Author/s:
Gatón-Hernandéz, P;Serrano, CR;da Silva, LAB;de Castañeda, ER;da Silva, RAB;Pucinelli, CM;Manton, D;Ustrell-Torrent, JM;Nelson-Filho, P

Title:
Minimally interventive restorative care of teeth with molar incisor hypomineralization and open apex—A 24-month longitudinal study

Date:
2020-01-01

Citation:
Gatón-Hernandéz, P., Serrano, C. R., da Silva, L. A. B., de Castañeda, E. R., da Silva, R. A. B., Pucinelli, C. M., Manton, D., Ustrell-Torrent, J. M. & Nelson-Filho, P. (2020). Minimally interventive restorative care of teeth with molar incisor hypomineralization and open apex—A 24-month longitudinal study. International Journal of Paediatric Dentistry, 30 (1), pp.4-10. https://doi.org/10.1111/ipd.12581.

Minimally interventive restorative care of teeth with Molar-Incisor Hypomineralization and open apex - a 24-month longitudinal study

Patrícia Gatón-Hernandéz[a], César Ruiz Serrano[b], Lea Assed Bezerra da Silva[c], Esther Ruiz de Castañeda[d], Raquel Assed Bezerra da Silva[e], Carolina Maschietto Pucinelli[f], David Manton[g], Josep María Ustrell-Torrent[h], Paulo Nelson-Filho[i]

[a] patricia@pgaton.com - School of Dentistry, University of Barcelona, Barcelona, Spain.

[b] ruizserranocesar@hotmail.com - Instituto Catalão da Saúde, Barcelona, Spain.

[c] lea@forp.usp.br - University of São Paulo, School of Dentistry of Ribeirão Preto, Ribeirão Preto, SP, Brazil.

[d] esther@egardent.com - Mínima Intervenção e Traumatismo Dental (MITD), Barcelona, Spain.

[e] raquel@forp.usp.br - University of São Paulo, School of Dentistry of Ribeirão Preto, Ribeirão Preto, SP, Brazil.

[f] carolinamaschietto@yahoo.com.br - University of São Paulo, School of Dentistry of Ribeirão Preto, Ribeirão Preto, SP, Brazil.

[g] djmanton@unimelb.edu.au – Growth and Development, Melbourne Dental School, University of Melbourne, Australia.

[h] jmustrell@ub.edu - School of Dentistry, University of Barcelona, Barcelona, Spain.

[i] nelson@forp.usp.br - University of São Paulo, School of Dentistry of Ribeirão Preto, Ribeirão Preto, SP, Brazil.

Word count: 2354

Acknowledges: The work was supported by the Department of Pediatric Dentistry - School of Dentistry of Ribeirão Preto - University of São Paulo in Ribeirão Preto, Brazil.

Author contributions

PGH, RABS, and PNF conceived the ideas; PGH, CRS, ERC, and JMUT collected the data; CRS, LABS, ERC, CMP, DM and JMUT analyzed the data; LABS, RABS, CMP, DM and PNF contributed to the writing.

Corresponding Author:

Carolina Maschietto Pucinelli

University of São Paulo, School of Dentistry of Ribeirão Preto

Av. do Café s/n – Monte Alegre
Ribeirão Preto – SP – Brazil
CEP: 14040-904
e-mail: carolinamaschietto@yahoo.com.br

MISS CAROLINA MASCHIETTO PUCINELLI (Orcid ID : 0000-0003-4876-6892)
DR. PAULO NELSON-FILHO (Orcid ID : 0000-0002-4007-7833)

Article type : Original Article

Minimally interventive restorative care of teeth with Molar-Incisor Hypomineralization and open apex - a 24-month longitudinal study

Summary

Aim: To assess the efficacy of treatment using a minimally invasive approach (selective removal of carious tissue, restoration and preventive strategies) in immature permanent molars with MIH.

