



Original article

González Aranda, Cristina
 Licensed in Dentistry. Professor Emeritus. Department of Prophylaxis, Pediatric Dentistry and Orthodontics. School of Dentistry. Universidad Complutense de Madrid (UCM).

Diéguez Pérez, Montserrat
 Doctor of Dentistry. Associate Professor. Department of Prophylaxis, Pediatric Dentistry and Orthodontics. School of Dentistry. Universidad Complutense de Madrid. Adjunct Professor. Department of Prosthetics and Pediatric Dentistry. School of Dentistry, Universidad Europea de Madrid (UE).

Saavedra Marbán, Gloria
 Doctor of Dentistry. Associate Professor. Department of Prophylaxis, Pediatric Dentistry and Orthodontics. School of Dentistry. Universidad Complutense de Madrid (UCM).

Mourelle Martínez, María Rosa
 Doctor in Medicine and Surgery. Doctor of Dentistry. Contracted Professor. Department of Prophylaxis, Pediatric Dentistry and Orthodontics. School of Dentistry. Universidad Complutense de Madrid (UCM).

Indexed in:
 - IME
 - IBECs
 - LATINDEX
 - GOOGLE SCHOLAR

Correspondence address:

Cristina González Aranda
 Universidad Complutense de Madrid. School of Dentistry. Departamento de Estomatología IV Plaza de Ramón y Cajal, s/n. Ciudad Universitaria. 28040 Madrid.
 Tel.: 913941984
 cgaranda@ucm.es

Date received: 17 January 2017.
 Date accepted for publication: 2 March 2017.



A study on the prevalence of radiographic manifestations caused by pulp failure in deciduous dentition

Published in Spanish *Científica Dental* Vol. 14. Nº 1. 2017
www.cientificadental.es

ABSTRACT

The purpose of this research was to study the pathological signs observed in temporary molars that had undergone pulpotomy.

Materials and methods. 79 intraoral radiographs of molars that had undergone pulpotomy were evaluated. Internal and external resorption patterns and the presence of radiolucent lesions in the furcation were studied.

Results. Pathological internal radicular reabsorption was observed in 43% of temporary molars and pathological external radicular resorption was observed in 34.2% of the sample. The radiolucent lesions of the radicular furcation were present in 39.1% of temporary molars.

Conclusions. The most common radiographic manifestation was pathological internal root resorption. However, this radiographic failure may be considered only a secondary effect if it is not accompanied by clinical manifestations and does not compromise tooth function before physiological exfoliation.

KEYWORDS

Pulpotomy; Temporary molars; Radiographic manifestations.

INTRODUCTION

Pulpotomy in temporary dentition is a treatment that is commonly performed in cases of extensive cavities with healthy pulp or reversible affectation. Intraoral radiographs provide key information on the extent of cavities, the proximity of restorations to the pulp horns, the presence of any type of peri-radicular pathology, the level of physiological or pathological reabsorption and the presence or absence of the successor tooth.¹

During pulpotomy, the coronal pulp is resected and different materials are placed in the entrance to the radicular canals, which gives the name to the pulpotomy (formocresol pulpotomy, glutaraldehyde pulpotomy, calcium hydroxide pulpotomy...)²

Pulpotomy treatment is considered successful when there is vitality in the major portion of the radicular pulp until its physiological change.^{2,3}

Failure of a pulpotomy in temporary teeth rarely causes pain, so it is important to perform adequate clinical and radiological follow-up.^{2,5}

A pulpotomy is considered a failure when any of the following are observed in the treatment revision and follow-up phase:

- Pathological symptoms; pain, swelling or sensitivity.
- Radiological signs of internal and/or external resorption.
- Pathology in the peri-radicular tissues.
- Lesions in the permanent teeth.²

Resorption is the disappearance of structures through a biological mechanism of cellular phagocytosis, similar to osteoclasia. Cells developed with phagocytic function arise from primary cells from connective, bone and cement or pulp tissue that, accompanied by other macrophages, eliminate one or various hard tissues. In tooth reabsorption, this process affects the dentin or cement (not the enamel) sometimes being physiological, as in the tooth eruption process.⁶

