Vital pulp therapy on external cervical resorption using Biodentine™

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Abstract

During the process of an external cervical resorption (ECR), the underlying pulp tissue remains vital until advanced stages. The development of the resorption is initiated via a punctual external entrance through the dentin and develops centripetally in the three dimensions of space within the dentin. The pulp does not intervene in any way in the advancement of resorption, and even on the contrary, tends to limit its advance by maintaining a protective layer on its periphery called Peri-radicular Resorption Resistant Sheet (PRRS). It is therefore important, when conditions allow it, to try to preserve the dental pulp when treating this kind of pathosis. In this context, the present article presents the case of a canine requiring a vital pulp therapy using Biodentine™ (Septodont) during the treatment of ECR, involving the elevation of a flap and composite placement.

Introduction

An external cervical resorption corresponds to a destruction of the mineralized dental tissue in the cervical region. This phenomenon is initiated via a punctual external entrance through the dentin (possibly made possible by a cemento-ligament discontinuity) and develops centripetally in the three dimensions of space within the dentin. under the action of clastic cells. ***(Patel, IEJ,2018)*** If left untreated, the resorption area can gradually extend centripetally until it surrounds the root canal system. The pulp tissue is considered to be protected by a non-mineralized and non-uniform barrier (thickness ranging from 70 to 490 micrometers) called Periradicular

Resorption Resistant Sheet (PRRS). However, despite the maintenance of the integrity of the odontoblastic layer and the underlying pulp tissue in initial stages, cellular changes within the pulp seem to eventually take place, such as odontoblastic atrophy, dispersed pulp calcification, formation of pulp stones, etc. In advanced cases, pulpitis or eventually pulp necrosis can occur. ***(Mavridou, JOE, 2016)***
The resorptive defect is quickly colonized by the cells of the surrounding tissues (bone, periodontal ligament, gum). In case of ECR, due to the coronal position of the defect, the tissue developing there originates from the gum and constitutes a fibro-vascular granulation tissue.

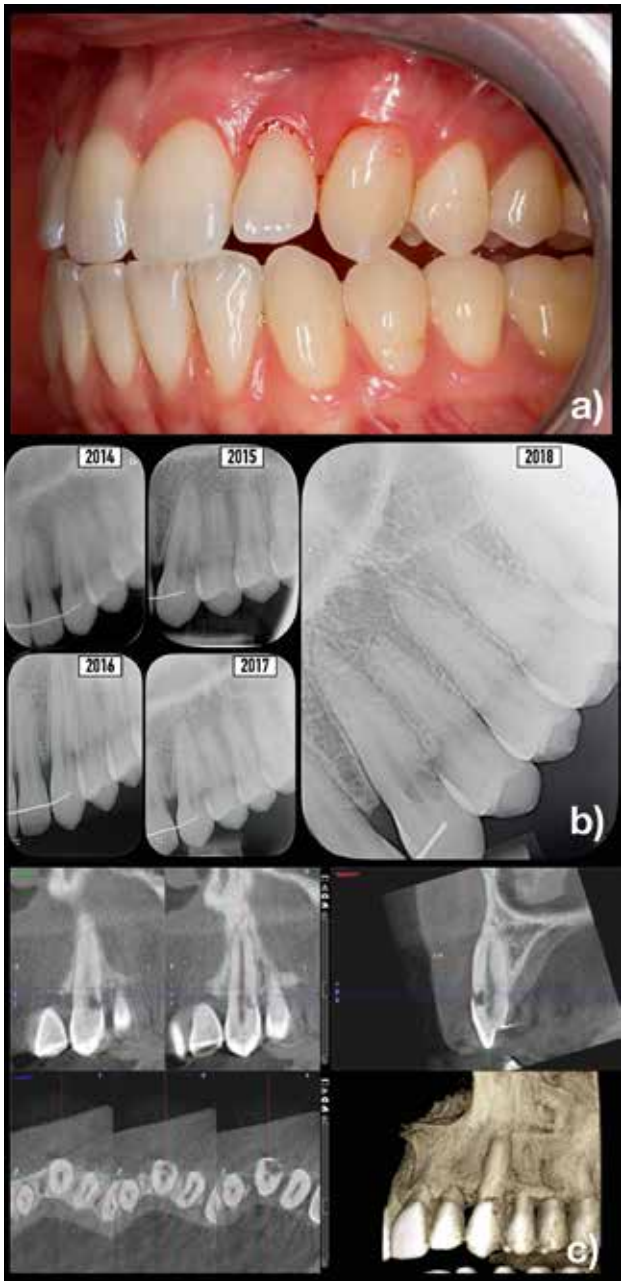

Fig. 1: Diagnosis a) initial situation b) radiographic monitoring c) CBCT pre-op.