Design: 281 patients, aged 6-8 years, with carious lesions (ICDAS 5-6), severe MIH, and incomplete root formation (one tooth/patient) were included. After clinical and radiographic examinations, selective carious tissue removal was performed, and the teeth received interim restoration for six months and were then restored with composite resin. Clinical and radiographic follow-up was undertaken, 6, 12, 18 and 24 months. A protocol of preventive oral care measures was established and repeated at each follow-up, including diet counseling, oral hygiene instruction, dental plaque control and topical application of fluoride varnish containing CPP-ACP. All clinical procedures and evaluations were done by a single operator.

Results: Clinical and radiographic success was observed 24 months after treatment in 96.8% of the cases. Failures were due to enamel fracture at restoration margins, resulting in pulpitis and absence of apex closure.

Conclusion: Selective removal of carious tissue, interim and subsequently definitive restoration, combined with home and professional preventive measures, maintained marginal integrity of restorations in immature permanent molars with severe MIH, confirmed by pulp vitality and occurrence of apexogenesis.

Key Words: molar incisor hypomineralization; MIH; selective removal of carious tissue; apexogenesis; open apex

Introduction

Molar-incisor hypomineralization (MIH) is described as a clinical enamel hypomineralization, with demarcated, qualitative development defects related with systemic factors, affecting 1-4 permanent first molars and, frequently associated with affected incisors [1].

Although its etiology is unknown, MIH unlikely to be caused by a single etiological factor, more likely is a combination of systemic and external factors [2, 4]. Factors may include maternal medical conditions during pregnancy, genetic susceptibility, and childhood illness, including pyrexia [3, 4]. Additionally, MIH may be linked to a contemporary lifestyle or environmental reasons [5]. Also, a positive relationship exists between MIH and dental caries experience, especially as the severity of MIH increases [6, 7].

MIH severity can be classified as mild (basically no enamel breakdown) or severe (enamel breakdown and caries) in order to help treatment planning for best prognosis [8]. Drive cases of patients with MIH is challenging to both patient and clinician, especially in severe cases, as the clinical manifestation and need for wide range of intervention and there is no consensus for the ideal treatment for these teeth. A recent literature review concluded that the most adequate restorative procedures for managing severe MIH are direct resin composite restorations, indirect restorations or treatment with metal crowns. Still according this same systematic review, the materials used to MIH treatment with the highest annual failure rates were fissure sealants (12±6%) and glass ionomer restorations (12±2%), while the lowest values were for treatments with indirect restorations (1±3%), metal crowns (1.3±2.1%) and composite restorations (4±3%). However, strong recommendations cannot yet be made based on the limited current evidence-base [9].

At the same time, before the restorative phase, in order to reduce the risk of pulp exposure during carious tissue removal, it's important adopt a minimally invasive approach. Particularly in permanent molar teeth with deep carious lesions and incomplete root formation, when pulp exposure occour during tissue removal could compromise the pulp health and initiate the need for complex endodontic treatment that includes apexification procedures; or lead to extraction [10].

The purpose of the present longitudinal study was to evaluate, both clinically and radiographically, the efficacy of treatment using a minimally invasive approach (selective removal of carious tissue, restorative treatment and preventive strategies) in immature permanent molars with MIH.

Materials and Methods

Initially, the study was submitted and approved by the Ethics Committee of the Catalan Health Institute (P12/109). The children's legal guardians signed the written informed consent form. Participated in this study 326 patients of both sexes (172 boys and 154 girls) aged 6 to 8 years, having teeth with MIH. All clinical and radiographic procedures and evaluations were performed by one experienced trained and calibrated operator (Kappa>0.8) (P.G.H. – first author).

One tooth per patient was selected, being a maxillary or mandibular first permanent first molar with open apex (Nolla stage until 9) presenting severe MIH [8] and associated carious lesions with occlusal surface impairment, with or without proximal surfaces involvement (185 teeth ICDAS scored 5 and 141 teeth ICDAS scored 6). During clinical and radiographic examination, the included teeth presented positive pulp sensibility, using a thermal refrigerant spray (Hygenic® Endo-Ice®; Coltene, Cuyahoga Falls, OH, USA); negative history of spontaneous or prolonged pain; negative response to percussion test; and clinical and radiographic absence of abscess or apical periodontitis. Initial periapical radiographic images were obtained using a digital radiograph system (Planmeca ProX with the Planmeca ProSensor digital sensor system; Helsinki, Finland).