Histologically, internal dentin resorption is done by odontoclasts with invasion of the pulp in the resorbed area. It may occur in the chamber or in the radicular canals and extends centrifugally, being able to reach the radicular cement. In order for odontoclast action to take place, there must be vital pulp tissue, which is generally inflamed. This is the most common cause for pulpotomy treatment.⁶ Internal radicular resorption has been described as the most common radiographic sign in molars that have undergone pulpotomy and it has been attributed to inflammation of the residual pulp since it is generally observed in the area where the drug is applied.^{2,3,7} Some studies have attributed it to the use of calcium hydroxide compounds but it can also occur with other techniques, though the radiographic appearance may be different. Histological studies have revealed that this occurs independently of the medication used.⁸

Internal resorption is diagnosed by radiographic examination which reveals a radiolucent image with irregular enlargement of the wall of the canal. Symptoms are generally absent and vitality tests are usually normal. If the resorption results in a communication with the periodontium, pulp necrosis prevails. When the entirety of the pulp tissue dies, resorption stops.⁶ Sometimes there is also external radicular resorption and in temporary molars, a radiotransparent zone appears in the area of the bifurcation or trifurcation (Figure 1), while in anterior teeth this transparency may be present in the apices or to the side of the roots. The differential diagnosis between internal and external resorption is difficult when total perforation of the tooth wall has occurred. The greater the destruction, the greater the mobility of the tooth; additionally, a fistula usually appears.⁶

Although the presence of radicular resorption processes is considered a radiological failure, it may not necessarily mean a clinical failure.⁷

The appearance of radiolucent lesions at the radicular bifurcation or trifurcation (Figure 2) may indicate treatment failure. In addition, the appearance of peri-radicular cystic lesions has been described.^{6,8}

The purpose of our study was to evaluate the pathological radiographic manifestations of temporary molars that had undergone pulpotomy.

MATERIALS AND METHODS

The study universe consisted of 664 patients seen at the School of Pediatric Dentistry at Universidad Complutense de Madrid. A selection of 209 medical records was made along with a convenient sample of radiographs. The criteria applied to carry out the study were:

Inclusion criteria:

1. Healthy child patients with bitewing or periapical radiographs of the 1st and 2nd temporary molars treated with the formocresol or ferrous sulphate pulpotomy technique.
2. Diagnostic intraoral radiographs prior to pulp treatment with no signs of pulp-periodontal pathology.
3. Follow-up post-treatment intraoral radiographs at least one month after pulp treatment.

Exclusion criteria:

1. Intraoral radiograph records of insufficient quality.
2. No documentation of the drug used in the pulpotomy.
3. Patients with allergies, severe systemic pathology or on pharmacological treatment.
4. Absence of informed consent.

After applying the above criteria, the principal investigator selected 79 radiographs that were digitalized using an Epson ScanJet 7400® digital scanner with VueScan 9X32® in transparency mode at 600 dpi. All of the images were coded to hide the patient-related data and the pulpotomy technique used. Two qualified investigators analyzed the radiographic records independently using the same portable computer, an Acer Travel Mate 290®, and completed the "Pulpotomy Evaluation" table according to the following criteria:

1. - Internal radicular resorption: radiolucent image with irregular enlargement of the wall of the canal.
2. - Pathological external radicular resorption: radiolucent image with irregular resorption of the radicular wall.

3. - Radiolucent lesion of the radicular furcation: radiolucent image in the radicular bifurcation or trifurcation and/or broadening of the periodontal ligament at this level.

RESULTS

Of the temporary molars submitted for the study, 40 were first molars and 39 were second molars. According to their location on the dental arch, 19 were superior and 60 were inferior (Figure 3). Regarding the medication used, 41 were treated with formocresol and 38 with ferrous sulphate.

Forty-three percent of the temporary teeth in the study (N=34) had pathological internal radicular resorption. In 34.2% of these (N=27) pathological radicular resorption was observed and in 39.2% (N=31), a radiolucent lesion at the furcation was detected.



