universal, Dentsply Maillefer, Switzerland) according to the manufacturer's instructions. During instrumentation a copious irrigation with 5.25% sodium hypochlorite was made. Because of the time limitations, the therapy was accomplished in two appointments. After the bio-mechanical preparation the root canals were dried with paper points and a paste of calcium hydroxide (Ultracal, Ultradent, USA) was used as intracanal medication. Cavit (Cavit W, 3M ESPE, Germany) was used as a provisional restorative filling between the two visits. At the second appointment a final irrigation protocol including 17% EDTA irrigation for one minute and one last rinse with 5.25% sodium hypochlorite was performed and the canals were dried. Gutta-percha master points were adapted and root canal lengths were confirmed by a radiograph. AH plus (AH Plus, Dentsply, Germany) was used as sealer. The obturation technique chosen was the continuous wave of condensation technique (System B, Sybron Endo, USA, and Obtura II, Obtura Spartan, USA) (Fig. 3). The final periapical radiograph showed the presence of four root canals, one for each root (Fig. 4). The pulp chambers were restored provisionally with Cavit temporary filling. The patient was scheduled for a permanent restoration.

Cone beam computed tomography analysis

Ten months later a cone beam computed tomography (CBCT) scan of tooth 16 was requested for a diagnostic purpose. At the same time the analysis confirmed the presence of four roots for tooth 37 (Figs. 5—8). The two mesial roots were mature roots with normal length, and the same was observed in the disto-buccal root. On the contrary, the disto-lingual root was a short conical root with distal orientation; this root might be considered as a radix entomolaris.

Results of the literature search

With the purpose of identifying all the published reports of cases of four-rooted mandibular second molars, an extensive search was performed in the most common electronic databases. Two references were found reporting this type of anatomy.[6,7] Purra,[6] in his study, described an *in vivo* root canal treatment on a mandibular second molar with three independent mesial roots and one distal root. Peiris[7] described an *ex vivo* case of a mandibular second molar with two mesial and two distal independent roots (Table 1).

Figure 4 Final periapical radiograph after root canal obturation.

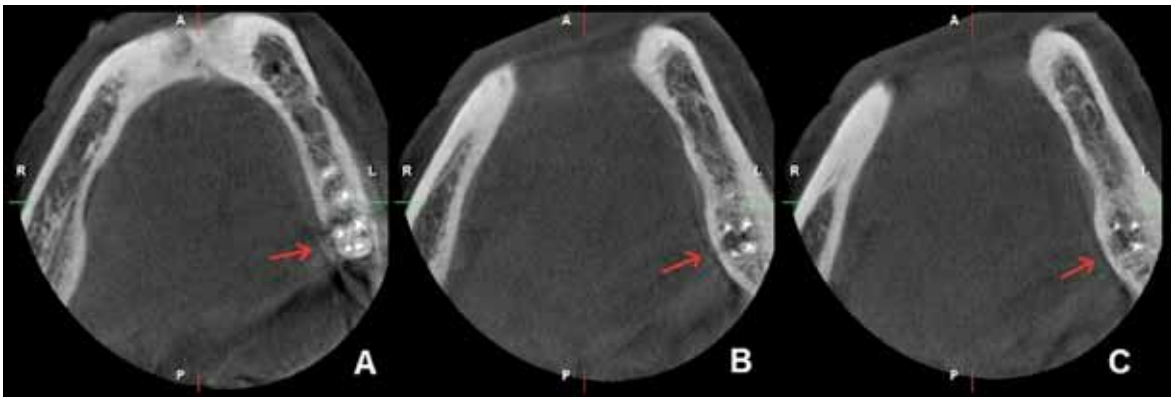

Figure 5 CBCT axial view: (A) coronal third, (B) middle third with four independent roots, (C) apical third.

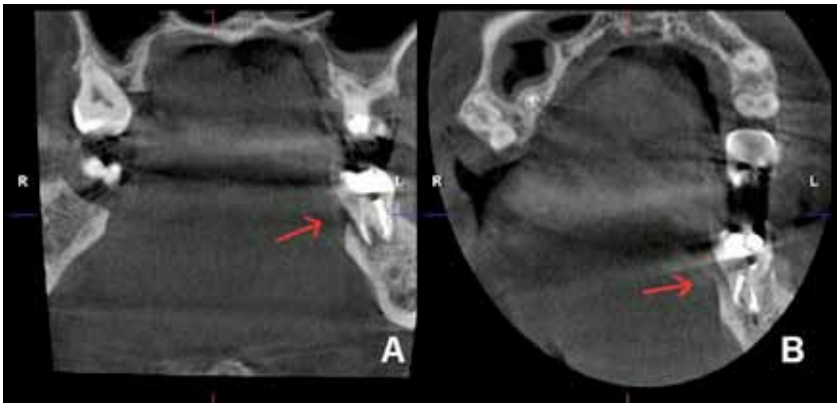

Figure 6 CBCT coronal view: (A) two independent mesial roots, (B) two independent distal roots. A smaller Radix Entomolaris can be identified.

Discussion

The formation of one, two, three or more roots is established during the embryological stages of the root formation. In the bell stage of odontogenesis, the epithelial cells of the inner and outer dental epithelium proliferate and meet at a point called cervical loop, forming the Hertwig horizontal root sheath. The apical end of the Hertwig horizontal root sheath bends to form a collar-like structure. In the single rooted teeth this collar structure grows apically like a tube around the newly formed pulp. In the multi-rooted teeth, epithelial cells from the Hertwig horizontal root sheath develop extensions that grow towards the center until they meet each other, dividing the original single collar into several collars, one for each root.[8] A four-rooted tooth means that four collars were formed by the invagination of the epithelial cells during the root formation. Several anatomic configurations on the mandibular second molar have been reported in the literature. The most common anatomy of this tooth is the presence of two roots and three root canals,[1,2] but four or even five root canals have been described.[9] The C-shape configuration has also been widely studied.[10] The number of roots may also change, one and three-root configurations have been reported.[3,5] The ethnic influence may have a key

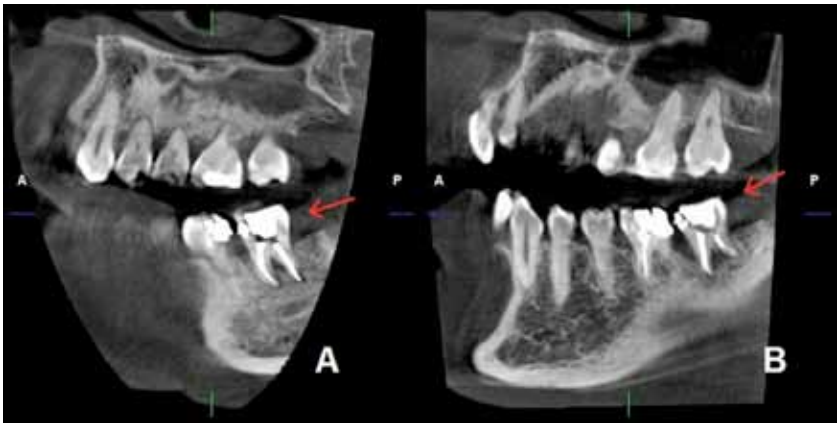

Figure 7 CBCT sagittal view: (A) two independent buccal roots, (B) two independent lingual roots.

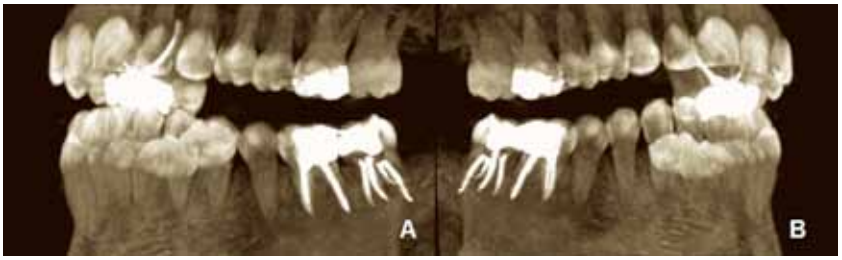

Figure 8 CBCT 3D reconstruction: (A) buccal view, (B) lingual view.

Table 1 Four-rooted mandibular second molar reports available in the literature.

Study	Type of study	Country	Ethnicity	Gender	Age	Position of roots	No. of root canals	Bilateral
Peiris[7]	*Ex vivo*	Sri Lanka	N/A	Female	23	MB, ML, DB, DL	4	N/A
Purra[6]	*In vivo*	India	N/A	Male	21	MB, MM, ML, DT	4	N/A
Present work	*In vivo*	Portugal	Caucasian	Female	33	MB, ML, DB, Radix Entomolarix	4	No

N/A, not available; MB, mesiobuccal; MM, middle mesial; ML, mesiolingual; DB, distobuccal; DL, distolingual; DT, distal.

Table 2 Characterization studies of the mandibular second molar in different populations.

Study	Country	Sample	One fused root	Two roots	Three roots	C-shaped roots	Four roots
Manning 1990[12]	Australia	149	14	113	3	19	0
Gulabivala 2001[13]	Burma	134	6	98	0	30	0
Gulabivala 2002[14]	Thailand	60	0	54	0	6	0
Ahmed 2007[15]	Sudan	100	4	86	0	10	0
Peiris 2007[16]	Sri Lanka	100	0	94	0	6	0
Rahimi 2008[17]	Iran	139	6	117	6	10	0
Rwenyonyi 2009[18]	Uganda	223	0	223	0	0	0
Al-Qudah 2009[1]	Jordan	355	8	310	0	37	0
Neelakantan 2010[2]	India	345	0	288	31	26	0
Park 2013[4]	Korea CBCT	710	13	387	17	293	0
		2315	51 (2%)	1770 (76%)	57 (3%)	437 (19%)	0 (0%)

role in the teeth anatomic configuration variations.[11] Several ethnic characterization studies have described the mandibular second molar in different populations. Ten studies from ten different populations, which included a combined sample of 2315 mandibular second molars, were unable to identify a single case of a four-rooted mandibular second molar (Table 2).

Since the ethnic characterization studies were not able to detect a single case, an electronic database search was conducted in this work to identify any previously published case report. Only one *in vivo* case report[6] was identified in the electronic database search.

The present case has two normal length mesial roots, a normal length disto-buccal root and a smaller conical radix entomolaris, which has been described as an uncommon feature in a mandibular second molar.[5] The X designed by the developmental lines in the pulp chamber floor is a clinical configuration similar to the one described by Kottoor[19] in a similar four-rooted mandibular first molar case report, which is also a rare anatomic configuration for the first molar. The four-root configuration has an incidence of 0.04% in the mandibular first molar,[20] with only three *in vivo* case reports available.[19,21,22] No incidence is available for the mandibular second molar. Kottoor figures out the hypothesis that this X designed by the developmental lines in the pulp chamber floor could be used as a diagnostic criterion for a four-rooted mandibular molar. This case report confirms that hypothesis.

Conclusion

Although it is an extremely rare condition, a four-rooted configuration may be present in the mandibular second molar. In this type of root configuration, the developmental lines draw an X in the pulp chamber floor; this feature may be used as a diagnostic criterion for this clinical condition.

Conflict of interest

The authors have no conflict of interests to declare.