After anesthesia and teeth isolation with rubber dam, enamel preparation was performed using a round diamond bur in a high-speed handpiece (8830RL Komet Dental; KaVo Dental, Lemgo, Germany). Removal of carious dentinal tissue on cavity walls was performed using a tungsten carbide rotatory bur (H1SE Komet Dental, Lemgo, Germany). Next was performed the selective removal of carious tissue, the soft and leathery dentin remaining on the pulpal floor was removed gently and with no pressure with an excavator (#70/71; American Eagle Instruments; Missoula, MT, USA), according to the hardness-tactile criteria (hardness

to probe) [11]. Following, in order to reduce the amount of residual cariogenic bacteria in the dentinal tubules of coronal dentin, was performed the cleansing of the cavity with a cotton soaked with sodium hypochlorite (CanalPro 3%; Coltene, Altstätten, Switzerland) [12]. After rinsing with triplex water, the remaining moisture was removed with a sterile cotton tip onto the cavity walls.

The cavity was then restored with glass-ionomer cement (EQUIA, GC Corporation, Tokyo, Japan) and another digital periapical radiograph was taken. After six months, the interim restoration was removed leaving a thin residual glass-ionomer layer. The tooth was then restored with resin composite (Scothbond Multipurpose adhesive and Filtek^{TM} Supreme XTE; 3M/ESPE, St. Paul, MN, USA), extending the restorative material to an area of sound enamel along the cavosurface angle.

After the periods of 6, 12, 18 and 24 months after initial treatment, the teeth were clinical and radiographic examineted, according to the following criteria: presence/absence of sensitivity to percussion, pulp sensibility, using a thermal refrigerant spray (Hygenic® Endo-Ice®); peripheral enamel and restoration marginal integrity; presence or absence of radiographic features (resorptions, thickening of the lamina dura, and apical radiolucency); and continued apical development. At each time point, if any clinical or radiographic alteration was detected, the tooth was not submitted to further evaluations and classified as a failure. The outcomes in the study included integrity of the restoration and peripheral enamel, normal response to pulp sensitivity test (refrigerant spray), absence of sensitivity to percussion, absence of radiographic features (resorptions, thickening of the lamina dura, and periapical lesions), and apical development and apexogenesis (to apex closure) in immature permanent molars with MIH.

During the 24-month experimental period, at every clinical follow-up, different preventive procedures were implemented in order to stabilize caries activity and favor the remineralization process. These procedures included: diet counseling, oral hygiene instructions, dental plaque control using a plaque disclosing agent (GC Tri Plaque ID Gel, GC Corporation, Tokyo, Japan) and professional topical application of fluoride varnish, material containing casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) (MI Varnish™ with RECALDENT™ - CPP-ACP; GC Corporation, Tokyo, Japan). In addition, the patients and/or parents were instructed to routinely use a pea size amount of a fluoride-containing dentifrice on the surface of the affected teeth at bedtime, without mouth rinsing.

After 24-month of follow-up was calculated the percentage of clinical and radiographic success and failure. Kaplan-Meier survival analyses were also performed to evaluate the survival rate, using GraphPad Prism 5.0a package (GraphPad, San Diego, CA, USA).

Results

A total of 281 patients (86.2%) completed the 24-month study follow-up, and 45 patients (13.8%) left the study after the initial visit (Figure 1 and Table 1). The mean age of the children was 7 years and 4 months.

In 272 teeth (96.8%), clinical and radiographic success (no pain, integrity of the restoration margins, and absence of pathological radiographic alterations) was observed at all time-points up to 24 months follow-up after the selective carious tissue removal technique and restoration plus preventive measures. Apexogenesis with physiological closure of the root apex was detected in all 272 successful cases (Figure 2).

The nine cases of failure (3.2%) presented enamel fracture at the restorative margin with consequent pulpitis and absence of apical closure. Endodontic treatment was performed in these cases. Table 2 describes the results obtained after different timepoints evaluation.

Figure 3 shows the Kaplan-Meier survival curve of the selective removal of carious tissue and restoration plus preventive measures in immature permanent molars. The 24-months survival rate was 99.07 %.