Thus, in some advanced cases, it is possible to see a cervical pink coloration due to this underlying highly vascularized infiltrating tissue. This rather rare clinical picture called "pink spot" is pathognomonic of ECRs and allows an easier diagnosis. ***(Bergmans, JCP, 2002)***
In general, the diagnosis of ECR constitutes a challenge in terms of detection (clinical and radiographic) and therapeutic strategy to adopt. In fact, except in advanced cases, teeth with this kind of damage are asymptomatic and the pulp tissue is still alive. ***(Patel, IEJ, 2018)***

Therefore, it is important not to sacrifice pulp vitality whenever possible and thus to prefer a more "pulp friendly" approach. This therapeutic option is dependent on various factors such as the position and extent of the defect, the ease of operation, the initial symptomatology.

Through this case report, a therapeutic proposal for maintaining pulp vitality has been illustrated.

Case report

A Caucasian woman of 26 years without medical history has been followed in our dental clinic for 4 years for a buccal external cervical resorption in tooth #23 with a visible pink spot ***(Fig. 1a)***.

The patient reported a history of orthodontic treatment 9 years ago, but no history of trauma. In the absence of symptoms (induced or spontaneous) and size change, clinical and radiographic follow-up was carried out annually.

Radiographically, apical retro-alveolar images taken with a sensor holder did not reveal any progression of the lesion, nor any enlargement of the periodontal space ***(Fig .1b)***.
Clinically, the cold sensitivity pulp tests remained normal, i.e. transitory pain disappearing immediately after withdrawal of the stimulus. Periodontal health remained stable with good plaque control.

However, an onset of cold-induced sensitivity led to a new appointment request in 2018. Clinically, the cold sensitivity test was positive, with exacerbated pain that stopped quickly after withdrawal of the stimulus. The diagnosis of reversible pulpitis was made and a CBCT was prescribed in order to plan the intervention.
The resorption area located a the CEJ level was spreading circumferentially (with an angulation from 90° to 180°) and seemed to be confined to the dentine, classification 1Bd according to ***Patel, IEJ, 2018 (Fig. 1c)***.

On the day of the intervention, the patient had an antiseptic mouthwash (1 minute Corsodyl - CHX 0.2%). A tracing para-apical anesthesia was then performed (Scandonest-Septodont).

The surgical approach was then made via an intra-sulcular incision from tooth #21 to #25 and the the flap was elevated ***(Fig. 2)***.
On Fig. 2a, (A) is the portal of entry of the resorption, which then spreads in all directions inside the tooth destroying cementum, dentin and enamel. An enamel fenestration (visible on Fig. 2a as (B) is the consequence of the dental tissue loss.
The resorption area was filled by a granulation tissue coming from the gum. This underlying highly vascularised inflammatory tissue gives the pink color of the pathognomic pink spot through the thinned enamel.

This residual layer of enamel was removed with a diamond bur under water,allowing a direct view of the underlying granulation tissue ***(Fig. 2b)***:
The whitish appearance of this tissue on Fig. 2b is due to local ischemia after local anesthesia with vasoconstrictors as well as to the section of vascular supply during the intrasulcular incision.

The tooth was isolated with a rubber dam, stabilised by an incisal clamp. This presented two advantages: 1) creating better conditions in terms of asepsis in case of a pulp exposure during the excavation (given the thinness of the PRRS layer ***(Fig. 3a)*** and 2) insuring better conditions for the bonding procedure (being in the aesthetic zone, a composite resin here was preferable).