References

1. Al-Qudah AA, Awawdeh LA. Root and canal morphology of mandibular first and second molar teeth in a Jordanian population. *Int Endod J* 2009;**42**:775—84.
2. Neelakantan P, Subbarao C, Subbarao CV, Ravindranath M. Root and canal morphology of mandibular second molars in Indian Population. *J Endod* 2010;**36**:1319—22.
3. Fava LRG, Weinfeld I, Fabri FP, Pais CR. Four second molars with single roots and single canals in the same patient: a case report. *Int Endod J* 2000;**33**:138—42.
4. Park JB, Kim N, Park S, Kim Y, Ko Y. Evaluation of root anatomy of permanent mandibular premolars and molars in Korean population with cone-beam computed tomography. *Eur J Dent* 2013;**7**:94—101.
5. Calberson F, De Moor R, Deroose C. The radix entomolaris and paramolaris: clinical approach in endodontics. *J Endod* 2007;**33**:58—63.
6. Purra AR, Mushtaq M, Robbani I, Farooq R. Spiral computed tomographic evaluation and endodontic management of a mandibular second molar with four roots. A case report and literature review. *Iran Endod J* 2013;**8**:69—71.
7. Peiris R, Ohzeki S, Igarashi Y, Satake T. Mandibular permanent second molar with four roots and root canals: a case report. *Odontology* 2009;**97**:51—3.
8. Castellucci A. Embriology. In: Castellucci A, editor. 1st ed., *Endodontics*, **vol. I**, 1st ed. Florence, IL: Tridente; 2004. p. 6—23.
9. Beatty R, Krell K. Mandibular molars with five canals: report of two cases. *J Am Dent Assoc* 1987;**114**:802—4.
10. Jafarzadeh H, Wu Y. The C-shaped root canal configuration: a review. *J Endod* 2007;**33**:517—23.
11. de Pablo O, Estevez R, Sanchez M, Heilborn C, Cohenca N. Root anatomy and canal configuration of the permanent mandibular first molar: a systematic review. *J Endod* 2010;**36**:1919—31.
12. Manning S. Root canal anatomy of mandibular second molar. Part I. *Int Endod J* 1990;**23**:34—9.
13. Gulabivala K, Aung TH, Alavi A, Ng Y-L. Root and canal morphology of Burmese mandibular molars. *Int Endod J* 2001;**34**:359—70.
14. Gulabivala K, Opasanon A, Ng Y-L, Alavi A. Root and canal morphology of Thai mandibular molars. *Int Endod J* 2002;**35**:56—62.
15. Ahmed HA, Abu-bakr NH, Yahia NA, Ibrahim YE. Root and canal morphology of permanent mandibular molars in a Sudanese population. *Int Endod J* 2007;**40**:766—71.
16. Peiris R, Takahashi M, Sasaki K, Kanazawa E. Root canal morphology of permanent mandibular molars in a Sri Lankan population. *Odontology* 2007;**95**:16—23.
17. Rahimi S, Shahi S, Lofti M, Zand V, Abdolrahimi M, Eshaghi R. Root canal configuration and prevalence of C-shaped canal in mandibular second molars in an Iranian population. *J Oral Sci* 2008;**50**:9—13.
18. Rwenyonyi C, Kutesa A, Muwazi L, Buwembo W. Root and canal morphology of mandibular first and second permanent molar teeth in Uganda population. *Odontology* 2009;**97**:92—6.
19. Kottoor J, Albuquerque D, Velmurugan N, Sumitha M. Four-rooted mandibular first molar with an unusual developmental root fusion line: a case report. *Case Rep Dent* 2012;237302. http://dx.doi.org/http://dx.doi.org/10.1155/2012/237302.
20. Morita M. Morphological studies on the roots of lower first molars in Japanese. *Shika Gakuho* 1990;**90**:837—54 (Japanese).
21. Friedman S, Moshonov J, Stabholz A. Five root canals in a mandibular first molar. *Endod Dent Traumatol* 1986;**2**:226—8.
22. Lee S, Jang K, Spangberg L, Kim E, Jung I, Lee C, et al. Three-dimensional visualization of a mandibular first molar with three distal roots using computer-aided rapid prototyping. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;**101**:668—74.

Giornale Italiano di Endodonzia (2014) **28**, 29—30

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ORIGINAL RESEARCH ARTICLE/ARTICOLO ORIGINALE

33° CONGRESSO NAZIONALE VINCITORE PREMIO RICCARDO GARBEROGLIO

A technique for the treatment of maxillary sinus membrane perforations occurred during endodontic surgery: a prospective comparative evaluation

Tecnica per il trattamento di perforazioni del seno mascellare in chirurgia endodontica. Valutazione prospettica comparativa

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Received 20 April 2014; accepted 14 May 2014
Available online 19 June 2014

KEYWORDS
PRP;
Endodontic surgery;
Maxillary sinus;
Quality of life;
Complications.

Abstract
Objectives: The aim of this study was to evaluate the use of PRGF in endodontic surgery to treat sinus membrane perforation.
Materials and methods: A total of 20 patients (ten per group) were included. In the control group the lesion of the sinusal membrane was treated with collagen sponge. In the test group PRGF was used to close the communication with the sinus cavity.
Results and conclusions: The use of PRGF resulted in better postoperative quality of life parameters if compared to the negative control group. Perceived pain was significantly lower in the test group than in the control one for the first six days after intervention.

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Peer review under responsibility of Società Italiana di Endodonzia.

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http://dx.doi.org/10.1016/j.gien.2014.05.003

PAROLE CHIAVE
PRP;
Chirurgia endodontica;
Seno mascellare;
Qualità della vita;
Complicanze.

Riassunto
Obiettivi: lo scopo di questo studio è stato di valutare l'uso del PRGF in chirurgia endodontica per il trattamento di perforazioni occasionali della membrana sinusale.
Materiali e metodi: un totale di 20 pazienti (dieci per gruppo) sono stati inclusi. Nel gruppo controllo la lesione della membrana sinusale è stata trattata con una spugna di collagene. Nel gruppo test il PRGF è stato usato per chiudere la comunicazione con la cavità sinusale.
Risultati e conclusioni: l'uso del PRGF ha condotto a una migliore qualità della vita post-operatoria se comparata al gruppo controllo. Il dolore percepito è stato significativamente minore nel gruppo test rispetto al gruppo controllo per i primi sei giorni dopo l'intervento.

Introduction

After the indtroduction of the "modern endodontic surgery" concept, many studies proposed a number of techniques using micros urgical instruments and magnification devices.[1–5] It is known that maxillary molar roots could be anatomically related to the Scheneiderian membrane and this may complicate surgical endodontic approach.[6]

The aim of this study was to evaluate postoperative quality of life after endodontic surgery performed on maxillary molars in cases of infraction or lesion of Schneiderian membrane.

Materials and methods

All patients gave their written informed consent. Patients with one maxillary molar treated with periapical surgery with the occurrence of a lesion of Schneiderian membrane were included.

A total of 20 patients (ten per group) were included. In the control group for 10 patients the lesion of the sinusal membrane was treated with collagen sponge. In the test group PRGF was used to close the communication with the sinus cavity.

A questionnaire was used to evaluate postoperative functions, pain and the occurrence of other symptoms.

Results

The lesions of the membrane were all smaller than 6 mm. Many quality of life parameters were significantly lower in the test group than in the control one (swelling and hematoma). Perceived pain was significantly lower in the test group than in the control one for the first six days after intervention.

Discussion

The lesion of Schneiderian membrane during endodontic surgery on maxillary molars can occur in 9.6—50% of cases.[7]

The use of platelet derivatives in oral surgery found a scientific validation in the evaluation of positive effects on soft tissues, reducing local inflammation and bacterial infection, thus resulting in better quality of life.[8]

In this study, it was shown that PRGF could reduce pain intensity in the treated patients and the duration of such symptom over time.

Clinical relevance

The perforation of sinusal membrane while performing endodontic surgery on maxillary molars did not cause severe complications if the size is small. The use of platelet derivatives may enhance soft tissue healing reducing postoperative quality of life.

Conflict of interest

The authors declare they were free from any conflict of interest when performing the research.

References

1. Tsesis I, Rosen E, Schwartz-Arad D, Fuss Z. Retrospective evaluation of surgical endodontic treatment: traditional versus modern technique. *J Endod* 2006;**32**:412—6.
2. Tsesis I, Faivishevsky V, Kfir A, Rosen E. Outcome of surgical endodontic treatment performed by a modern technique: a meta-analysis of literature. *J Endod* 2009;**35**:1505—11.
3. Velvart P. Papilla base incision: a new approach to recession-free healing of the interdental papilla after endodontic surgery. *Int Endod J* 2002;**35**:453—60.
4. Setzer FC, Shah SB, Kohli MR, Karabucak B, Kim S. Outcome of endodontic surgery: a meta-analysis of the literature — Part 1: Comparison of traditional root-end surgery and endodontic microsurgery. *J Endod* 2010;**36**:1757—65.
5. Del Fabbro M, Taschieri S, Lodi G, Banfi G, Weinstein RL. Magnification devices for endodontic therapy. *Cochrane Database Syst Rev* 2009;CD005969.
6. Oberli K, Bornstein MM, von Arx T. Periapical surgery and the maxillary sinus: radiographic parameters for clinical outcome. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;**103**:848—53.
7. Rud J, Rud V. Surgical endodontics of upper molars: relation to the maxillary sinus and operation in acute state of infection. *J Endod* 1998;**24**:260—1.
8. Del Fabbro M, Bortolin M, Taschieri S, Weinstein RL. Effect of autologous growth factors in maxillary sinus augmentation: a systematic review. *Clin Implant Dent Relat Res* 2013;**15**:205—16.

Giornale Italiano di Endodonzia (2014) **28**, 31—35

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CASE REPORT/CASO CLINICO

33° CONGRESSO NAZIONALE VINCITORE PREMIO GIORGIO LAVAGNOLI

Complex endodontic and conservative treatment of a traumatized central incisor

Recupero endodontico-conservativo complesso di un incisivo centrale superiore traumatizzato

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Received 7 May 2014; accepted 13 May 2014
Available online 19 June 2014

KEYWORDS
Open-apex;
MTA;
Direct restoration;
Dental trauma;
Composite.

Abstract
Objectives: The functional recovery of a tooth with open-apex already endodontically treated is possible thanks to the materials, such as the MTA, able to produce an effective seal of the apex which can induce a *restitutio-ad-integrum*. A direct composite resin restoration may then provide a coronal seal immediate and effective in time, able to ensure a complete healing of the endodontic pathology.
Materials and methods: The hereby-clinical case describes a combined approach (endodontic and conservative) for the aesthetic-functional recovery of a severely fractured upper incisor of a child of 11 years.
Results and conclusions: At the control visit, after 12 months from the completion of the coronal restoration, a complete healing of periradicular bone tissue is observed through Rx. Clinical examination showed gingival tissue without inflammation and the probing depth is not increased, despite the presence of a cavity margin placed below the gingival margin.

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Peer review under responsibility of Società Italiana di Endodonzia.

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http://dx.doi.org/10.1016/j.gien.2014.05.002

PAROLE CHIAVE
Apice beante;
MTA;
Restauro diretto;
Trauma dentale;
Composito.

Riassunto
Obiettivi: Il recupero funzionale di un elemento dentario con apice beante già trattato endodonticamente è oggi possibile grazie a materiali, quali l'MTA, in grado di produrre un sigillo apicale efficace in grado di portare ad una restitution-ad-integrum. Un restauro diretto in composito può successivamente fornire un sigillo coronale efficace nel tempo, indispensabile per ottenere una guarigione endodontica completa.
Materiali e metodi: Il caso clinico presentato mostra un approccio combinato (endodotico e conservativo) per il recupero estetico-funzionale di un incisivo centrale superiore di un bambino di 11 anni.
Risultati e conclusioni: Alla visita di controllo, dopo 12 mesi dal completamento del restauro coronale, si può osservare dall'esame radiografico una completa guarigione dei tessuto osseo periradicolare. All'esame clinico si può apprezzare un tessuto gengivale non infiammato senza aumento di profondità di sondaggio nonostante un margine del restauro coronale posto sottogengiva.

Introduction

Previous epidemiological studies claim that one in four people has past experience of dental trauma, with an annual incidence that, in the United States, ranging from 1 to 3% of the population.[1]

The dental trauma may present different clinical situations, depending on the direction and the force with which they occur, which significantly affect the diagnosis, treatment and, most importantly, the prognosis of teeth involved. The most common dental traumas include fractures of the enamel (67% of cases), followed by enamel-dentin fractures (25.3%). Indeed, we can have different levels of fracture: involving only the clinical crown or, in the worst cases, with margins of fracture at the level of the gingival sulcus, below the CEJ or even engaging the root. In some of these cases may also be involved the endodontic portion of the tooth. In any case, it is fundamental for a proper treatment plan to identify properly the extension of the enamel-dentine fracture and which dental and/or periodontal tissues are involved.

The fracture extension leads, in fact, the treatment. Currently, when lesions are mostly localized above the CEJ, and the fragment lost is recovered, stored correctly and still intact, it can be repositioned thanks to adhesive techniques. When the portions of the clinical crown fractured are not retrieved, the tooth can be rehabilitated by means of direct or indirect adhesive restorative techniques.[3] When you have complicated fractures or dislocations that lead to irreversible damage to the pulp tissue, endodontic therapy is necessary.[4]

All patients affected by dental trauma should receive a restorative treatment fast, simple and that gives good aesthetic and functional results. In cases of large losses of tissue, the rehabilitation of the anterior teeth of these patients is used obtained through indirect restorations.[5,6] However, thanks to the development of composite materials and adhesive techniques, currently the direct restorations with composite resins, if properly planned, can provide excellent aesthetics and function in the face of a less invasive therapy.