Discussion

The presence of MIH and dental caries is known to be closely related [6, 7], possibly due to the affected enamel already missing considerable mineral content, predisposing it to post-cariogenic challenge cavitation; and post-eruptive breakdown related to the lower enamel strength, predisposing the enamel to plaque accumulation and subsequent demineralization [7]. Carious lesions are frequently observed in very young children with immature teeth affected by MIH, such as those used in the present study.

The intense pain reported by patients with severe MIH, the frequent difficulty in achieving pain control during treatment, the extensive coronal destruction and the rapid carious lesion progression [2] may lead to excessive removal of dental tissue and misdiagnosis of the actual pathological status of the pulp. This may result in unnecessary endodontic treatment or extraction [2, 13]. Therefore, to preserve as much healthy dental tissue as possible, it is important to adopt minimally invasive clinical techniques. A systematic review and meta-analysis [14] concluded that incomplete carious tissue removal, particularly when dealing with deep carious lesions, reduces the risk of pulp exposure, improving the prognosis of the tooth [14]. The results of the present studydemonstrated that after selective carious tissue removal in teeth with MIH and open apex, pulp vitality was maintained, evidenced by continued root development and physiological apical closure was observed. To the best of our knowledge, there are no studies evaluating the maintenance of pulp vitality and the physiological apexogenesis in immature permanent molars with MIH as outcomes of selective removal of carious tissue and restoration in combination with a preventive oral care protocol.

Several treatment approaches have been proposed for teeth with severe MIH [2, 3, 15]. In the present work, a minimal intervention treatment protocol for severe MIH cases was established, involving the selective removal of carious tissue, filling of cavities using glass ionomer cement for six months followed by definitive restoration with composite resin in combination with preventive home and professional oral care measures. According to the clinical parameters established for this protocol, a high clinical and radiographic success rate (96.8%) was achieved after 24 months, which is a relevant result from a clinical standpoint. Materials containing CPP-ACP, such as used in the present study, provide a supersaturated environment of minerals such as phosphate and calcium on the enamel surface, enhancing remineralization [3]. These have been recommended for MIH cases [2, 16].

The authors agree with Lygidakis et al. (2010) [3], who state that the prevention of dental caries is very important, because caries and postoperative breakage are more likely to occur in affected teeth, especially due to its higher porosity, mineral density and hardness. If the prevention measures are efficient, a more favorable oral environment is created for the occurrence of remineralization, reducing the caries risk. According to Crombie et al. (2013) [17], caries remineralizing agents increase mineral content and decrease porosity in teeth with MIH, demonstrating that the mineral content in these teeth can be improved.

Also, the enamel porosity in MIH could facilitate the penetration of bacteria through the dentinal tubules, resulting in subclinical pulpal inflammation [18]. However, MIH hypersensitivity is not only related to carious lesions, as Raposo et al. (2019) reported significant association between MIH and air blast and tactile stimuli [19]. Some treatments have been suggested in order to improve the hypersensitivity, such as Nd:YAG Laser [20], CPP-ACP [21] and desensitizing products [22].

An important factor that certainly increases the reliability of the obtained results is that, in the present study, a single researcher with extensive experience in diagnosis, operative/restorative procedures and clinical/radiographic follow-up of cases was the sole clinician. This fact minimized the interference of confounding factors on the results, which may occur in multicenter studies, where various operators perform these procedures.

According Dhareula et al., 2019 [23] there is no agreement on the best restorative treatment options for severe MIH with hypersensitivity and post-eruptive breakdown. There are many restorative options available for these patients, including: Glass-ionomer cement and composite resins [3]. In this present study glass-ionomer cement was used as an interim restoration material, before the permanent restoration. In combination with diet counseling, oral hygiene instructions, dental plaque control, and professional application of fluoride, the interim restoration was used in order to improve the oral environment conditions, enhancing remineralization and subsequently reduce the caries risk. According to the results obtained, it was observed that the adoption of these approach showed a high efficacy, since was observed almost 96.8% of success. Also, was observed no pain, integrity of the restoration margins, and absence of pathological radiographic alterations.