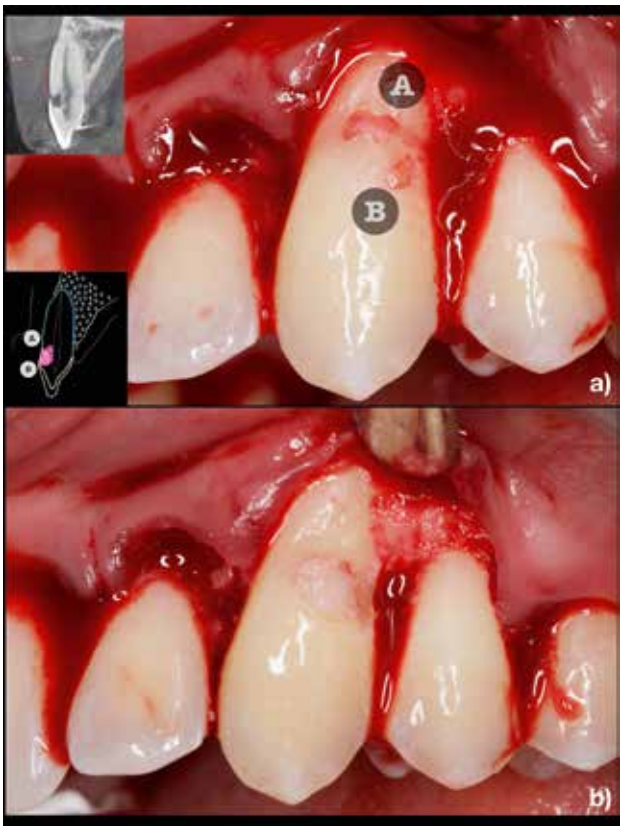

Fig. 2: Surgical access: a) flap rised b) view of the underlying granulation tissue

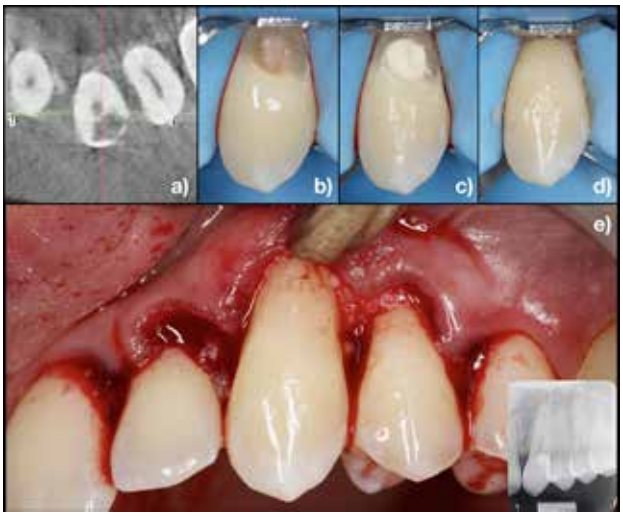

Fig. 3: Vital Pulp Therapy a) 3D extension of the resorption b) direct view of the PRRS c) indirect pulp capping using a liner of Biodentine™ d) Composite filling e) composite filling after polishing.

Granulation tissue (not adhering to the tooth) was removed by hand excavator. The excavation of resorption tissue was carried out under magnification (Zeiss microscope, Pico) using a tungsten carbide round bur under water until a sound dentin was obtained. At the end of the excavation, there was a close pulp proximity but the PRRS had been preserved (avoiding any iatrogenic exposure) ***(Fig. 3b)***.

A cervical enamel bevel was made to improve the aesthetic integration of the future composite and improve the bonding interface.
Given the symptomatology (reversible pulpitis) and close pulp proximity, indirect pulp capping was performed using Biodentine™ ***(Fig. 3c)***.
After complete setting of Biodentine™,a self-etch adhesion protocol (Clearfil SE Bond, Kuraray) was performed with selective enamel etching with phosphoric acid 40%, then an anterior composite (Clearfil Majesty, shade body A3, Kuraray) was applied and light-cured ***(Fig. 3c)***.

The rubber dam was removed and the composite was polished under water ***(Fig. 3d)***.

The flap was then sutured using 5.0 silk thread. Classical post-operative instructions were given to the patient. A check at 1 week was planned to remove the sutures. Controls at 1 month, 3 months, 6 months, and 1 year were planned to ensure monitoring of symptoms and to assess gingival healing ***(Fig. 4)***.

At the 1 year check-up appointment, the patient did not report any aesthetic complaint or any pain. The cold sensitivity test for tooth #23 was still positive and normal, the periodontal health was good and stable with optimal plaque control. The patient being in her first trimester of pregnancy at the 1-year control appointment, the apical radiography was postponed until after delivery.