Materials and methods

The patient P.S., 10-year-old male, has come to the Department of Operative Dentistry and Endodontics of The University of Turin because of an exacerbation of chronic apical periodontitis in the right upper central incisor with previous dental trauma. Clinically, the tooth showed an incongruous and fractured composite restoration, made as a result of complicated coronal fracture extended below the gingival margin, due to an injury occurred three months earlier (Fig. 1). The periapical radiography showed that 1.1 has an open-apex with previous and incongruous endodontic treatment, endodontic material beyond the apex and a large periradicular osteolytic lesion (Fig. 2).

In order to resolve in the first instance the endodontic lesion an endodontic retreatment was performed. After having anesthetized the area, the field isolation was obtained by means of a rubber dam. Once the access to the root canal was created, the material employed for the previous endodontic treatment was removed. Then, to obtain cleansing and disinfection of the root canal without the risk that the solutions could go over-apex, alternating washes were performed with 5% sodium hypochlorite and 10% EDTA with the aid of a negative pressure system (Endovac,....). Since the large diameter of the apex, a MTA apical-plug (ProRoot, Maillefer, Ballaigues, Switzerland) has been realized (Fig. 3). After a week, the proper hardening of the MTA was checked and the orthograde endodontic therapy was completed with the back-pack with Hot Shot (Sybron Endo, California, USA) and the coronal seal with glass-ionomer (Fuji IX, GC, Tokyo, Japan).

After 6 weeks, the micro-surgical endodontic therapy was performed in order to remove the endodontic material beyond the apex and regularize the shape of the apex. After having anesthetized the area with local anesthesia, using a solution of adrenaline mepivacaine + sol. 1:100000, and maintained haemostasis with a solution of mepivacaine + epinephrine 1:50000, a sulcular incision extended to 1.2

Figure 1 Initial clinical condition: 1.1 shows a severe fracture because of a dental trauma that occurred 3 month before.

Figure 2 Initial peri-apical X-ray.

and 2.1 was made. Distally to 1.2 a releasing incision was performed and a full-thickness flap was raised up to highlight the granulomatous tissue placed apically to 1.1.

Once the lesion and the endodontic material were removed, we debrided with care the resulting bony-cript. At this point, thanks to the orthograde canal obturation with MTA, it was sufficient to regularize the shape of the apex with tungsten carbide multi-blades bur (Fig. 4). The soft tissues were repositioned with the aid of a synthetic monofilament suture (Tevdek 6/0), which was removed after 4 days.

The clinical and radiographic control carried out after 3 months showed an initial bone remineralization and healed soft tissues, thus justifying the completion of therapy with direct composite restoration. In order to highlight and expose the cervical fracture margin, thus allowing a proper isolation of the operative field and get a peripheral seal on the enamel, a second full-thickness flap was necessary (Fig. 5). It was then isolated with a rubber dam, the glass-ionomer was removed and the enamel margins were finished

Figure 3 MTA apical plug.

Figure 4 Apex shape at the end of the endodontic surgery with MTA apical seal.

Figure 5 Full-thickness flap to expose cervical margins of the fracture.

with a medium grit disc (Sof-Lex XT, 3 M ESPE, St. Paul, USA) in order to remove the not supported enamel prisms (Fig. 6).

The adhesive system, a 3-step etch-and-rinse (Optibond FL, Kerr, Bioggio, Switzerland), was applied as follow: etching with 36% phosphoric acid (Ultradent, Salt Lake City, USA) for 40 s on enamel and 15 seconds on dentin; rinsing with water spray for 30 s and air-drying; multi-layer application of the primer; multi-layer application of the bonding; curing with LED lamp (Valo, Ultradent) for 20 s. The direct restoration was performed using an incremental layering technique. The composite resin (Clearfil ES-2, Kuraray) was applied stratifying the masses starting from the buccal surface. For this step, the use of a silicone guide obtained from a diagnostic wax was fundamental as a guide either for the reconstruction morphology either as a support, while the interproximal walls were realized thanks to acetate matrix.

Figure 6 After rubber dam positioning, the fourth class cavity was cleaned and finished.

Figure 7 Direct composite restoration once finished and polished.

Afterwards the dentin mass was stratified on the composite buccal wall and, finally, a translucent composite for applied as final layer of the vestibular surface (Fig. 7). Once the restoration was finished and polished, the rubber dam was removed and the soft tissues were repositioned with a synthetic monofilament suture.

After one week the sutures were removed and finishing and polishing procedures were completed with a fine-grit diamond bur (Komet, Lemgo, Germany), medium-grain disks (Sof Lex XT 3 M ESPE), silicone points (PoGo, Dentsply De Trey GmbH, Konstanz) and self-polishing brushes (Occlubrush, Kerr Dental Corporation, Bioggio, Switzerland).

Results

The X-ray control after 12 months (Fig. 8) showed an effective coronal seal and complete bone healing. At clinical examination, the composite restoration showed a good integration, both aesthetic and functional, with the remaining

Figure 8 After 12 month coronal seal is still effective and periradicular bone appear healed.

Figure 9 Clinical exam after 12 month: the composite restoration shows good functional and aesthetical integration.

tissues (Fig. 9). The periodontal tissues also appear healthy, showing no residual scars to surgical procedures, which were performed to allow functional recovery of the tooth.

Discussion

The dental trauma is an accidental event that brings the clinician to act promptly with high-level therapies in order to guarantee a durable rehabilitation. Then, above all when the patient is a child, the direct composite restorations are considered the ideal or rather the mandatory therapeutic choice for the rehabilitation of a traumatized anterior tooth. This type of restoration is typically used for aesthetic restorations in small or medium cavities.

The main advantage of a direct composite restoration of a traumatized anterior tooth is the minimally invasiveness: the cavity preparation is almost absent and it saves the most sound hard tissue as possible, thus allowing re-intervention without a great sacrifice of additional tissue. That is why the above technique is considered the gold standard for the rehabilitation of an anterior tooth in a young patient. The concept of reversibility led to consider the direct composite restoration as the first choice rehabilitation.

Direct techniques, in addition, could be completed in one appointment, ensuring the patient a fast result both aesthetically and functionally. Moreover, in case of endodontically treated teeth, the possibility to quickly obtain a hermetic coronal seal could also significantly influences the success of the endodontic therapy itself.[7]

In the present clinical case, the initial endodontic condition was definitely tied to a wrong choice in the root canal treatment technique previously performed. In the case of large apices, is amply demonstrated that the gutta-percha is not able to create a hermetic apical seal,[8] fundamental to avoid the onset of periapical disease. In these conditions, it was obviously necessary to perform a first orthograde approach, in order to remove the endodontic material used previously and disinfect the root canal, and subsequently a retrograde approach, in order to remove the over-apex endodontic material and regularize the shape of the apex to ensure a clinical condition more inclined to healing.

Conclusion

The 12-month follow-up visit showed that the combined orthograde-retrograde endodontic approach and subsequent direct composite restoration created ideal conditions for

obtaining a complete healing of both hard tissue and soft tissue.

Conflict of interest

The authors have no conflict of interests to declare.

References

1. Andersson L. Epidemiology of traumatic dental injuries. *J Endod* 2013;**39**(3 Suppl.):S2—5.
3. Diangelis AJ, Andreasen JO, Ebeleseder KA, Kenny DJ, Trope M, Sigurdsson A, et al. International Association of Dental Traumatology, International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations of permanent teeth. *Dent Traumatol* 2012 Feb;**28**(1):2—12.
4. Andersson L, Andreasen JO, Day P, Heithersay G, Trope M, Diangelis AJ, et al. International Association of Dental Traumatology, International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. *Dent Traumatol* 2012 Apr;**28**(2):88—96.
5. Stojanac I, Ramic B, Premovic M, Drobac M, Petrovic L. Crown reattachment with complicated chisel-type fracture using fiber-reinforced post. *Dent Traumatol* 2013;**29**(6):479—82.
6. Vital MC, Caprioglio C, Martignone A, Marchesi U, Botticelli AR. Combined technique with polyethylene fibers and composite resins in restoration of traumatized anterior teeth. *Dent Traumatol* 2004;**20**(3):172—7.
7. Sjögren U, Figdor D, Persson S, Sundqvist G. Influence of infection at the time of root filling on the outcome of endodontic treatment of teeth with apical periodontitis. *Int Endod J* 1997;**30**(5):297—306.
8. Hachmeister DR, Schindler WG, Walker 3rd WA, Thomas DD. The sealing ability and retention characteristics of mineral trioxide aggregate in a model of apexification. *J Endod* 2002;**28**(5):386—90.

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ORIGINAL RESEARCH ARTICLE/ARTICOLO ORIGINALE

33° CONGRESSO NAZIONALE VINCITORE PREMIO FRANCESCO RIITANO

Glide-path: comparison between manual instruments, first generation rotary instruments and M-Wire new generation rotary instruments

Preparazione del glide-path: confronto tra strumenti manuali, strumenti meccanici di prima generazione e strumenti di nuova generazione in lega M-Wire

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Received 29 April 2014; accepted 22 May 2014
Available online 25 June 2014

KEYWORDS
Pathfiles;
Proglider;
M-wire;
Canal shaping;
Glide-path.

Abstract
Objectives: The aim of this research is to compare the different glide path instruments in order to assess the work time and the number of use for each instrument.
Materials and methods: There were used 100 endodontic resin blocks with an S curvature for each group of instruments, on each block, first were used the k file # 10 and then the glide path was done using always the Xsmart machine, setting torque 5.2 n/cm^2, speed 250 g/m, all instruments were used until their separation and then the results were studied.

The time was also counted to obtain the complete pre-flaring for each group.

The same test was also repeated on extracted teeth, chosen from mb canal of maxillary molars, and mandibular molars, a total of 50 canals for each group; also in this group the

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Peer review under responsibility of Società Italiana di Endodonzia.

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http://dx.doi.org/10.1016/j.gien.2014.05.006

pre-flaring was done counting the number of use for each instrument up to their separation and counting the time to obtain it.
Result and conclusions: Pathfiles group tested on resin blocks: pathfile #13 the result was: 100 out of 100 canals, pathfiles#16: 60 out of 100 canals, pathfile #19: 42 out of 100 canals.

Pathfiles group tested on extracted teeth: pathfile #13: 50 out off 50 canals, pathfiles#16: 50 out of 50 canals, pathfile #19: 50 out of 50 canals, no separated instruments.

Proglider group on resin block: single proglider 100 out of 100 blocks.

Proglider group on extracted teeth: single proglider 50 out of 50 canals.

Time to obtain the pre-flaring with pathfile: 10 s.

Time to obtain the pre-flaring with proglider: 8 s.

Both files give good results for an effective canal pre-flaring and glide path, making easier the following canal shaping independently of the chosen shaping technique.

There are no significant differences in the working time, and the strength of the pathfiles is confirmed for the new M-wire file: proglider.

PAROLE CHIAVE
Pre allargamento dei canali;
Variazione anatomia canalare;
Fatica ciclica;
Percorso di scivolamento;
Tempi di lavoro.

Riassunto
Obiettivi: Obiettivo di questo lavoro è mettere a confronto differenti strumenti per il glide-path, strumenti tradizionali in acciaio, strumenti per praflaring in ni-ti e strumenti di nuova generazione per preflaring in lega M-wire. Verrà valutato il numero di utilizzi prima della frattura sia su denti estratti che su simulatori endodontici, e il loro tempo di lavoro.
Materiale e metodi: sono stati utilizzati 100 simulatori endodontici in resina con curva ad s per ogni tipo di strumento analizzato, ed effettuato il preflaring in ogni silmulatore, è sempre stato utilizzato il motore xsmart con torque 5,2 n/cm^2, velocità 250 giri/m tutti gli strumenti sono stati utilizzati fino alla frattura ed analizzato poi statisticamente il risutato, è stato inoltre calcolato il tempo per ottenere il preflaring per ogni gruppo.

Gli stessi strumenti sono stati poi valutati anche su denti estratti, sono stati utilizzati prevalentemente radici vestibolari di molari superiori e mesiali di molari mandibolari, per un totale di 50 canali per ogni gruppo, è stato effettuato il preflering secondo la tecnica prevista dai singoli strumenti, calcolato il numero di utilizzo per ogni singolo strumento fino alla frattura, sono stati inoltre calcolati i tempi di utilizzo per ottenere il preflaring completo in ogni gruppo.
Risultati e conclusioni: Da questo studio si è evidenziato come il preflaring meccanico confrontato con il preflaring tradizionale manuale riesca a conservare meglio l'anatomia del canale evitando spiacevoli incidenti di percorso come false strade o trasporto del canale tipici degli strumenti in acciaio; permette agli irriganti di arrivare all'apice già dalle prime fasi di strumentazione canalare, e si riducono i tempi di lavoro.

con gli strumenti di nuova generazione in lega Ni—Ti M-wire si riesce ad ottenere il preflaring con numero minore di strumenti(si passa da tre ad uno) riducendo di conseguenza ulteriormente i tempi di lavoro.