In the present study, resin composite was used as the restorative material in order to minimize removal of dental tissue. Resin composites seem to be the most suitable material for direct restorations in MIH cases, once this material doesn't need retentive preparations in order to bond to the enamel [9], requiring only the use of adhesive system such as self-etching or total-etch [24]. However, adhesion of the restorative material is decreased on the soft, hypomineralized enamel of teeth with MIH, therefore the risk of early loss of restorations and development of carious lesions at the restorative margin is much higher [2]. Possibly, the high success rate obtained in the present study (96.8%) is associated to the improvement of the oral environment conditions, which favors remineralization and enhances the quality of enamel, as a result of the preventive oral care measures and periodic evaluation of the resin composite restorations at follow-up visits. Additionally, care was taken to extend the resin composite to sound enamel along the entire cavosurface angle, as recommended by William et al. (2006) [25], which putatively allowed an adequate marginal seal of the cavity.

It is important to consider that rehabilitation related to teeth with MIH could be challenging for the clinician; especially issues related to enamel-adhesive interface. The enamel of affected teeth is more porous, favoring enamel breakdown and decreasing bond strength [9]. Besides that, our results showed only a few cases (3.2%) with marginal restorative breakdown. In order to improve the adhesion of restorative materials with enamel surface from teeth with MIH, some alternatives have been proposed. CPP-ACP for example, can improve mineral density of the enamel of MIH lesions, improving the final result of the restoration [16]. Another possibility is the removal of protein from the affected surface with 5% sodium hypochlorite to increase bond strength [26].

Despite the intrinsic limitations of clinical studies, it may be concluded that selective removal of carious tissue followed by interim glass ionomer cement and resin composite restorations with a glass ionomer

cement layer underneath, in combination with home and professional preventive measures, resulted in marginal integrity in 96.8% of the cases in immature permanent molars with severe MIH. This was confirmed by the maintenance of pulp vitality and incidence of physiological apical closure (apexogenesis) within a 24-month period.

Conflict of interest

The authors have no conflict of interest to declare.

Bullet Points

- The management of MIH is challenging, especially in cases of immature permanent molars.
- This study supports the use of a minimally invasive approach in order to reduce the risk of pulp exposure.

References

[1] Weerheijm KL, Jalevik B, Alaluusua S. Molar-incisor hypomineralisation. Caries Res. 2001; **35**: 390-1.

[2] Mast P, Rodrigueztapia MT, Daeniker L, Krejci I. Understanding MIH: definition, epidemiology, differential diagnosis and new treatment guidelines. Eur J Paediatr Dent. 2013; **14**: 204-8.

[3] Lygidakis NA. Treatment modalities in children with teeth affected by molar-incisor enamel hypomineralisation (MIH): A systematic review. Eur Arch Paediatr Dent. 2010; **11**: 65-74.

[4] Silva MJ, Scurrah KJ, Craig JM, Manton DJ, Kilpatrick N. Etiology of molar incisor hypomineralization - A systematic review. Community Dent Oral Epidemiol. 2016; **44**: 342-53.

[5] Kuhnisch J, Lauenstein A, Pitchika V et al. Was molar incisor hypomineralisation (MIH) present in archaeological case series? Clin Oral Investig. 2016; **20**: 2387-93.

[6] Kosma I, Kevrekidou A, Boka V, Arapostathis K, Kotsanos N. Molar incisor hypomineralisation (MIH): correlation with dental caries and dental fear. Eur Arch Paediatr Dent. 2016; **17**: 123-9.

[7] Americano GC, Jacobsen PE, Soviero VM, Haubek D. A systematic review on the association between molar incisor hypomineralization and dental caries. Int J Paediatr Dent. 2017; **27**: 11-21.

[8] Ghanim A, Silva MJ, Elfrink MEC, Lygidakis NA, Mariño RJ, Weerheijm KL, Manton DJ. Molar incisor hypomineralisation (MIH) training manual for clinical field surveys and practice. Eur Arch Paediatr Dent. 2017; **18**(4): 225-242.

[9] Elhennawy K, Schwendicke F. Managing molar-incisor hypomineralization: A systematic review. J Dent. 2016; **55**: 16-24.