Fig. 4: Gum evolution a) On the day of the surgery, b) after 1 week, c) 1 month, d) 3 months, e) 6 months, f) 1 year

Discussion

The initiation of the resorptive process was described to be favoured when a cemento-enamel discontinuity was present, opening a gap with direct access to dentin. The exposed dentin then becomes more vulnerable to a resorptive attack mediated by circulating immune cells or cells from surrounding tissues (periodontal ligament, bone, or gingival cells). ***(Mavridou, JOE, 2016)***

Simplifying the resorption mechanism to only a destructive action is overly simplistic. Indeed, different mechanisms come into play concomitantly at different levels on the same resorptive area. There is obviously a clastic activity mediated by odontoclasts,but active repair mechanisms are also taking place (notably secretion of osteoid tissue) as well as a reshaping of this tissue within this same defect. These resorption and repair mechanisms take place concomitantly in a dynamic equilibrium and therefore make ECRs a dynamic process in constant evolution. ***(Mavridou, JOE, 2016)***

As a result, the annual monitoring carried out using retro-alveolar (hence 2D) images appears unsuitable given the three-dimensional evolution of the resorption area. Periapical radiographs have some limitation in detecting resorptions because of geometric distorsion, anatomical noise, and their lack of information concerning the depth of the resorption. ***Patel, IEJ, 2018***. Moreover, in the present case, the different periapical radiographs of annual control did not have the same angulation despite the use of a X-raysensor holder. It means that comparing these images may not be sufficient to ensure a good surveillance of the disease evolution.

On the other hand, symptomatic surveillance in the absence of aesthetic complaints seems rational. Nevertheless, given the ease of surgical access to the defect, a more rapid intervention would probably have been indicated to intercept resorption at an earlier stage, thereby reducing the risk pulp involvement. The intervention at the stage of reversible pulpitis was without a doubt indicated here.

From a gingival point of view, excessive traction from the suture thread associated with incomplete plaque control led to initial scarring in the form of a « double papilla », which improved over time. The buccal position of the root, the fine gingival biotype associated with the cervical location of the composite, led in all likelihood to the recession observed at the one-year control appointment.

Fig. 5: Smile line at 1 year a) general smile b) gingival discovery with a view of the recession

his nevertheless did not bother the patient, who was satisfied with the end result ***(Fig. 5)***.

From the pulpal point of view, given the positive pre-operative sensitivity test, it was deemed essential in this case to try to preserve tooth vitality. According to clinical tests and the history of pain, the pulpal involvement seemed to be reversible. The correlation between clinical tests and the real histological state of the pulp was reported to be fairly high ***(Ricucci, JOE, 2014)***. The pulpal inflammation present in this case was not due to the resorption itself but rather to the spread of pathogen-associated molecular

patterns through the weakened axial dentine layer ***(Reeves)***. The pulp is then likely to return to normal conditions after the removal of the pro-inflammatory stimuli, provided that the cavity is sealed via the placement of a hermetic filling material. The question of the ideal material to choose was therefore raised taking into account various parameters, notably the pulp proximity and the management of the aesthetic aspect. There is currently no significant short-term difference between Biodentine™ and glass cement ionomer regarding the preservation of pulp vitality on a tooth with reversible pulpitis of carious origin ***(Hashem, Clin Oral Investig, 2019)***. Nevertheless, a Biodentine™ liner was applied here for its anti-bacterial properties, but mostly for its biocompatibility given the extremely close proximity. The idea was to induce the release of dentin growth factors, which could promote the secretion of tertiary dentin.
Working under rubber dam allowed to wait during the complete setting time without contamination of the working area. Finally, given the aesthetic component of the lesion, Biodentine™ was preferred to MTA to avoid ulterior dental staining.

A composite was preferred here given the aesthetic needs and the good isolation conditions, allowing optimal bonding placement.

Given the close pulp proximity and the large dentin adhesion required in a cervical defect, a self-etch bonding protocol with selective enamel etching was chosen. This was reported to be more predictable than an total-etch one ***(B. Van Meerbeek, Journal of dentistry 1998)***. Again, the objective here was to reduce any possible additional cause of iatrogenic pulpal inflammation.