Introduction

Pre-flaring is the pre-enlargement of canals needed to decrease the fracture risk of Ni—Ti instruments inside the canal.

With pre-flaring the taper lock on the instrument tip is decreased and a glide path is created that facilitates the penetration of the subsequent rotary instruments regardless of the technique used.

Traditionally pre-flaring and glide paths are achieved with manual steel instruments, k-files #10, #15, and #20, used sequentially.

Despite the introduction over the years of rotary instruments specifically designed for pre-flaring, the manual technique continues to offer undeniable advantages: greater tactile control, lower risk of endodontic fracture, the option of pre-curving the instrument in order to pass ledges and false channels; in addition to these benefits, however, it also has disadvantages: long operation times and a higher chance of instrument deformation makes work in very long and sharply curved canals more difficult. It also involves the use of an excessive number of instruments and more complications such as the formation of ledges and apical transportation if used improperly.

These disadvantages and typical complications of steel instruments led to the introduction of the first instruments for mechanical pre-flaring in Ni—Ti: the PathFiles.

The pathfiles are three instruments with tip diameters of #13, #16, and #19 (Fig. 1) characterized by a 0.2 constant taper, elevated flexibility, due both to the slight taper and

Figure 1 Pathfiles instruments.

the Ni—Ti alloy, and still provide resistance thanks to their square cross section.

Although PathFiles are mechanical instruments in their operation, the use of at least one manual steel file is involved (generally a k-file #10), which serves as an initial exploratory tool.

In 2009[1] several preliminary studies were conducted on pathfiles, which aimed to evaluate the qualitative and quantitative deformations (zips and ledges) at the apical level and the mean percentage of variation in the coronal and apical radius of curvature.

Four groups of operators were used to perform pre-flaring: expert operators who used pathfiles, non-expert operators who used pathfiles, expert operators who used k-files and non-expert operators who used k-files.

The results showed that Path Files better preserved the original anatomy of the canal compared to steel files at both the coronal and apical level.

The steel instruments were responsible for a higher incidence of apical deformations, particularly among the non-expert operators ($p < 0.001$), with apical transportation found to be the most common deformation in the work groups using steel files.

Subsequently, in 2011,[2] several studies were performed using microtac analysis, aimed at evaluating the variation in canal anatomy after creating a glide path both manually and mechanically. 2400 360° views were taken on eight extracted first maxillary molars; only the vestibular roots were considered. These were assigned randomly to the pathfiles pre-flaring or k-file pre-flaring group. All the samples were micro-scanned 1 mm from the apical foramen and at the point of maximum curvature.

The micro-CT study also confirmed that a mechanical glide path (pathfiles) preserves the original anatomy of the canal with significantly improved results compared to a manual glide path and also causes fewer canal abnormalities.

Despite their excellent quality, Ni—Ti instruments pose a risk of "unexpected" fracture.

Fractures, due primarily to cyclic fatigue, particularly in severely curved canals, thus remain the principal problem, and although the design and methods of manufacturing Ni—Ti rotary instruments have improved, this issue does not appear to be entirely resolved.

Of late different methods have been studied and used for optimizing the Ni—Ti alloy using thermomechanical processes that make it possible to change the bond, making it more flexible and more resistant to cyclic fatigue and torsional stress.[3]

A new generation of Ni—Ti alloys was created: M-wire, R-phase (intermediate phase with rhomboid structure that forms during the transformation from martensite to austenite and vice versa), and Cm-wire (introduced in 2010, extremely flexible but with no elastic memory and thus rarely used).[3]

The improved resistance to cyclic fatigue and torsional stress of the new alloys (with the most widely used being the M-wire alloy), compared to the classic Ni—Ti alloy used for rotary instruments is due precisely to these new thermomechanical processes.

Preliminary studies have shown that a microstructure containing martensite and R-phase is created in addition to the austenite of the traditional Ni—Ti.[4,5]

Various studies have been performed to compare the resistance to cyclic fatigue of the M-wire alloy with other alloys and with traditional Ni—Ti, but since it is impossible to eliminate certain factors such as instrument design and dimensions that are the characteristics of the manufacturer, a comparison study of the alloys has been difficult.

A study by Jhonson [sic: Johnson] et al.[4] reported that instruments in M-wire with a Profile design demonstrated approximately 400% more resistance to cyclic fatigue compared to traditional Ni—Ti with the same design.

The M-wire alloy has thus been used not only for shaping rotary instruments but also for mechanical pre-flaring instruments.

The second generation of instruments for mechanical pre-flaring was thus produced: the progliders.

The principal features of the proglider are: M-wire alloy, square cross section with semi-active tip, and a single size of 016.02 with progressive taper; the active component is 18 mm compared to 16 mm in the pathfiles, and three different lengths are available: 21 mm, 25 mm, 31 mm; the 11 mm handle is in gold colored brass and is individually blister packed.

After exploring the canal with a k-file #10, the instrument is used in continuous rotation at 300 rpm/2 Ncm, until it reaches the length of the space (Fig. 2).

Preliminary studies have shown that progliders, like their predecessors, better preserve canal anatomy compared to steel files.

Figure 2 Proglider instrument.

The purpose of this study was to compare the number of uses of pathfiles and progliders prior to fracture on both extracted teeth and on resin endodontic simulators and to calculate the mean time required to achieve complete pre-flaring with both techniques.

Materials and methods

200 endodontic simulators with a 90° curve were used and 100 canals selected between vestibular roots of the first maxillary molars and mesial roots of the first mandibular molars.

These were divided into four groups:

Group (1) Number of uses of pathfiles on resin simulators

100 endodontic simulators with a 90° curve were used, each simulator was explored with a #10 file, and pre-flaring was performed with the pathfiles in each endodontic simulator; an x smart motor at a torque of 5.2 n/cm^2 and a velocity of 250 rpm was used.

The number of uses until fracture was evaluated for each individual instrument and the mean of the simulators used was calculated.

Each individual fractured instrument was replaced with an equivalent new instrument.

Group (2) Number of uses of pathfiles on extracted teeth

35 extracted teeth were tested (vestibular roots of maxillary molars and mesial roots of mandibular molars) for a total of 50 canals.

The pulp chambers were opened, all canals explored with a k-file #10, and mechanical pre-flaring performed with pathfiles™.

The same settings were used for the x smart motor at 250 rpm and with a torque of 5.2 n/cm. Irrigation was performed after each instrument and the number of uses for each individual instrument was calculated.

None of the pathfiles fractured, but pathfile #16 and pathfile #19 showed unwound blades.

Group (3) Number of uses of the proglider on resin simulators

100 resin simulators were used with a 90° curve.

Each simulator was explored with a #10 file and mechanical pre-flaring performed with a proglider in each simulator; an x smart motor with a torque of 4.0 n/cm^2 and a velocity of 300 rpm was used. The number of uses before fracture was evaluated for each individual instrument.

Group (4) Number of uses of the proglider on extracted teeth

35 extracted teeth were tested (vestibular roots of maxillary molars and mesial roots of mandibular molars) for a total of 50 canals. The pulp chambers were opened and all canals explored with a k-file #10, mechanical pre-flaring was performed with a proglider, and the same settings used on the x smart motor: 300 rpm and a torque of 4 n/cm. Irrigation was performed after each instrument and the number of uses for each individual instrument was calculated; none of the progliders fractured.

The mean use times for both the progliders and pathfiles were also calculated.

Figure 3 Number of simulators resin can be shaped by pathfiles.

Results

Group (1)

Pathfile #13 never fractured and shaped 100 endodontic simulators, pathfile #16 fractured after 60 uses and was replaced with a new one, pathfile #19 fractured after 42 uses and was replaced with a new one (Fig. 3).

Group (2)

No pathfiles fractured and all three pathfiles operated on 50 canals of extracted teeth; however, pathfiles #16 and pathfiles #19 showed unwound blades (Fig. 4).

Group (3)

The proglider never fractured and shaped 100 endodontic simulators (Fig. 5).

Group (4)

The proglider never fractured and shaped 50 canals of extracted teeth (Fig. 6).

The difference in mean use times for pre-flaring was 10 s for pathfiles and 8 s for progliders (Fig. 7).

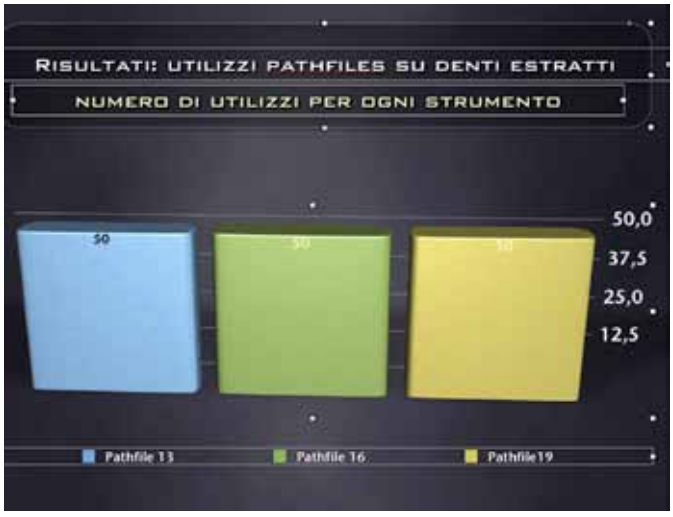

Figure 4 Number of uses pathfile on extracted teeth.

Figure 5 Number of simulators resin sagomabiuli from single proglider.

Figure 6 Number of uses of proglider on extracted teeth.

Discussion

There are undeniable advantages to performing mechanical pre-flaring with both first generation (pathfiles) and second generation (progliders) instruments.

The pathfiles technique involves the use of three instruments with a 0.2 constant taper; they offer elevated resistance to cyclic fatigue, preserve the anatomy of the canal, and create no apical abnormalities.

They are also able to create a glide path in a relatively short time on average.

On the other hand, the proglider is a single instrument with progressive taper and has shown, like its predecessor, to provide elevated resistance to cyclic fatigue; compared to the pathfiles, however, the proglider starts working in the mid and coronal region of the canal, facilitating the use of subsequent instruments by removing coronal obstructions.

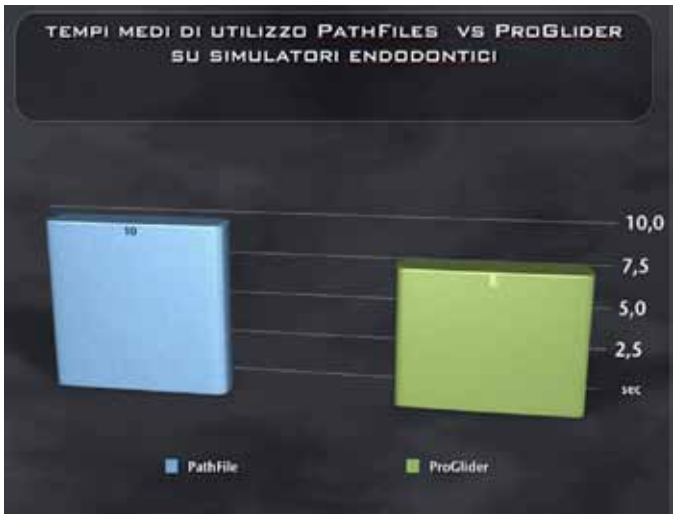

Figure 7 Difference between the average time of use and proglider pathfiles.

The proglider has also been shown to be highly effective in preserving canal anatomy and creating no apical abnormalities.

Conclusions

Both mechanical files have been shown to be effective in preflaring and Glide path creation in canals, facilitating the subsequent shaping phases of the canal, regardless of the instrument chosen. Significant differences in operation times were not found since the greater number of the PathFiles was balanced by a slower endodontic advance with the Progliders. The relative resistance to fracture already established for PathFiles was confirmed for ProGliders, despite the larger tip diameter and progressive taper. This can be explained by the greater resistance to cyclic fatigue of the M-Wire alloy used in ProGliders.