[10] Hernandez-Gaton P, Serrano CR, Nelson Filho P et al. Stepwise Excavation Allows Apexogenesis in Permanent Molars with Deep Carious Lesions and Incomplete Root Formation. Caries Res. 2015; **49**: 637-9.

[11] Maltz M, Jardim JJ, Mestrinho HD et al. Partial removal of carious dentine: a multicenter randomized controlled trial and 18-month follow-up results. Caries Res. 2013; **47**: 103-9.

[12] Hamama HH, Yiu CK, Burrow MF. Viability of intratubular bacteria after chemomechanical caries removal. J Endod. 2014; **40**: 1972-6.

[13] Rao MH, Aluru SC, Jayam C, Bandlapalli A, Patel N. Molar Incisor Hypomineralization. J Contemp Dent Pract. 2016; **17**: 609-13.

[14] Schwendicke F, Dorfer CE, Paris S. Incomplete caries removal: a systematic review and meta-analysis. J Dent Res. 2013; **92**: 306-14.

[15] Gaardmand E, Poulsen S, Haubek D. Pilot study of minimally invasive cast adhesive copings for early restoration of hypomineralised first permanent molars with post-eruptive breakdown. Eur Arch Paediatr Dent. 2013; **14**: 35-9.

[16] Baroni C, Marchionni S. MIH supplementation strategies: prospective clinical and laboratory trial. J Dent Res. 2011; **90**: 371-6.

[17] Crombie FA, Cochrane NJ, Manton DJ, Palamara JE, Reynolds EC. Mineralisation of developmentally hypomineralised human enamel in vitro. Caries Res. 2013; **47**: 259-63.

[18] Fagrell TG, Lingström P, Olsson S, Steiniger F, Norén JG. Bacterial invasion of dentinal tubules beneath apparently intact but hypomineralized enamel in molar teeth with molar incisor hypomineralization. Int J Paediatr Dent. 2008; **18**(5): 333-40.

[19] Raposo F, de Carvalho Rodrigues AC, Lia ÉN, Leal SC. Prevalence of Hypersensitivity in Teeth Affected by Molar-Incisor Hypomineralization (MIH). Caries Res. 2019; **24**: 1-7.

[20] Machado AC, Maximiano V, Eduardo CP, Azevedo LH, de Freitas PM, Aranha AC. Associative Protocol for Dentin Hypersensitivity Using Nd:YAG Laser and Desensitizing Agent in Teeth with Molar-Incisor Hypomineralization. Photobiomodul Photomed Laser Surg. 2019; **37**(4): 262-266.

[21] Pasini M, Giuca MR, Scatena M, Gatto R, Caruso S. Molar incisor hypomineralization treatment with casein phosphopeptide and amorphous calcium phosphate in children. Minerva Stomatol. 2018; **67**(1): 20-25.

[22] Bekes K, Heinzelmann K, Lettner S, Schaller HG. Efficacy of desensitizing products containing 8% arginine and calcium carbonate for hypersensitivity relief in MIH-affected molars: an 8-week clinical study. Clin Oral Investig. 2017; **21**(7): 2311-2317.

[23] Dhareula A, Goyal A, Gauba K, Bhatia SK, Kapur A, Bhandari S. A clinical and radiographic investigation comparing the efficacy of cast metal and indirect resin onlays in rehabilitation of permanent first molars affected with severe molar incisor hypomineralisation (MIH): a 36-month randomised controlled clinical trial. Eur Arch Paediatr Dent. 2019.

[24] de Souza JF, Fragelli CB, Jeremias F, Paschoal MAB, Santos-Pinto L, de Cassia Loiola Cordeiro R. Eighteen-month clinical performance of composite resin restorations with two different adhesive systems for molars affected by molar incisor hypomineralization. Clin Oral Investig. 2017; **21**: 1725-33.

[25] William V, Messer LB, Burrow MF. Molar incisor hypomineralization: review and recommendations for clinical management. Pediatr Dent. 2006; **28**: 224-32.

[26] Mathu-Muju K, Wright JT. Diagnosis and treatment of molar incisor hypomineralization. Compend Contin Educ Dent. 2006; **27**: 604-10; quiz 11.