Finally, regular follow-up appointments made it possible to ensure the long-term success of the procedure in terms of both symptoms and gingival healing. There is currently no consensus on the ideal intervals between control appointments. However, given the risk of recurrence of the resorptive process (if both resorptive tissue and inflammation remain) it is important to monitor these cases regularly and over the long term. ***(Patel. 2018)***

Conclusion

External cervical resorptions are difficult both to understand and to manage. Indeed, their position makes their detection and differential diagnosis difficult. The affected teeth most often remain vital and asymptomatic, which explains their often fortuitous discovery. Pulp vitality is not involved in the mechanism of propagation of resorption, so, when conditions allow, it is best to keep the tooth vital. Indirect Biodentine™ pulp capping performed during the management of an ECR seems to be an efficient therapeutic solution providing both short and long term pulp survival.

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Dr Stalla completed his license and master of dentistry at the Catholic University of Louvain. After his graduation in 2016, he completed his certificate in endodontics and conservative dentistry during 3 years (full-time) at the department of Professor Julian Leprince at Saint-Luc University Hospital, Brussels. Dr Stalla is now a part-time hospital dentist specialist, and an exclusive endodontist the rest of the time.

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External Cervical resorption: decision making and treatment using Biodentine™ and bioceramic sealers

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Summary

Aim: this case report aims to critically apply the ESE position statement and classification for External Cervical Resorption in clinical practice and describe the use of Biodentine™ and bioceramic sealers for the treatment of advanced ECR.

Materials & Methods: the paper describes the diagnosis, the classification process and treatment of 3 different External Cervical Resorptions on two patients with a 1 year follow up.

Results: the classification process requires accuracy, besides its simplicity allows an immediate clinical application.

Conclusions: the new classification is a powerful tool for clinicians as it relates CBCT images to treatment options although limits are present.

Introduction

External Cervical Resorption has recently gained a lot of interest from clinicians and researchers across Europe.
In 2018 the European Society of Endodontology published its "position statement" offering a general overview of the diagnosis, etiology and treatment of this specific inflammatory root resorption at present. (1)
The increased attention is probably due to the frequency which clinicians face this type of injury. However, it is not clear whether the exposure to risk factors for patients increases or the higher number of CBCT performed on patients leads to a more frequent diagnosis. (5)
It is important to remember that any type of root resorption in permanent dentition involves non-reversible damage and therefore it is not desirable, however among these External Cervical Resorption (ECR) are the most complicated to diagnose in early stages and more complex to treat. (6)
The etiology is not completely understood yet,

An accredited hypothesis suggests that the inflammatory process arises from a damage to the periodontal ligament associated with factors that maintain clastic activity. (1)
ECRs are dynamic lesions that evolve from destructive phases to repair phases with variable times and degrees of invasiveness.
Heathersay et al. in 1999 introduced a 4-stage classification, correlating each stage to the success rate in the treatment.
More recently Patel et al. suggested a new classification based on three-dimensional radiological diagnosis, correlating the different stages to the therapeutic options that can be followed.
The purpose of this case report is to highlight how the use of the ESE guidelines can be introduced into clinical practice by the use of Biodentine™.

Clinical case #1

A 39-year-old female patient with a negative medical history (8), came in for a visit referred by a colleague who during the periodical clinical inspection identified a small reddish buccal lesion on tooth 12. ***(figs. 1 and 2)*** On the same day a periapical X-ray was detected.
Dental history reports a trauma involving second sextant that occurred about 15 years earlier. (5, 12).

The clinical examination confirms a small lesion of the buccal enamel of 12, the pulp sensitivity tests were physiological and no mobility associated.
The periapical radiographic examination ***(fig. 3)*** shows an extensive radicular radiolucency that does not involve the root canal. (5) At cervical level, the co-presence of the 2 main phases of the RCI is noted: distally the clastic phase, while mesially the replacement phase.