Figure 1. Inferior molar with pulpotomy. Area of internal and external radicular reabsorption.

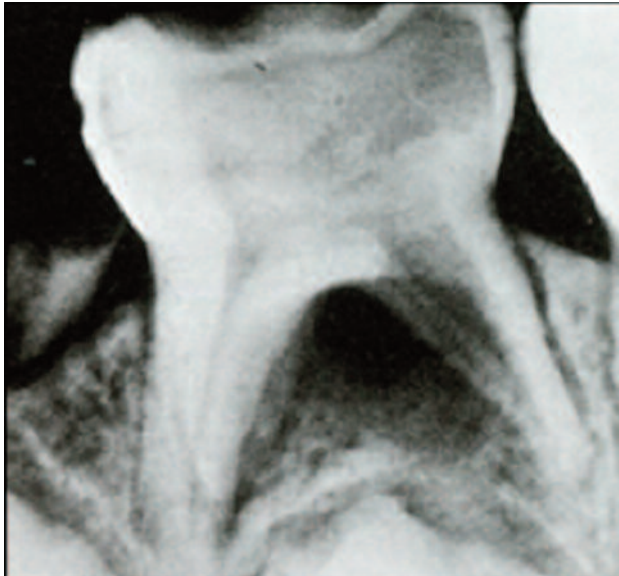


Figure 2. Radiographic image of a temporary inferior molar with an interradicular lesion⁸

Of the sample, 7 were first right superior temporary molars; 42.9% of these had pathological internal radicular resorption, 57.1% had pathological external radicular resorption and 57.1% had an interradicular radiolucent lesion.

Study of the radiographic findings in the 5 second right superior second molars revealed that 40% had pathological internal and external radicular resorption and 20% had a pathological interradicular radiolucent lesion.

When analyzing the radiographs of the 4 left superior temporary molars, 50% of the sample had pathological internal radicular resorption and 75% had an interradicular radiolucent lesion.

Regarding the 3 left superior temporary molars, 33.3% had pathological internal and external resorption as well as a pathological inter- or peri-radicular radiolucent image.

A study of the 17 left inferior temporary molars revealed that 47.1% of these had pathological internal radicular resorption. In addition, 29.4% had external radicular resorption as well as a pathological image in the furcation in 41.2%.

A study of the 15 left inferior temporary second molars revealed pathological internal radicular resorption in 53.3%, pathological external resorption in 26.7% and a pathological interradicular image in 40%.

Of the 12 right inferior temporary first molars evaluated, 66.7% had pathological internal radicular resorption, 41.7% had pathological external radicular resorption and a pathological interradicular radiolucent image was present in 58.3%.

Finally, analysis of the 16 right inferior temporary second molars revealed pathology in 12.5% according to the criteria for pathological internal and external radicular resorption and a pathological radiolucent lesion at the level of the interradicular furcation (Figure 4).

DISCUSSION

Pulpotomy allows for preservation of vital temporary teeth affected by deep cavities that would otherwise have to be extracted.^{9,10} The most common radiographic finding observed in our study was internal radicular resorption, in coincidence with other studies.^{5,11-13}