Table Legend

Table 1 - Number of failure per time period, failure rate and survival rate at each analyzed time period, after selective removal of carious tissue and restoration plus preventive measures in immature permanent molars

Table 2 - Causes of failures and periods of occurrence, after selective removal of carious tissue and restoration plus preventive measures in immature permanent molars

Figure Legends

Figure 1. Flow diagram of = intervention and follow-up.

Figure 2. (A) Initial periapical radiograph showing caries lesion and incomplete root formation; (B) Clinical aspect showing severe MIH; (C) Interim restoration with glass ionomer cement; (D) Periapical radiograph after the 24-month postoperative evaluation showing integrity of the lamina dura and occurrence of physiological apical closure (apexogenesis).

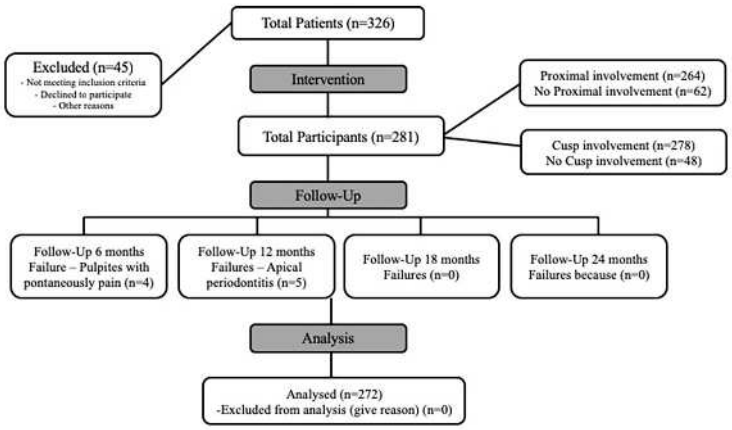
Figure 3. Kaplan–Meier survival curve for the selective removal of carious tissue and restoration plus preventive measures in immature permanent molars.

Table 1 - Number of failure per time period, failure rate and survival rate at each analyzed time period, after selective removal of carious tissue and restoration plus preventive measures in immature permanent molars