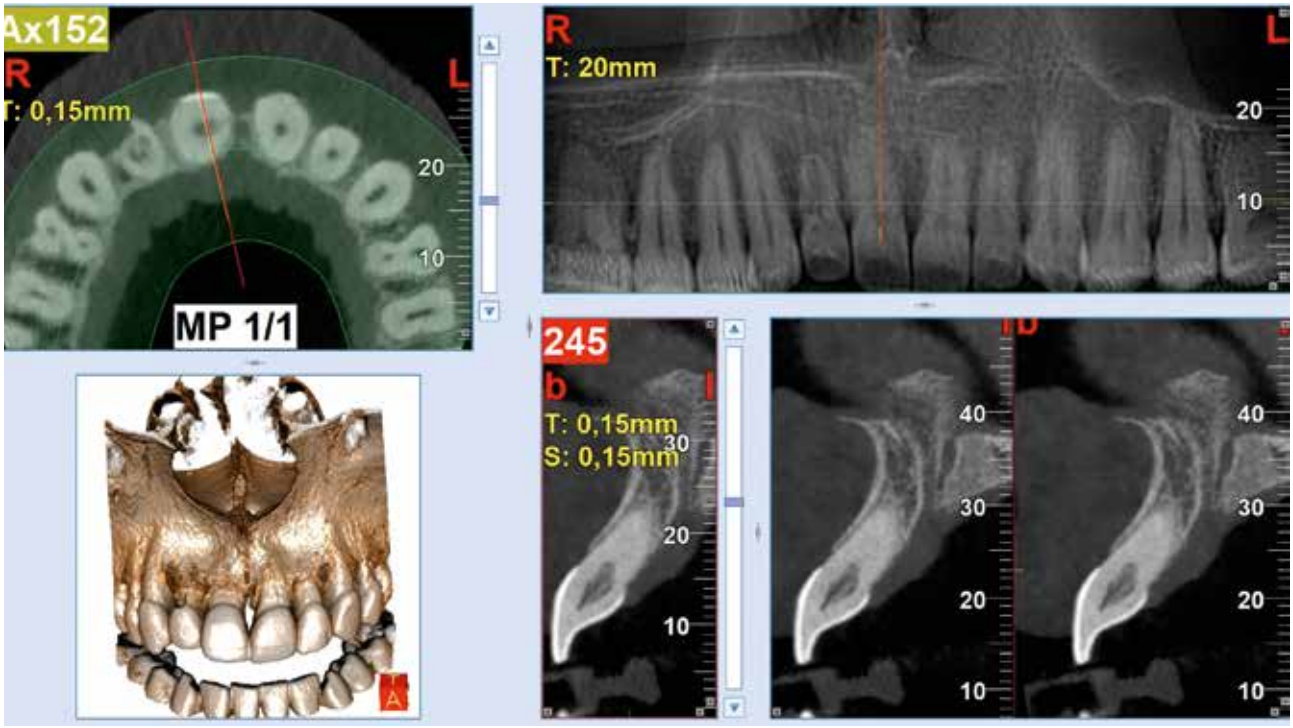
The diagnosis for element 12 is Grade 4 iexternal cervical resorption according to Heithersay. (5)
The clinical and radiographic examination is extended to the whole second sextant: element 11 is also affected by an ECR with clinical characteristics similar to the previous one, however classified as Hiethersay grade 3. (5)
Three-dimensional analysis of the lesion is a key factor in planning the therapeutic approach and establishing an initial prognosis of the element, as well as allowing identification of early stage lesions (1, 3, 5, 6), as it is the extension of the area involved in the reabsorption and its position to influence the success of the treatment.

Fig. 1

Fig. 2

Fig. 3

Hight	Circumferential Involvement	Proximity to root canal
Gr1at CEJ level (supracrestal)	A: <= 90°	d: limited to dentin
Gr2 extending to coronal third of the root (subcrestal)	B: between 90° e 180°	p: probable endodontic involvement
Gr3 extending to middle third of the root	C: between tra 180° e 270°	
Gr4 extending to apical third of the root	D: >270°	



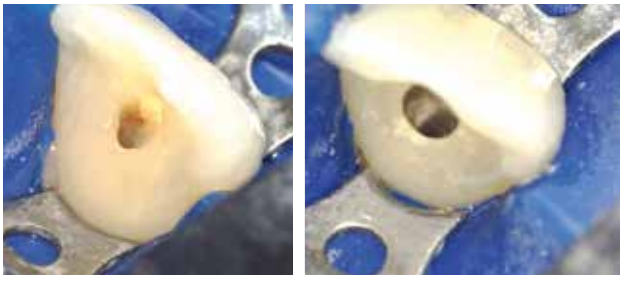
A high resolution CBCT with 5x3 FOV of the second sextant is then prescribed.

Patel and colleagues based on the analysis of three-dimensional radiographic images proposed a scheme to represent the extent of the lesions in three dimensions (tab. 1) (1).