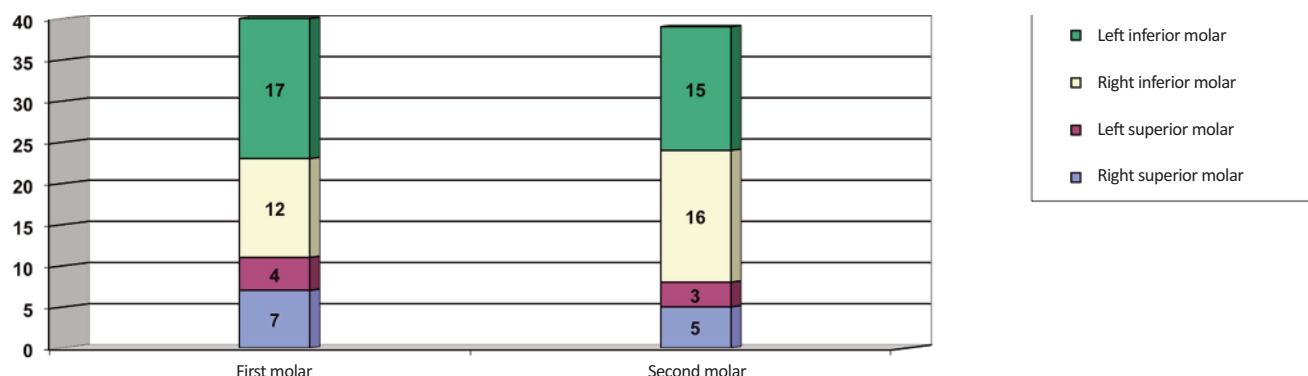


Figure 3. Distribution of the study sample.

In order to affirm that pulpotomy treatment has been adequate, the clinical and radiographic signs are considered separately. Therefore, the presence long-term vitality in the majority of the radicular pulp and the absence of painful symptoms (pain, swelling, fistula,...) are favorable. However, the presence of radiographic signs of resorption or periapical radiolucent images indicate that a pulpotomy that was clinically considered a success contains chronic inflammation in the radicular pulp.^{6,8}

Some investigators do not consider the presence of internal reabsorption to be a sign of radiographic failure but rather a secondary effect that in some cases does not compromise tooth function until physiological exfoliation.^{5,11-13} Nevertheless, in the research by Kurji *et al.*, 41% of cases with internal resorption resulted in bone involvement and/or clinical signs and symptoms which ultimately led to extraction.¹⁴

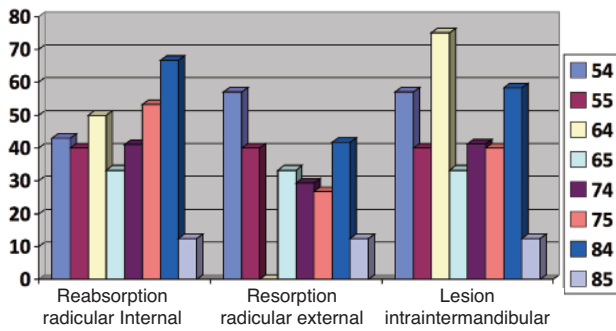


Figure 4. Percentage of pathological radiographic signs in temporary molars in those who had undergone pulpotomy.

Early exfoliation of temporary teeth that have received this treatment is attributed to the chronic inflammatory process of periodontal tissues generated by filtration of the drug or the zinc-eugenol oxide cement from the pulp chamber.^{15,16} However, ferrous sulphate may not be the cement of choice in pulpotomies since the eugenol may

irritate pulp tissue.⁹ Ferrous sulphate, unlike formocresol, does not cause pulp mummification when it is applied in the chamber. For this reason, zinc-eugenol oxide cement in ferrous sulphate pulpotomies may be associated with the presence of pathological radicular resorption. However, the specific role of direct application of this cement to the pulp tissue has not been analyzed in this study and more research on the subject is needed.

Radiographic evaluation of resorption patterns was more complicated for the roots of superior molars versus inferior molars. We agree with Kurji *et al.* and Maroto *et al.* that this difficulty is due to the superposition of the maxillary sinuses and the radicular anatomy itself.^{2,14} In fact, some investigators only use mandibular molars in the evaluation of pulp stenosis and/or internal radicular resorption phenomena given that these radiographic changes are much more evident than in maxillary molars.^{2,14,17,18}

CONCLUSIONS

The most common radiographic manifestation was pathological internal radicular reabsorption. However, this radiographic failure may be considered only a secondary effect if it is not accompanied by clinical manifestations and does not compromise tooth function before physiological exfoliation.

ACKNOWLEDGMENTS

Our most sincere thanks to Professor Elena Barberia Leache, professor at the Department of Stomatology IV of Universidad Complutense de Madrid, for her help and the provision of the records used in this study.