References

1. Berutti E, Cantatore G, Castellucci A. Use of nickel—titanium rotary pathfile to create the glide path: comparison with manual preflaring in simulated root canals. *J Endod* 2009;**35**(3):408—12.
2. Pasqualini D, Bianchi CCA, Cantatore G, Castellucci A, Berutti E. Computed microtomographic evaluation of glide path with nickel—titanium rotary pathfile in maxillary first molars curved canals. *J Endod* 2011;**38**(3):389—93.
3. ya shen, Hui-min Zhou, Yu-feng Zheng, Bin-Peng, Haapasalo, Current challenges and concept of the thermomechanical treatment of nickel—titanium instruments. http://dx.doi.org/10.1016/j.joen.2012.11.005.
4. Johnson E, Lloyd A, Kuttler S, Namerow K. Comparison between a novel nickel—titanium alloy and 508 Nitinol on cyclic fatigue life of ProFile 25/0.04 rotary instruments. *J Endod* 2008;**34**(11):1406—9.
5. Alapati SB, Brantley WA, Iijima M, Clark AT, Johnson WB. Metallurgical characterization of a new nickel—titanium wire for rotary endodontic instruments. *J Endod* 2009;**35**(11):1589—93.

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CROSS-SECTIONAL STUDY/STUDIO TRASVERSALE

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

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

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

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Received 30 April 2014; accepted 14 May 2014
Available online 18 June 2014

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

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

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Peer review under responsibility of Società Italiana di Endodonzia.

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http://dx.doi.org/10.1016/j.gien.2014.05.001

The distance between the AC and the apical foramen was determined by means of a digital ruler. *Results and conclusion:* 52.6% of the observed ACs was ambiguous (present on one projection but not on the other one). Only 21.0% of the canals showed a tridimensional AC (present on both projections). Inter-rater agreement was very good (k = 0.839). The morphology, from greater to least, was flaring (25%), single (21.1%), parallel (21.1%), tapered (19.7%), apical delta (10.5%) and multiple (2.6%). Inter-rater agreement was again very good (kappa = 0.869). Root canal anatomy as described in the literature is more conceptual than real. The presence of AC appears to be an exception rather than a canon.

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

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

Introduction

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

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

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

Materials and methods

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

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

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

Results and discussion

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

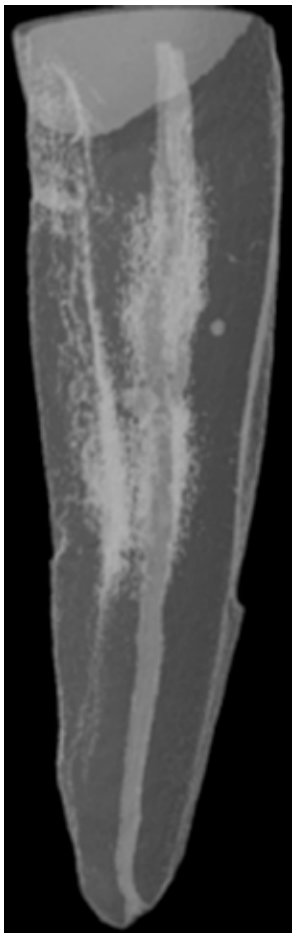

Figure 1 Tridimensional reconstruction, rendered semi-transparent on bucco-lingual projection.

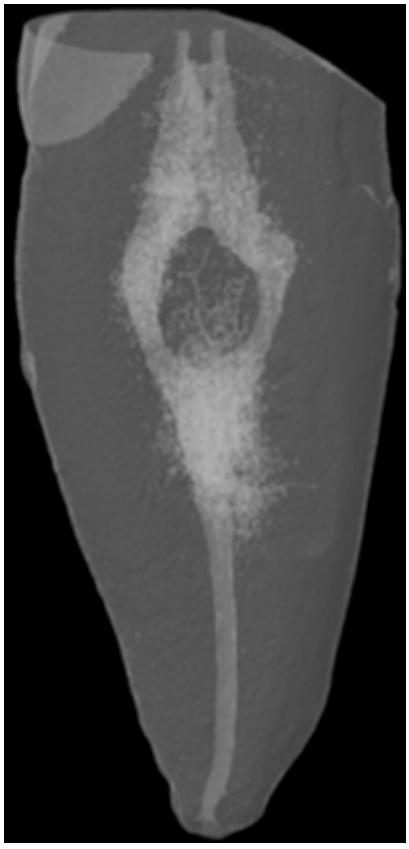

Figure 2 Tridimensional reconstruction, rendered semi-transparent on mesio-distal projection.

by at least one examiner. More than half of the ACs (52.6%) was ambiguous (i.e. AC present on one projection but not on the other). In approximately one third of the sample (32.6%) the AC was classified as absent on both projections by at least one examiner. Inter-rater agreement of examiner was very good ($k = 0.839$ with a 95% CI ranging from 0.665 to 1.014).

Regarding the morphology of the AC, we have distinguished the presence of AC (single AC, multiple AC, tapered AC) by the absence of AC (flaring AC, parallel AC and apical delta) (Fig. 4). The more represented morphologies were flaring (25%), single (21.1%) and parallel (21.1%), tapered (19.7%), apical delta (10.5%) and multiple (2.6%). Only 8 canals showed the same AC morphology in both projections. Among the mesio-distal projections, the single AC was the most represented (34.2%). On the other hand among bucco-lingual projections single AC appeared only in 7.9% of the cases, whereas the flaring AC was observed in 36.4% of the canals. Inter-rater agreement of the examiner was very good ($k = 0.869$ with a 95% CI ranging from 0.747 to 0.990).

When the AC was present, symmetry was assessed. However, only 33.3% of the AC showed a symmetrical appearance. The mean AC-AF distance was: 724.28 ± 348.56 μm. At the end of the study, no AC met all the criteria to be classified as a clinically valid AC.

Micro-CT scanning allowed a detailed analysis of the teeth included in the sample.

Most of the canals observed showed an ambiguous AC. Thus, since teeth are tridimensional structures and RCTs are tridimensional treatments, ambiguous ACs cannot be considered as reliable landmarks to determine the working length in endodontics.

The fact that our results disagreed with the results from classical studies about the AC is mainly due to the methods of

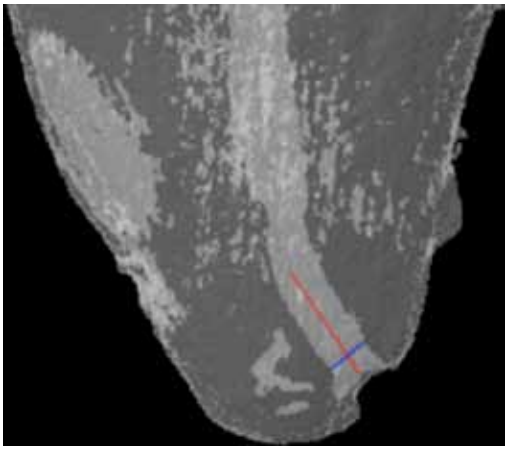

Figure 3 Analysis of the symmetry of the AC; blue line = plane of the AC; red line = long axis of root canal.

Table 1 Summary of results. MD = mesio-distal; BL = bucco-lingual; A = single AC; B = multiple AC; C = tapered AC; D = flaring AC; E = parallel AC; F = apical delta.

Case	Projection	Examiner 1	Examiner 2	Symmetric AC	AC-AF (μm)
1a	MD	A	A	NO	464.1
	BL	D	D	—	—
1b	MD	D	C	—	—
	BL	D	D	—	—
2	MD	A	A	YES	446.2
	BL	D	E	—	—
3a	MD	C	C	NO	606.9
	BL	D	D	—	—
3b	MD	A	A	YES	553.3
	BL	E	E	—	—
4a	MD	A	A	NO	908.7
	BL	A	A	YES	1106.7
4b	MD	A	A	NO	249.4
	BL	D	D	—	—
5	MD	C	A	NO	678.3
	BL	D	A	—	—
6	MD	B	B	NO	1124.5
	BL	D	D	—	—
7	MD	C	C	NO	773.4
	BL	C	E	—	—
8	MD	E	E	—	—
	BL	C	C	NO	571.2
9	MD	A	A	YES	1160.2
	BL	E	E	—	—
10a	MD	F	F	—	—
	BL	F	F	—	—
10b	MD	F	F	—	—
	BL	F	F	—	—
11	MD	C	C	NO	150.2
	BL	C	C	YES	1356.6
12	MD	C	C	NO	714.0
	BL	E	E	—	—
13	MD	E	E	—	—
	BL	E	E	—	—
14	MD	D	D	—	—
	BL	D	D	—	—
15	MD	D	D	—	—
	BL	E	E	—	—

analysis. Dummer[4] observed the presence of an AC in 89% of the canals of his sample. When considering each projection independently, we found an AC on at least one projection in 44.7% of the canals observed. On the other hand, AC was present on both projections in only 21.0% of the canals analysed, when projections from the same tooth were plotted. Obviously, the observation of two projections from the same tridimensional reconstruction of a tooth at the time is a more accurate analysis than that made with only one projection. Clearly, the methods used by Dummer, who observed anatomical sections with a steromicroscope, are the most imprecise. Since the prevalence of the AC decreases when the accuracy of the analysis increases, it is likely that the prevalence of the AC in a sample depends on the quality of the observation. Therefore, it appears that there is an indirectly proportional relationship between the precision of the analysis and the identification of the AC.

Older studies also failed to identify complex morphologies of the AC when compared with recent studies performed with micro-TC.[4,6] Thus, it looks reasonable to think that non-tridimensional observations tend to simplify the actual morphology of the AC. Hence we can conclude that older classifications do not represent accurately the tridimensional morphology of the AC and the attempt to classify the apical morphology based on such classifications may not serve meaningful purposes.

Finally, since no canal met the requirement to be considered as presenting a clinically valid AC, we can state that AC can no longer be thought to be a reliable landmark in endodontics.

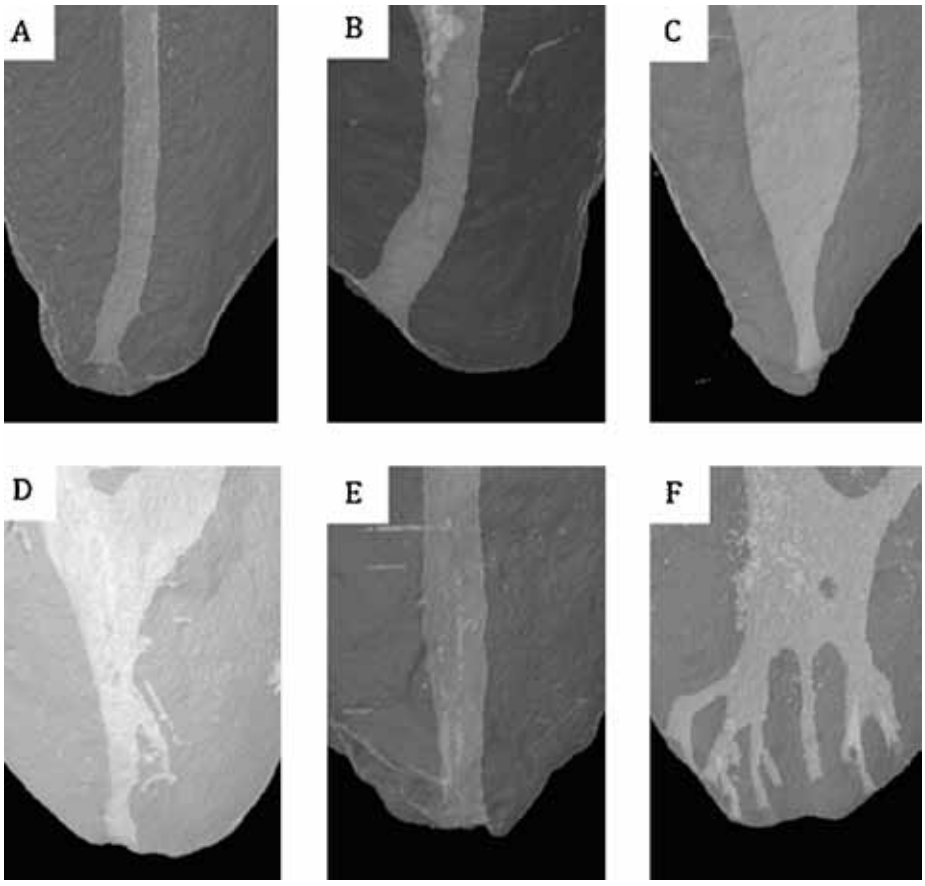

Figure 4 Morphology of the AC; A = single; B = multiple; C = tapered; D = flaring; E = parallel; F = apical delta.