The same authors propose to associate different therapeutic options to each type of classified lesion as follows:

1. Surgical access and repair of the lesion associated with/without endodontic treatment.
   The excavation of the defect after surgical access and direct restoration is indicated on small coronal lesions or for classes 1Ad, 2Ad, 2Bd.
   The same treatment, but associated with endodontic treatment is indicated for the same previous classes, but with subgroup "p" (proximity to the endodontic space) or 1Ap, 2Ap, 2Bp.
2. Internal repair associated with endodontic treatment.
   Endodontic treatment associated with careful cleaning of the inflammatory tissue through endodontic access is indicated for corona land medium lesions with extension plus 2Cp, 2Dp, 3Cp, 3Dp.
3. Intentional Replantaiton
   The extraction of the previously endodontically treated tooth, cleaning of the lesion associated with root plastic or restoration of the defect is indicated for deep but limited lesions such as extension 3Ad, 3Bd.
4. Periodic Follow up
   It is indicated for inaccessible or very large lesions 2-4Dd, 2-4Dp.
5. Extraction
   Finds its indication if the tooth cannot be restored with functional and aesthetic success.

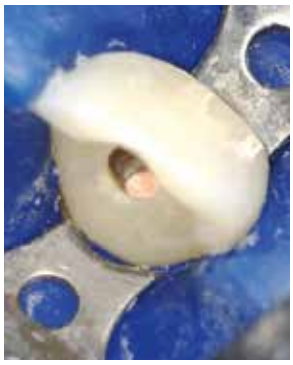
In the described case, therefore, tooth 12 is classified 4Dp. In detail: the apical third (Gr4) is affected by resorption, the extension is circumferential (D) and the root canal appears in close proximity to the lesion (p).

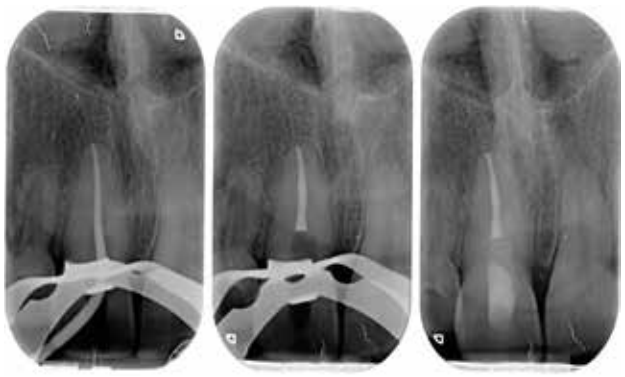


The tooth does not require restoration to maintain relational function and aesthetics. An annual radiographic and clinical follow-up was therefore

proposed without further treatment, informing the patient of the poor prognosis of the element. Tooth 11, on the other hand, is involved within the coronal third even if sub-crestal (Gr2) with an extension of 90 ° (A) and an important proximity to the root canal, therefore it has been classified 2Ap.

The approach suggested by Patel et al. for 2Ap cases is the excavation and repair of the inflammatory tissue with a surgical approach following the endodontic treatment of the tooth.
In our opinion, it is also important to consider the outcome of the surgical approach which can be different according to the accessibility





of the defect. If the lesion is buccal or palatine (possible gingival recession) rather than interproximal (predicted hard and soft tissue loss involving adjacent teeth). And further the position of the tooth in the arch where, as in our case, the aesthetic result becomes a factor of primary importance.
Then, an internal repair approach associated with endodontic treatment was chosen for element 11 (2Ap).

The treatment plan provided the isolation of the operating field, the creation of endodontic access and the complete removal of the inflammatory tissue with micro excavators and ultrasound tips. After completing the debridement of the infiltrated dentine, the endodontic system was cleaned, shaped and filled to the apical limit of the resorption. The remaining defect was then repaired with Biodentine™ (Septodont, France) in the same session. Given the hardening of the biomaterial (9, 10), the access cavity was sealed with bonded composite material.

The clinical and radiographic follow up at two years is reported.
Tooth12 is asymptomatic, physiological periodontal probing, physiological mobility and positive for pulp sensitivity tests.
Tooth 11 is asymptomatic, physiological periodontal probing, physiological mobility and absence of discoloration.
The radiographic examination shows no evolution of the RCI at 12 and the presence of hard lamina on the whole root contour of 11.