BIBLIOGRAPHY

1. Rodd HD, Waterhouse PJ, Fucks AB, Fayle SA, Moffatuk MA. Pulp therapy for primary molars. National Clinical Guidelines in Paediatric Dentistry. *Int J Paediatr Dent* 2006; 16 (Suppl. 1): 15-23.
2. Maroto M. Estudio clínico del agregado trióxido mineral en pulpotomías de molares temporales. [Tesis Doctoral]. Madrid: universidad Complutense de Madrid, servicio de publicaciones, 2003.
3. Cardoso C. Estudio clínico del agregado trióxido mineral en pulpotomías de molares temporales: comparación de resultados con MTA gris y MTA blanco. [Tesis Doctoral]. Madrid: universidad Complutense de Madrid, servicio de publicaciones, 2010.
4. Camp JH, Barrett EJ, Pulver F. Endodoncia pediátrica: tratamiento endodóncico en la dentición temporal y permanente joven. En: Cohen S, Burns RC, editores. *Vías de la pulpa*. 9ªed. Madrid: Mosby Elsevier; 2008.
5. Smith NL, Seale NS, Nunn ME. Ferric sulphate pulpotomy in primary molars: a retrospective study. *Pediatr Dent* 2000; 22(3): 192-9.
6. Azabal M. Patología pulpar y periapical. En: *Patología y terapéutica dental*. Editor: García-Barbero J. Madrid: Editorial Síntesis. 1997.
7. Vargas KG, Packham B. Radiographic success of ferric sulfate and formocresol pulpotomies in relation to early exfoliation. *Pe-diatr Dent* 2005; 27: 233-7.
8. Magnusson BO, Koch G, Poulsen S. *Odontopediatría*. Enfoque sistemático. Barcelona. Salvat Editores SA, 1985.
9. Smaíl-Faugeron V, Courson F, Durieux P, Muller-Bolla M, Glenny AM, Fron Chabouis H. Pulp treatment for extensive decay in primary teeth. *Cochrane Database Syst Rev* 2014 6(8):CD003220.
10. Ranly DM, García-Godoy F. Current and potential pulp therapies for primary and young permanent teeth. *J Dent* 2000; 28:153-61.
11. Hingston EJ, Parmar S, Hunter ML. Vital pulpotomy in the primary dentition: attitudes and practices of community dental staff in Wales. *Int J Paediatr Dent* 2007; 17(3):186-91.
12. Aeinehchi M, Dadvand S, Fayazi S, Bayat Movahed S. Randomized controlled trial of mineral trioxide aggregate and formocresol for pulpotomy in primary molar teeth. *Int Endod J* 2007; 40: 261-7.
13. Peng L, Ye L, Guo X, Tan H, Zhou X, Wang C, Li R. Evaluation of formocresol versus ferric sulphate primary molar pulpotomy: a systematic review and meta-analysis. *Int Endod J* 2007; 40: 751-7.
14. Kurji ZA, Sigal MJ, Andrews P, Tittley K. A Retrospective Study of a Modified 1-minute formocresol pulpotomy technique. Part 1: Clinical and radiographic findings. *Pediatr Dent* 2011; 33: 131-8.
15. vAguado JM, De la Cruz I, Maroto M, Barbería E. Posibilidades terapéuticas del agregado trióxido mineral (MTA) en Odontopediatría. *J Am Dent Assoc* 2009 (Edición Española); 4(4): 185-93.
16. Peng L, Ye L, Tan H, Zhou X. Evaluation of the formocresol versus mineral trioxide aggregate primary molar pulpotomy: a meta analysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006; 102(6): e40-e44.
17. Ansari G, Ranjpour M. Mineral trioxide aggregate and formocresol pulpotomy of primary teeth: a 2-year follow-up. *Int Endod J* 2010; 43: 413-8.
18. Srinivasan V, Patchett CL, Waterhouse PJ. Is there life after Buckley's formocresol? Part I - A narrative review of alternative interventions and materials. *Int J Paediatr Dent* 2006; 16: 117-27.