Conclusions

Based on the results of our observations, we concluded that root canal anatomy as described in the literature is more conceptual than real. The presence of AC appears to be an exception rather than a canon. The AC is a structure that constantly appears to be complex, variable and most of all tridimensional.

Conflict of interest

The authors declare that there are no conflicts of interest.

References

1. Chapman CE. A microscopic study of the apical region of human anterior teeth. *Int Endod J* 1968;**3**(4):52—8.
2. Simon JH. The apex: how critical is it? *Gen Dent* 1993;**42**(4): 330—4.
3. Kuttler Y. Microscopic investigation of root apexes. *J Am Dent Assoc* 1955;**50**(5):544—52.
4. Dummer P, McGinn J, Rees DG. The position and topography of the apical canal constriction and apical foramen. *Int Endod J* 1984;**17**(4):192—8.
5. Ponce EH, Fernández JV. The cemento-dentino-canal junction, the apical foramen, and the apical constriction: evaluation by optical microscopy. *J Endod* 2003;**29**(3):214—9.
6. Meder-Cowherd L, Williamson AE, Johnson WT, Vasilescu D, Walton R, Qian F. Apical morphology of the palatal roots of maxillary molars by using micro-computed tomography. *J Endod* 2011;**37**(8): 1162—5.
7. Olson DG, Roberts S, Joyce AP, Collins DE, McPherson JC. Unevenness of the apical constriction in human maxillary central incisors. *J Endod* 2008;**34**(2):157—9.
8. Wu MK, Wesselink PR, Walton RE. Apical terminus location of root canal treatment procedures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000;**89**(1):99—103.

LETTERA DEL PRESIDENTE

Carissimi Soci,

avrò l'onore di guidare la Società per questo triennio, insieme al Consiglio che voi avete eletto.
E' un compito molto gravoso per l'importanza che la nostra Società riveste nel panorama scientifico e per il momento non particolarmente favorevole che stiamo attraversando.
Problematiche che coinvolgono la nostra professione e di conseguenza anche la nostra Società, cosa che si traduce in una più limitata partecipazione agli eventi, sia da parte dei nostri soci, sia da parte degli sponsor.
Questo ci impone di cambiare alcune abitudini, di limare il più possibile i costi e di creare un prodotto sempre più innovativo e attraente.
Per realizzare questo progetto servono due fattori: le idee e le energie per tradurle in fatti concreti.
Di idee ce ne sono già tante, oltre a quelle che voi vorrete aggiungere; per quanto riguarda le energie, serve l'aiuto, la collaborazione, la partecipazione di tutti.

I progetti a cui vorrei lavorassimo inizialmente sono quelli già elencati durante l'ultima assemblea a Torino:
- dare a tutti i consiglieri un ruolo definito per poter coinvolgere maggiormente le energie. Separare il ruolo di segretario da quello di Tesoriere per poter ottimizzare il grande lavoro che questi ruoli hanno nei riguardi della Società e creare una figura che si occupi di tutte le forme di comunicazione.
- Migliorare i rapporti con le altre Società. Più sinergie per un' offerta più interessante. Il primo incontro è stato con la SICOI il 22 marzo: l'opportunità di poter spiegare anche agli implantologi l'importanza del mantenimento del dente naturale!
- Le date dei prossimi tre Congressi e dei prossimi tre Closed Meeting già stabilite per poterci organizzare prima e meglio.
- Dimensione internazionale della SIE a partire dal prossimo Congresso.
- Accentuare la comunicazione dell'importanza dell'endodonzia in un piano di trattamento ineccepibile.
- Implementare la collaborazione con l'Università nell'ottica di una reciproca, indispensabile collaborazione.
- Creare nuove commissioni per coinvolgere più Soci per lavorare di più e con più energia al cambiamento e all'evoluzione.

Infine è per me doveroso rivolgere un caloroso ringraziamento al nostro Past-President, Marco Martignoni, che con l'aiuto di Vittorio Franco alla Segreteria e Mario Lendini alla Segreteria Culturale, insieme a tutto il Consiglio e ai Revisori dei conti, ha operato nel precedente triennio con grande energia, organizzando manifestazioni ed eventi di grande rilevanza italiana e internazionale.
Per realizzare tutti questi progetti ci sarà bisogno di tanta partecipazione che ognuno potrà dare nelle forme che gli sono più congeniali.
Sarò sempre disponibile ad ascoltare le idee e i suggerimenti di tutti, ma, per favore, tenete sempre a mente la frase di John Fitzgerald Kennedy che ho parafrasato durante l'assemblea: "Prima di chiedere cosa la SIE potrebbe fare per voi, domandatevi cosa voi potreste fare per la SIE"!

Il Presidente SIE
Pio Bertani

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Il singolo caso clinico nel suo complesso, coerentemente con gli scopi e i fini della SIE, deve essere presentato considerando non solo l'aspetto clinico del caso, ma anche quello formale della documentazione presentata.

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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.
La domanda dovrà essere firmata da un Socio Attivo il quale dovrà aver esaminato e approvato la documentazione. Quest'ultimo è responsabile della correttezza clinica e formale della documentazione presentata.

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 2014

- **Dott. Davide Fabio Castro**
- **Dott. Mario Mancini**
- **Dott. Franco Ongaro**
- **Dott. Giancarlo Pongione**
- **Dott. Mauro Rigolone**

Aziende Informano

SIMIT DENTAL

IL POTERE DI SALVARE UNA VITA CON IL DEFIBRILLATORE HEARTSTART ON SITE DI PHILIPS.

60.000 persone all'anno vittime di arresto cardiaco.
Oggi grazie al defibrillatore semiautomatico chiunque è in grado di salvare una vita.

L'arresto cardiaco improvviso può colpire chiunque, a prescindere dall'età e dalle condizioni fisiche, in qualsiasi momento ed ovunque. La vittima perde immediatamente conoscenza e collassa, non mostrando più segni di vita, come il polso regolare ed il respiro.
L'unica terapia efficace e comprovata per scongiurare il rischio di morte è un trattamento di defibrillazione, che deve essere somministrato nei primissimi minuti dall'evento, accompagnato da manovre di rianimazione cardiopolmonare.
I cardiologi sono concordi nel ribadire l'importanza della tempestività. La possibilità di salvare le persone colpite da arresto cardiaco, infatti, diminuisce drasticamente ogni istante che passa.
Al giorno d'oggi, le persone senza formazione medica possono usare i defibrillatori semiautomatici che forniscono istruzioni vocali semplici e guidano il soccorritore durante l'intervento. **Dotarsi di un defibrillatore significa preoccuparsi della sicur ezza, come riportato dal decreto attuativo del 18 marzo 2011 della legge n. 191/2009, dove sono consigliati i luoghi che devono essere dotati di defibrillatori semiautomatici esterni, fra cui alberghi, ristoranti e stabilimenti balneari. Viste le recenti morti sui campi sportivi, il decreto attuativo Balduzzi n.158 del 13 Settembre 2012, prevede l'obbligatorietà nelle società sportive sia professionistiche che dilettantistiche di dotarsi di defibrillatori semiautomatici.**
Per oltre un secolo, Philips ha aperto nuove strade verso la realizzazione di tecnologie che migliorano la qualità della vita. Oggi questo impegno fa un passo avanti grazie a prodotti che, oltre a migliorarla, aiutano a preservarla.
Philips Healthcare è oggi l'azienda leader nella produzione di defibrillatori semiautomatici, con oltre 1.000.000 di apparecchi venduti nel mondo.
I defibrillatori semiautomatici Philips Heartstart consentono di intervenire sulla causa più comune dell'arresto cardiaco, la fibrillazione ventricolare, erogando, quando necessario, una scarica elettrica al cuore della vittima.
La tecnologia Philips Heartstart fornisce dei dispositivi compatti, leggeri, che non necessitano di manutenzione. Sono gli unici garantiti 8 anni.

IL PARERE DELLO SPECIALISTA
Il pensiero di Daniela Aschieri, responsabile della Cardiologia territoriale dell'Asl di Piacenza, da anni in prima linea per la diffusione dei defibrillatori sul territorio.

Daniela Aschieri, nel 1998, ha ideato assieme al professor Alessandro Capucci il "Progetto Vita", il primo programma europeo di defibrillazione precoce.

Dottoressa Aschieri, l'arresto cardiaco non è un qualcosa che si può prevenire. Dunque, che fare?
"Di arresto cardiaco si muore, ma il defibrillatore può salvarti la vita. Noi, a Piacenza, utilizziamo questi defibrillatori e abbiamo già salvato la vita a 74 persone".

Perché è importante disporre di un defibrillatore nelle vicinanze?
"Da statistiche internazionali, se viene applicato il defibrillatore entro un minuto, c'è una percentuale pari al 90% di salvezza per l'infortunato; entro due minuti la percentuale rimane alta, circa l'80%. E così via. Se però si applica dopo sei minuti, hai già perso il 60% di possibilità di salvare il paziente dalla morte".

Ci troviamo di fronte ad una macchina molto semplice da usare...
"Sì, basta un semplice corso di un paio d'ore. Non occorre essere medici, chiunque è in grado di applicare due elettrodi sul petto. Poi l'apparecchio, da solo, fa la diagnosi e dice se erogare la scarica o meno, non sempre siamo in presenza di un arresto cardiaco".

È sicuro?
"Anche se è talmente semplice che chiunque può usarlo ti parla, ti dà la diagnosi di quanto sta accadendo e fa lui in automatico l'operazione giusta. E chi esegue l'attività è anche sollevato da responsabilità".

Quanto costa un defibrillatore?
"Quelli che usiamo noi, semiautomatici, davvero poco - conclude la dottoressa Aschieri - , una cifra abbordabilissima per qualsiasi azienda. Se ne dovrebbero dotare autonomamente tutte le strutture ricettive, le scuole e magari anche i condomini".

PROTAPER•NEXT™

the future gold **standard**

PROTAPER NEXT™ è il successore del sistema Dentsply Maillefer PROTAPER® UNIVERSAL, che da molti anni è considerato il Gold Standard in endodonzia.
Basato anch'esso sulla filosofia PROTAPER®, è un sistema versatile e flessibile in grado di trattare la maggior parte dei canali radicolari:

» una sola sequenza di file per tutti i casi clinici
» conicità variabili per una tecnica crown-down ottimizzata
» diametri di finitura apicale comunemente approvati.

L'innovativo effetto "swaggering"
La sezione rettangolare eccentrica di **PROTAPER NEXT™** conferisce allo strumento un movimento "swaggering" simile a quello tipicamente ondulatorio del serpente, il quale genera uno spazio più ampio per la raccolta dei detriti. L'effetto "swaggering" permette anche l'ottimale tracciatura del canale.

La lega M-WIRE®
Il materiale NiTi M-Wire®, in cui è prodotto il nuovo strumento, ne migliora la flessibilità pur mantenendo l'efficienza di taglio ideale. Questo è possibile grazie ad un avanzato processo di trattamento termico esclusivo di Dentsply. Il NiTi M-Wire® assicura anche una maggior resistenza al lavoro ciclico, causa principale della rottura dello strumento.

La creazione del Glide Path
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. Dentsply Maillefer raccomanda l'uso del nuovo strumento **PROGLIDER™**:

» è realizzato in lega NiTi M-Wire® con conicità progressiva variabile
» è sufficiente un solo file PROGLIDER™ per creare un glide path nel pieno rispetto dell'anatomia radicolare
» 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.

Il sistema **PROTAPER NEXT™** comprende anche punte di carta, punte di guttapercha ed otturatori GuttaCore dedicati, cioè corrispondenti alla dimensione dei canali preparati.

Gli strumenti **PROTAPER NEXT™** sono disponibili in blister presterilizzati da 6 files nelle misure singole (X1-X2-X3-X4-X5) oppure assortite (X1-X3) nelle lunghezze 21, 25 e 31 mm.

Rispetto ai brand principali il nuovo **PROTAPER NEXT™** risolve i casi clinici più difficili, conferisce maggior sicurezza, abbrevia i tempi della sagomatura ed il rispetto dell'anatomia originale del canale radicolare è notevolmente maggiore.

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Un trattamento endodontico perfetto necessita di un restauro perfetto!