Clinical case #2

A 30 years old male, was referred to our office due to a sinus track present buccally between tooth 22 and 23. During the anamnestic interview no recent dental treatment or systemic disease were reported. Relating to dental history, although, the patient signals a previous orthodontic treatment and orthognathic surgery performed 6 years earlier. No symptoms were complained.

A clinical examination was performed: physiological periodontal probing was found in all quadrants, buccal palpation was negative, pulpal sensitivity tests (EPT and cold) were physiological, 23 was tender to percussion.

The periapical X-ray with fistulography reveals a radiolucency along the root of 23 extending from the coronal to the middle third of the root canal, on the other hand sinus track drained from the interproximal bone peak between 22 and 23 giving no further information.
The history of orthodontic treatment and tooth position suggested a ECR.
A CBCT was taken in order to confirm diagnosis and classify the lesion accordingly.
A Gr3-B-p External Cervical Resorption was identified.

Unclear origin of the sinus track was adduct to a superinfection of the inflammation tissue as described by previous case reports.
Due to patient's highly esthetic concerns, intentional replantation was declined. The patient approved an orthograde and surgical approach.
The final treatment plan included the endodontic

treatment of 23 as the lesion involved the root canal space, followed by the elevation of a full thickness flap allowing the surgical debridement and repair of the resorption.
During the endodontic treatment several ports of entrance of the resorption tissue were identified coronally, while no debridement could be performed to the lesion in the middle third.
A bioceramic sealer with a cold single cone technique was used to seal the endodontic space as a completely dry the root canal could not be achieved. A bonded composite was immediately applied to seal the access cavity.
After seven days surgery was performed.
The flap elevation revealed an enamel pearl, probable portal of entry of bacteria causing the sinus track.

After removing the enamel pearl a complete debridement of the resorption tissue was performed and the cavity was repaired with Biodentine™. While waiting the material to set, rubber dam was mounted and a class V composite restoration was performed in order to allow a connective tissue graft to be placed attached to the flap.
A six weeks follow up exhibits a proper healing of the surgical wound and the closure of the sinus track.
At one year the follow up X-ray shows a normal PDL surrounding the root of tooth 23 and no further expansion of radiolucency associated with the resorption.

Discussion

The use Patel's classification requires accuracy in the procedure, however the conceptual simplicity makes it usable in daily clinical practice.
Unlike the previous classifications that correlated the extent of resorption to the prognosis of the element, the new classification used by the European Society of Endodontology relates radiographic images and practicable therapeutic options, a choice of great utility, allowing the clinician to immediately discuss with the patient.
The pre-visualization of the position and extent of the root defect through CBCT offers the clinician an important help, both for therapeutic planning and for a precise informed consent by the patient.

One limit to this classification may be the lack to consider the position of the dental element in the arch and the position of the defect relative to the root surface. Both of these aspects may influence the surgical approach to the root defect and its outcome.

Conclusions

The classification proposed in the ESE "position statement" offers to clinicians a clear and applicable tool in clinical practice.
However, the therapeutic choice should also consider: operator's skill and experience, the patient's expectations and possible complications.

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Graduated from the University of Verona. He attended numerous Post Graduate courses specialized in Endodontics: Advanced Endodontics Santa Barbara California, Dr. Cliff J. Ruddle (USA), Fellowship at the University of Boston, Goldman Dental School Dr. Mani Mulahzade (USA), and in Clinical Periodontology, under the coordination of Dr. Luca Landi, Fixed Prosthetics, under the guidance of Dr. Dario Castellani. In 2013 earned his Master's Degree in Clinical and Surgical Microendodontics from the University of Turin, under the guidance of Dr. Elio Berutti. He is conducting his clinical activity focusing on endodontics and periodontology. He gave many national and international lectures. He is an active member of the AIE member (Academia Italiana di Endodonzia) being part of the board of directors for 2019-2020 and certified ESE member (European Society of Endodontology). He published articles in specialized magazines and he is also the co-author of some important books in the field. Since 2015 he actively teaching as a Clinical Instructor at the Master in Clinical and Surgical Microendodontics from the University of Turin directed by prof. Elio Berutti e prof. Damiano Pasqualini. Since 2017 he is a part time Teacher at University of Verona lecturing on Restorative Dentistry.

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