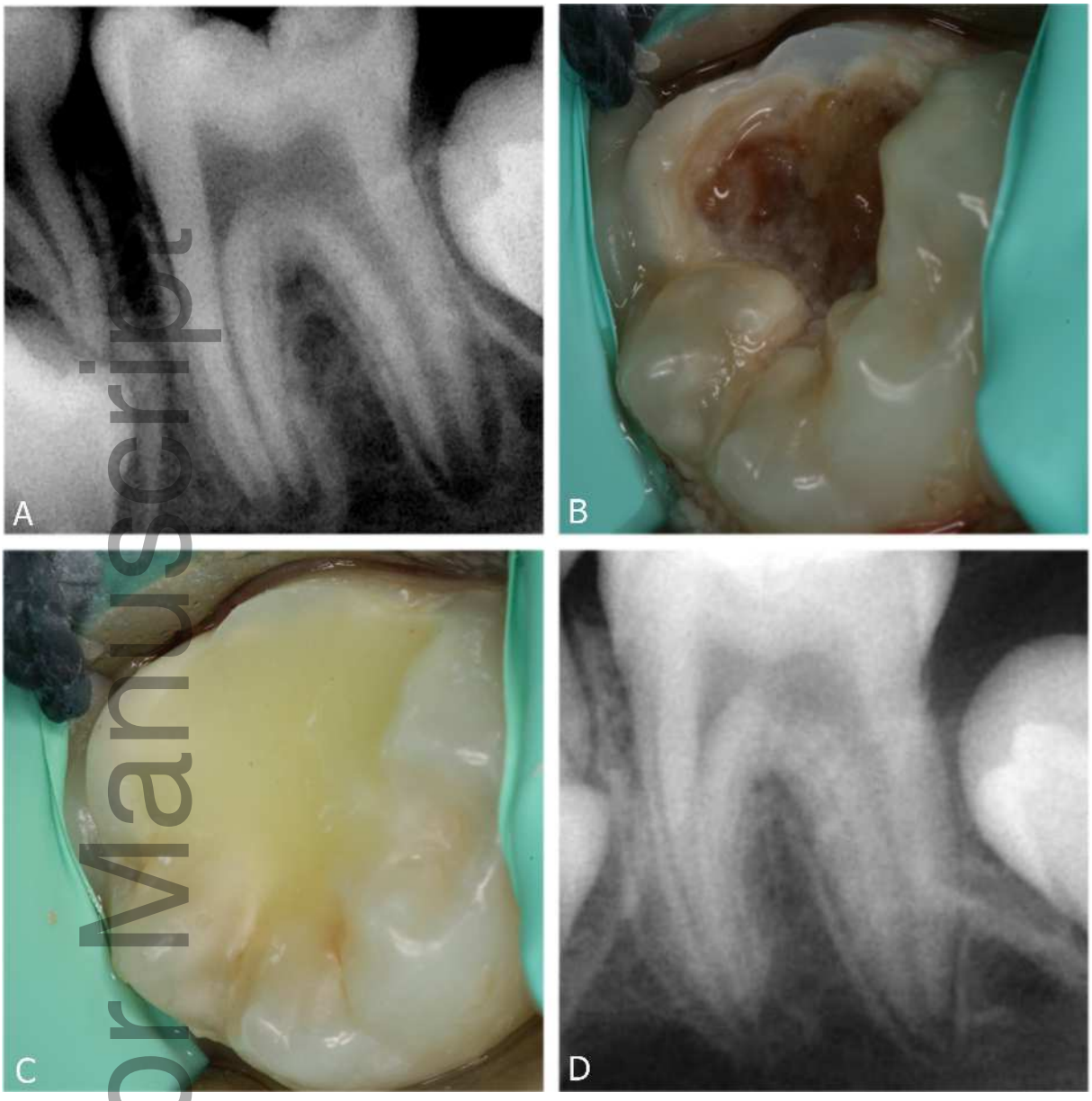
Months	Number of failure per time period	Failure rate	Survival rate
2 months	1	0.071%	99.929%
6 months	3	0.338%	99.662%
12 months	5	0.929%	99.071%
18 months	0	0.929%	99.071%
24 months	0	0.929%	99.071%

Table 2 - Causes of failures and periods of occurrence, after selective removal of carious tissue and restoration plus preventive measures in immature permanent molars

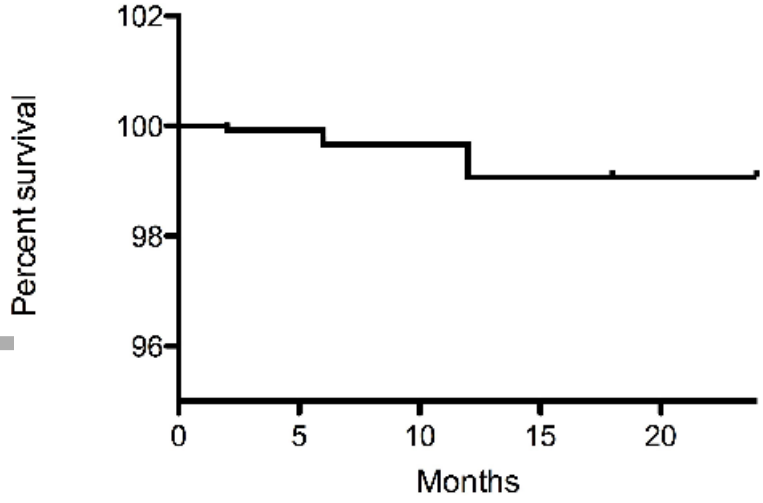
	Periods of Evaluation (months)			
	6	12	18	24
Clinical Failure	n = 4 (Pulpitis with spontaneously pain)	–	–	–
Radiographic Failure	–	n = 5 (Apical periodontitis)	–	–
Failure of Integrity of the restorations and peripheral enamel	n = 4 (Enamel fracture on restoration margins)	n = 5 (Enamel fracture on restoration margins)	–	–
Absence of Apical Closure	n = 4	n = 5	–	–



ipd_12581_f1.jpg



ipd_12581_f2.jpg



ipd_12581_f3.jpg