"La percentuale di successo di una buona otturazione canalare scende dal 90% al 44% nel caso in cui non sia seguita da un adeguato restauro coronale"[1]

SDR® SICURO E AFFIDABILE

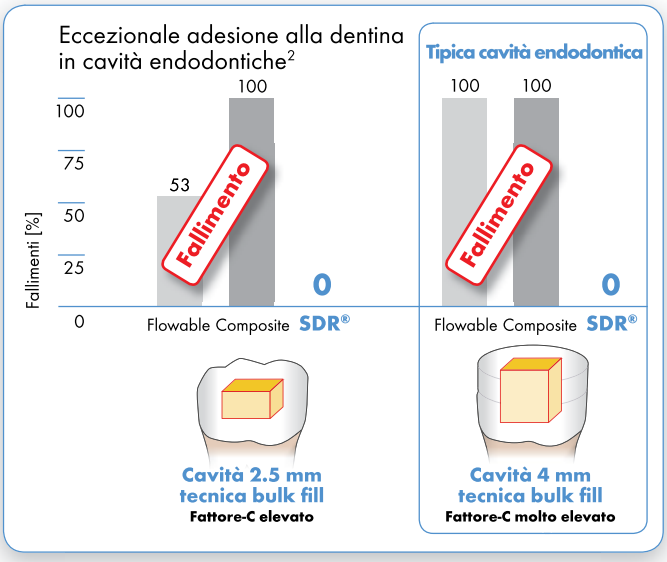
1 Eccezionale adesione alla dentina in cavità endodontiche con un elevato fattore C

- **Nessun fallimento clinico**
- **Adesione affidabile: 41,8 MPa in 4 mm**

"Quando le cavità con un elevato fattore C sono riempite in massa, la scelta del composito sarà fondamentale al fine di evitare il distacco dall'adesivo".

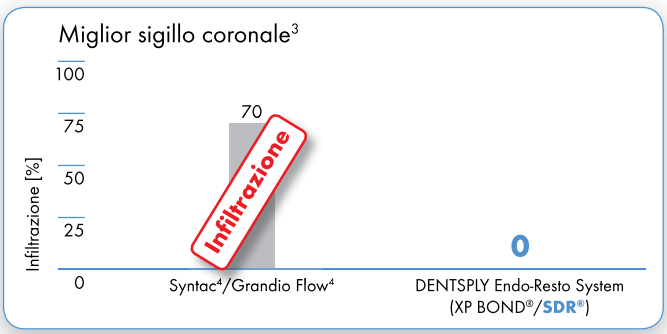
"[SDR] fornisce un legame adesivo soddisfacente a prescindere dalla tecnica di riempimento utilizzata e dalla profondità della cavità[2]".

(Università di Lovanio, 2013)



2 Miglior sigillo coronale

- **Nessuna infiltrazione nei canali radicolari**
- **Migliora la percentuale di successo del restauro dei denti trattati endodonticamente**



[1] Zirkel C., 2011, „Moderne Endodontie – ein antimikrobielles Konzept" Dtsch. Zahnärztl. Z., 66: 185-195 referring to Ray HA, Trope M: Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and the coronal restauration. Int Endod J 28, 12–18 (1995).

[2] Van Ende A et al.; Bulk-filling of high C-factor posterior cavities: Effect on adhesion to cavity-bottom dentin. Dental Materials 29 (2013): 269-277. Conventional composite and flowable tested.

[3] Ebert J, University of Erlangen, 2011. Dati disponibili in archivio.

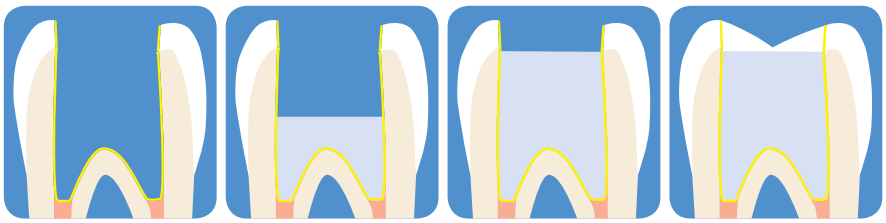
[4] Syntac e Grandio Flow non sono marchi registrati DENTSPLY.

SDR® SEMPLICE, VELOCE ED EFFICIENTE

"SDR® è un composito ideale per la procedura post-endodontica"

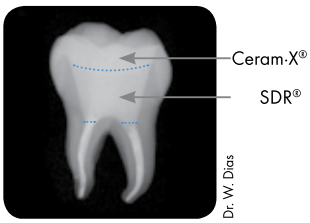
Professor Dr. Naumann, University of Ulm, Germany

✔ Semplifica il restauro post-endodontico



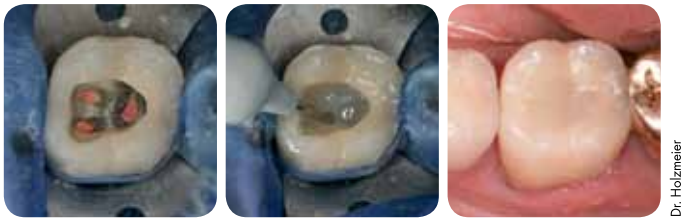
Cavità endodontica pronta per il restauro in composito. | Posizionamento in massa di SDR® fino a 4 mm. | Ulteriore strato di 4 mm di SDR®. | Copertura con composito universale Ceram·X®.

✔ Chiaramente visibile ai raggi X



Alta radiopacità di SDR®.

✔ Riempimento in massa e adattamento eccellente alle cavità profonde



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✔ Facilmente ritrattabile

L'alta traslucenza di SDR® permette di vedere l'otturazione in guttaperca durante il ritrattamento. | Dente 3.6 dopo la rimozione di SDR® con guttaperca totalmente visibile.

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33° CONGRESSO NAZIONALE SIE

Torino, 7/9 Novembre 2013
"Endodonzia: problemi e soluzioni"

Centro Congressi Lingotto

Si è svolto presso il Centro Congressi Lingotto di Torino, dal 7 al 9 Novembre scorso, il 33° Congresso Nazionale della Società Italiana di Endodonzia, dal titolo "Endodonzia: problemi e soluzioni" L'evento, accreditato ECM da CIC provider e patrocinato dall'ANDI (Associazione Nazionale Dentisti Italiani), dall'AIO (Associazione Italiana Odontoiatri), dalla Università degli Studi di Torino, dalla Federazione Nazionale degli Ordini dei Medici Chirurghi ed Odontoiatri e dal Collegio dei Docenti di Odontoiatria, ha visto il supporto di ben 28 aziende sponsor espositrici e circa 1000 partecipanti.
*Il **Corso Pre-Congresso** di giovedì pomeriggio, intitolato "Esami radiografici 3D in endodonzia: impatto sulla diagnosi e sul piano di cura" tenuto dai dottori Shanon Patel e Jean Yves Cochet, è stata un'occasione per approfondire l'impiego della Cone-Beam CT in Endodonzia.*
*La giornata di giovedì si è conclusa con **l'assemblea dei Soci** seguita da un cocktail di benvenuto e dalle elezioni del **nuovo Consiglio Direttivo**. Il nuovo Consiglio, che rimarrà in carica per il triennio 2014-2016, vede come suoi membri: il Past-President Marco Martignoni, il Presidente Pio Bertani, il Presidente Eletto Francesco Riccitiello, il Vice-Presidente Giovanni Cavalli, il Segretario Tesoriere Vittorio Franco, il Segretario Culturale Roberto Fornara e i Consiglieri Mario Lendini e Damiano Pasqualini.*
*Il **Congresso** è stato aperto venerdì mattina dal Presidente SIE Marco Martignoni, alla presenza di numerose personalità del mondo Accademico e Scientifico ed ha avuto il suo momento più toccante nel ricordo di Francesco Riitano da parte di Sandro Rengo.*
La mattinata è poi proseguita con un'originale lezione tenuta dal Maestro Pasquale Catalano, musicista e compositore, che ha brillantemente relazionato circa il rapporto tra la musica e le immagini.
Dopo la pausa sono iniziate le sessioni scientifiche ad inviti, i Simposi dei Main Sponsor Sweden & Martina, Dentsply Italia, SybronEndo e le sessioni finali dei Premi Giorgio Lavagnoli e Riccardo Garberoglio, oltre che dal nuovo premio intitolato a Francesco Riitano.
*La giornata si è conclusa con la consueta **Cena Sociale**, svoltasi presso il ristorante "Da Esterina" e conclusasi con l'immancabile estrazione dei premi assegnati dagli sponsor ai fortunati commensali.*
*Il sabato ha visto, oltre al completamento delle sessioni ad inviti ed al simposio organizzato della Simit Dental, la premiazione dei **Vincitori delle Sessioni Finali** e la replica in auditorium della presentazione vincente:*
- per il Premio Miglior Tesi di Laurea in Ambito Endodontico
Filippo Citterio con "Analisi della Costrizione Apicale con Microtac e Sezioni Anatomiche"*
- per il Premio Riccardo Garberoglio
Stefano Corbella et Al. con "Tecnica per il trattamento di perforazioni del seno mascellare in chirurgia endodontica. Valutazione prospettica comparativa"*
- per il Premio Giorgio Lavagnoli
Nicola Scotti con "Recupero endodontico-restaurativo complesso di un incisivo centrale superiore"*
- per il Premio Francesco Riitano
Alessandra D'Agostino et Al. con "Preparazione del glide-path: confronto tra strumenti manuali, strumenti meccanici di prima generazione e strumenti di nuova generazione in lega m-wire".*
Quest'ultimo premio è stato consegnato dalla figlia del Dottor Riitano: la Dottoressa Giuseppina Riitano.
*Durante la giornata di sabato si sono svolte, inoltre, le **tavole cliniche** nella zona expo, sempre molto apprezzate per il contatto docente - discente, le presentazioni degli altri lavori che avevano partecipato ai Premi SIE ed il **Corso per Assistenti alla Poltrona,** coordinato da Vasilios Kaitsas e da Emilio Pilotti, con la partecipazione di Luigi Scagnoli e di Maria Elvira Sbardella.*
I lavori si sono chiusi nel pomeriggio di sabato 9, dando a tutti gli appassionati appuntamento alle prossime Manifestazioni Regionali, nonché al prossimo Congresso "Internazionale" che si svolgerà dal 6 all'8 Novembre nella splendida città di Parma.

Jean-Yves Cochet

Shanon Patel e Marco Martignoni

Sintesi della Giornata Endodontica Lombarda

22 Febbraio 2014 – Dott. Cristian Coraini

Lo scorso sabato 22 febbraio si è svolta la Giornata Endodontica SLE, sezione lombarda della SIE, dal titolo "Endodonzia: disciplina viva!".
La manifestazione ha avuto luogo nella prestigiosa, quanto davvero splendida, cornice dell'Aula Magna di Medicina e Chirurgia dell'Università degli Studi di Brescia e ha visto la presenza complessiva di 115 partecipanti. Fra questi, in perfetta sincronia di aspettative vista la sede istituzionale, ben 58 gli studenti, a riprova della necessità di tenere ove possibile queste giornate in sedi di insegnamento anche per poter mantenere nel contesto societario una sorta di "linfa vitale" giovane ed in costante divenire. La giornata è stata patrocinata dalla Regione Lombardia, dall'Ordine dei Medici Chirurghi e Odontoiatri della Provincia di Brescia, dalle sezioni di Brescia ANDI ed AIO, e naturalmente dalla Clinica Odontoiatrica – Corso di Laurea Specialistica in Odontoiatria e Protesi Dentaria dell'Università di Brescia; l'evento ha ottenuto 3 crediti formativi.
La giornata è stata aperta con i ringraziamenti di rito forniti dal Segretario Regionale Lombardo, Dott. Cristian Coraini, che ha poi ceduto la parola al Presidente SIE, Dott. Pio Bertani ed a sua volta al Prof. Stefano Salgarello, Associato di Endodonzia e Chirurgia Orale/Implantologia presso l'Ateneo bresciano. Il Dott. Coraini ha enfatizzato il supporto prezioso ricevuto proprio dal Prof. Salgarello, che si è dimostrato nel corso dell'organizzazione della manifestazione un "aiuto interno" davvero straordinario, nonché dalla consueta ed infaticabile Segreteria Nazionale SIE.
Con la Presidenza di sessione svolta da parte del Prof. Dino Re e dal Dott. Luigi Cecchinato di Milano, ha aperto i lavori il Dott. Roberto Fornara, Responsabile Scientifico e coordinatore culturale nazionale degli eventi SIE, il quale ha relazionato circa l'imaging 3D nella diagnosi endodontica come di consueto in modo chiaro ed esaustivo. Gli è succeduta la relazione tenuta da parte del Dott. Davide Castro, ugualmente completa ed efficace, relativa al non facile quanto attuale tema della mini-invasività e dei tempi clinico-operativi connessi alla terapia endodontica moderna. La sessione mattutina si è chiusa poi con una relazione doppia, svolta dai Dottori Angelo Fassi e Francesco Ausilio, che hanno illustrato ai partecipanti una brillante relazione su come mantenere la vitalità pulpare da parte dell'endodontista, non prescindendo dalle altre specialità odontoiatriche. Ciò anche come una sorta di "premio", in quanto il Dott. Ausilio, pur non essendo socio attivo SIE, oltre ad aver seguìto tutte le recenti manifestazioni formali ed informali della sezione lombarda, ed aver già presentato in contesti informali della SLE, ha ancora una volta dimostrato di possedere una casistica che gli varrà senz'altro presto l'ormai auspicabile status di "attivo" che merita. Dopo il coffee break e la Presidenza di sessione svolta da parte dei Dottori Giovanni Cavalli (Vice Presidente SIE) e Stefano Calderoli, i lavori sono ripresi con l'intervento del Dott. Luigi Cecchinato che, messo in "pre-allarme" il giorno prima ma avvisato di dover parlare all'ultimo momento proprio durante il coffee-break, ha dimostrato prontezza, relazionando sul tema dell'apertura della cavità di accesso al posto dell'influenzato relatore designato, il Dott. Stefano Gaffuri, cui è andato il plauso di essersi comunque alzato la mattina pur non sentendosi affatto bene, e provare comunque a relazionare per ferreo attaccamento alla SLE, cosa che alla fine purtroppo non è appunto riuscito a fare. Ha infine chiuso i lavori congressuali il Dott. Matteo Capelli, a cui era stato affidato un tema molto sentito oggi, vale a dire endodonzia vs implantologia alla luce delle evidenze della letteratura scientifica disponibile: anche lui di certo non ha tradito le aspettative riposte.
Durante il lunch organizzato nello spazio espositivo, animato dalla presenza complessiva di 9 aziende, si sono svolte infine 2 tavole cliniche, che hanno visto una nutrita partecipazione e manifestato l'interesse dei partecipanti, Relatori designati delle tavole cliniche i Dottori Riccardo Tonini di Brescia (per Simit Dental) ed Enrico Cassai (per Dentsply Italia).
La giornata si è quindi conclusa con un arrivederci alle prossime manifestazioni lombarde della SLE, gli incontri informali, che riprenderanno a partire da giugno a Milano.

Pio Bertani, Cristian Coraini, Giovanni Cavalli

Stefano Salgarello

Sintesi della Giornata Endodontica Marchigiana

1 Marzo 2014 – Dott. Roberto Mancini

Nella suggestiva cornice del piano panoramico dell'Hotel Cruiser di Pesaro si è svolta sabato 1 marzo la Giornata Endodontica Marchigiana, sul tema "Endodozia di successo alla luce delle attuali acquisizioni in ambito restaurativo e impiantare".
La manifestazione ha riscosso un ottimo successo, sia in termini di pubblico che di qualità scientifica.
Durante la mattinata gli argomenti trattati sono stati incentrati sugli aspetti più prettamente restaurativi.
Il Dott. Marco Forestali, primo relatore della Giornata, ha parlato dell'importanza dell'Endodonzia nello sviluppo del piano di trattamento, esaminandone in maniera dettagliata i vari aspetti diagnostici.
A seguire il Dott. Stefano Bottacchiari ha esaminato approfonditamente il tema della restaurativa indiretta nei settori posteriori, in relazione ai fondamentali aspetti endodontici e parodontali. La relazione è stata opportunamente corredata dalla presentazione di interessanti casi clinici.
E' stata poi la volta del Presidente SIE Dott. Pio Bertani, primo relatore esterno, che ha trattato l'argomento del sigillo coronale, aspetto fondamentale della terapia endodontica, partendo dal "restauro intracanalare" fino ad arrivare a quello coronale "tout court".
L'ultima relazione della mattina ha visto la presenza del secondo ospite esterno, il Dott. Giacomo Fabbri, specialista in protesi, che ha esposto dettagliatamente le moderne opzioni terapeutiche in relazione alla scelta dei nuovi materiali ceramici da utilizzare nei denti recuperati endodonticamente, con particolare attenzione alla mini-invasività delle soluzioni.
Durante il break i due Main Sponsor, Simit e Dentsply, hanno organizzato delle tavole cliniche relazionate rispettivamente dal Dott. Eugenio Tosco e dal Dott. Marco Simonetti.
Dopo il pranzo, la giornata è continuata con una impronta più tipicamente "endodontica". Ha dato inizio alla sessione il Dott. Mario Mancini, che ha illustrato le novità più significative tra gli strumenti a disposizione per una corretta sagomatura canalare, arricchendo la relazione con utilissimi consigli pratici.
Il Dott. Daniele Natalini ha poi approfondito l'argomento dell'irrigazione canalare secondo le più recenti fonti bibliografiche a disposizione.
A conclusione della giornata, il Dott. Filippo Cardinali ha parlato di otturazione canalare, occupandosi nello specifico dell'attualissima tecnica che prevede l'utilizzo di guttaperca calda veicolata da carrier, focalizzandone l'attenzione sulle sue indicazioni e sui suoi limiti.
La Giornata si è così conclusa tra testimonianze di apprezzamento dei partecipanti per il valore e l'utilità dell'evento e la soddisfazione del sottoscritto e dei soci che hanno contribuito attivamente alla sua realizzazione.

I Relatori della Giornata SME

La sala

Sintesi del Seminario Endodontico Abruzzese

8 Marzo 2014 – Dott. Claudio Tiberi

Il seminario si è svolto il giorno 8 marzo 2014 presso la sede dell' Ordine dei Medici ed Odontoiatri di Pescara.
Hanno presenziato circa trenta partecipanti.
Ha iniziato il Dott. Vincenzo Lamorgese di Roma offrendo una casistica impressionante di casi di ricostruzione post-endodontica con tecnica diretta. Egli ha incantato i presenti offrendo spunti di riflessione e coinvolgendoli in una discussione, che è la finalità di ogni seminario. Ciascuno dei partecipanti ha avuto modo di cogliere tanti aspetti: dai problemi legati all'adesione fino ai temi occlusali di tale tecnica di ricostruzione.
Nel primo pomeriggio altra relazione interessantissima perchè originale e nuova, quella del Prof. Camillo D'arcangelo, che ha preso in esame i restauri in composito indiretto sui denti trattati endodonticamente. L'aspetto innovativo della trattazione è stato quello di correlare i restauri con l'esame di posturologia.
Infine il Dott. Lucio Daniele ha spiegato quali sono le linee guida per la ricostruzione post-endodontica utilizzando i perni in fibra.
Il seminario ha concluso i lavori intorno alle 17.30 con grande soddisfazione degli intervenuti.

I Relatori del Seminario SAE

La sala

Sintesi della Giornata Endodontica Laziale

29 Marzo 2014 – Dott. Giovanni Schianchi

Sabato 29 marzo 2014 presso la Sede dell' Università "La Sapienza" nell'aula "L.CAPOZZI"-Dipartimento di Scienze Odontostomatologiche e Maxillo-Facciali si è svolta la Giornata Endodontica SER con il patrocinio dell'Università stessa, dell'ANDI e dell'AIO.
L'argomento trattato è stato: "Criteri di valutazione diagnostica per il trattamento endodontico o Implantare", dove si è messo in evidenza la complementarietà di queste due discipline, sfatando il tanto dibattuto interrogativo se affrontare a priori un caso clinico, secondo la disciplina che si è scelta, con un Ritrattamento o un Impianto.
Tutti i valenti Relatori di grande esperienza hanno dato indicazioni e linee guida sul piano di cura da seguire prima dell'intervento, soprattutto oggi che abbiamo a disposizione mezzi diagnostici di rilevante precisione.
Sono stati valutati tutti i parametri del successo endodontico ed implantare nel tempo e come affrontare casi complessi in sinergia tra Endodonzia e Implantologia per quanto riguarda piani di cura riabilitativi completi.
Si è infine preso in considerazione il ruolo che può svolgere un endodontista quando si confronta con l'opportunità di operare un impianto post-estrattivo immediato e quali siano le linee guida e i requisiti clinici che lo guidino.
I Main Sponsor hanno effettuato le loro Tavole Cliniche durante il break del pranzo, che come da programma è stato di un'ora e mezzo, durante il quale si sono riuniti i Soci Attivi della SER. L'affluenza dei partecipanti è stata più che soddisfacente avendo avuto circa 120 presenze principalmente rappresentate da Colleghi Odontoiatri.
Un ringraziamento particolare a Gianluca Gambarini, Emanuela Faitelli, Carlo Altamura ed all'efficientissima Segreteria per la collaborazione offertami per il buon fine del successo ottenuto da quest' Evento della nostra Sezione Regionale.

La sala

Carlo Altamura, Giovanni Schianchi, Emanuela Faitelli

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

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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.

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

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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

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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.

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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.
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- **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.
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- **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.

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- **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.

Main Text of Mini Review Articles should be divided into Introduction, Review and Conclusions. The Introduction section should briefly introduce the subject matter and justify the need and timeliness of the literature review. The Review section should be divided into logical sub-sections to enhance readability and understanding and may be supported by up to 5 tables and figures. Search strategies must be described and the use of state-of-the-art evidence-based systematic approaches is expected. The Conclusions section should present clear statements/recommendations and suggestions for further work. The manuscript, including references and figure legends should not normally exceed 4000 words.

Main Text of Clinical Reports and Clinical Articles should be divided into Introduction, Report, Discussion and Conclusion,. They should be well illustrated with clinical images, radiographs, diagrams and, where appropriate, supporting tables and graphs. However, all illustrations must be of the highest quality

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5.3. References

It is the policy of the Journal to encourage reference to the original papers rather than to literature reviews. Authors should therefore keep citations of reviews to the absolute minimum.

We recommend the use of a tool such as EndNote or Reference Manager for reference management and formatting. EndNote reference styles can be searched for here: www.endnote.com/support/enstyles.asp. Reference Manager reference styles can be searched for here: www.refman.com/support/rmstyles.asp

In the text: a number in order of citation is the reference inside the manuscript; example (1)

Reference list: All references should be brought together at the end of the paper in numerical order and should be in the following form.

- 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 (.)
- Title of journal abbreviated (es. Journal of Endodontics : J Endod)
- Year of publication followed by ;
- Volume number
- Issue number in parenthesis (es.: (5)) followed by :
- First and last pages

Examples of correct forms of reference follow:

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.

URLs

Full reference details must be given along with the URL, i.e. authorship, year, title of document/report and URL. If this information is not available, the reference should be removed and only the web address cited in the text.

Smith A Select committee report into social care in the community [WWW document]. (1999) URL http://www.dhss.gov.uk/reports/report015285.html
[accessed on 7 November 2003]

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Unnecessary figures and parts (panels) of figures should be avoided: data presented in small tables or histograms, for instance, can generally be stated briefly in the text instead. Figures should not contain more than one panel unless the parts are logically connected; each panel of a multipart figure should be sized so that the whole figure can be reduced by the same amount and reproduced on the printed page at the smallest size at which essential details are visible.

Figures should be on a white background, and should avoid excessive boxing, unnecessary colour, shading and/or decorative effects (e.g. 3-dimensional skyscraper histograms) and highly pixelated computer drawings. The vertical axis of histograms should not be truncated to exaggerate small differences. The line spacing should be wide enough to remain clear on reduction to the minimum acceptable printed size.

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6. AFTER ACCEPTANCE

Upon acceptance of a paper for publication, the manuscript will be forwarded to the Production Editor who is responsible for the production of the journal.

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Hard copies of all figures and tables are required when the manuscript is ready for publication. These will be requested by the Editor when required. Each Figure copy should be marked on the reverse with the figure number and the corresponding author's name.

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The corresponding author will receive an email alert containing a link to a web site.
A working email address must therefore be provided for the corresponding author. The proof can be downloaded as a PDF (portable document format) file from this site. Acrobat Reader will be required in order to read this file. This software can be downloaded (free of charge) from the following Web site: www.adobe.com/products/acrobat/readstep2.html.
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Per quanto attiene le norme editoriali per la pubblicazione di articoli aventi come tema l'Endodonzia in senso lato si pregano gli autori di riferirsi al documento in inglese reperibile sul sito www.gi-endodonzia.com.

Articoli in lingua italiana saranno pubblicabili, ma si darà preferenza a contributi in lingua inglese che potrebbero avere una risonanza internazionale ben più ampia.

La Società Italiana di Endodonzia si farà carico di rivedere la forma dei contributi in lingua inglese attraverso un sistema di controllo specifico.