

Indirect Pulp Capping Treatment on Tooth 26 with Follow Up Class 1 Composite Restoration

Nurma Murti Hapsari¹, Fajar Fatriadi²

¹Padjadjaran University, Faculty of Dentistry, Bandung, Jawa Barat, Indonesia
Email: Nurmamurti3011@yahoo.co.id

²Padjadjaran University, Faculty of Dentistry, Bandung, Jawa Barat, Indonesia
Email: fajar.fatriadi@fkg.unpad.ac.id

Abstract: ***Introduction:** The preservation of pulp vitality is crucial when treating cases of severe caries. When cavities are excavated without pulpal exposure, there is still a chance that the pulp tissue will heal. However, such minimally intrusive therapy is dubious and impulsive in the case of pulp exposure. In these situations, indirect pulp capping (IPC) therapy is crucial to preventing pulpal exposure. **Case Report:** This case report describes the multiple visit indirect pulp therapy in maxillary first molar. Patient reported with a chief complaint of moderate pain when drink cold water or eat some food. There was no history of spontaneous pain. The tooth was examined for vitality using thermal test and revealed vital pulp. The treatment was done with the protocol of multiple visits indirect pulp therapy using calcium hydroxide and cavity was disinfected with 2% chlorhexidine. Cavity was lined with Glass Ionomer Cement and final restoration was done using composite resin restoration. The patient was followed up till 8 weeks and showed satisfactory outcome eliminating the need of more invasive approach of root canal therapy. **Conclusion:** Indirect pulp capping therapy is a safe, economical and proven treatment option in the teeth that have severe caries but not involved pulp exposure and with sound peri-radicular tissues; The success of indirect pulp capping relies on proper case selection and diagnosis, complete isolation, caries removal and disinfection with selection of suitable pulp capping material*

Keywords: Indirect pulp capping, multiple visit indirect pulp capping, calcium hydroxide, deep carious lesion

1. Introduction

Dental and oral health is one of the many health problems that occur in Indonesia. Based on the calculation of basic health research results in 2018, Indonesia's dental and oral health problems reached 57.6% and the condition of dental caries was the most frequent case, reaching 45.3%. [1]

Untreated and constantly developing dental caries will form cavities. Thus, caries tissue must be taken mechanically. All demineralized dentin should be removed until hard dentin remains (nonselective removal). In deep caries, the technique carries the risk of pulp opening and/or postoperative symptoms. [2] Selective removal of carious lesions can be performed on deep caries, removing only infected dentin and leaving affected dentin to maintain pulp vitality. The vitality of the pulp is important for maintaining the viability of the tooth because it provides nutrients and acts as a biosensor to detect pathogens, therefore care to maintain the vitality of the pulp is recommended. [3,4]

The main goal of vital pulp therapy is to treat reversible pulp injury and maintain pulp vitality/function. Factors such as adequate blood supply, severity of inflammation, homeostasis, disinfection of the site of exposure, antibacterial properties and biocompatibility of pulp covering agents and adequate coronal seals can affect the success of vital pulp therapy. [4] The success of vital pulp therapy also has some clinical challenges. These challenges include the accuracy of pulp tissue diagnosis; determine the most effective approach to taking carious lesions; and the selection of the best restoration materials. [5]

One of the vital pulp therapies is pulp capping treatment. Pulp capping is the application of a thin layer of protective

material for treatment above the pulp that will stimulate the formation of reparative dentin. The purpose of pulp capping is to remove irritation to the pulp tissue and to preserve pulp vit. There are two types of pulp capping treatments, namely direct pulp capping and indirect pulp capping. Direct pulp capping is the placement of medicament or non-medical material on pulp that has been accidentally exposed due to trauma or during cavity preparation. [6] Meanwhile, indirect pulp capping is a procedure of maintaining a small amount of caries tissue in the dentin with a deep cavity area to avoid pulp exposure, followed by appropriate placement of medication and restoration material that closes dentin caries and can promote pulp healing. While indirect pulp capping is the procedure of maintaining a small amount of caries tissue in the dentin with a deep cavity area to avoid exposure to the pulp, followed by the placement of appropriate medication and restoration material that closes dentin caries and can promote pulp healing. [7]

Indirect pulp capping treatment plays an important role in this case with the aim of preventing pulp capping. This type of treatment management can be a one-step or two-step procedure. [8] In this case, indirect pulp capping treatment with two steps is performed. This procedure requires multiple patient visits, The first step of the procedure prevents bacteria from entering the pulp and slows down the mechanical deterioration of the tooth structure and delivers pulp capping material. The second step is an 8-week visit after the first visit to complete the restoration procedure.

Pulp capping material ideally has three characteristics, namely forming an immediate seal to protect the pulp in the first few weeks when the mineralization bridge is formed, biocompatibility and noncytotoxic, and having bioactive

properties that trigger biological processes in the formation of mineralization barriers in tissues. For pulp protection, remineralization can be induced by placing calcium hydroxide (bactericidal or bacteriostatic coating) on dentin caries, which is considered a traditional procedure for indirect pulp capping treatment. Calcium hydroxide is white, odorless powder, poorly soluble in water & has an increase in pH. If the remaining dentin thickness is at least 0.5 mm without pulp exposure, the relevance of acid conditioner to the enamel or dentin will not cause irreversible pulpitis. [8]

This case report will explain the treatment of caries with indirect pulp capping on the left first molars of the upper jaw with composite grade 1 restoration.

2. Case Report

A 24-year-old female patient came to RSGM UNPAD with complaints of cavities on the left upper tooth behind and felt pain, especially if she ate food and cold drinks. The tooth never hurts suddenly but hurts sharply when the trigger is applied and the pain goes away when the trigger is removed. The patient feels uncomfortable when using the tooth because of the pain and sometimes food often gets tucked into the area of cavities. The patient wants to have his teeth treated so that they don't get worse and get comfortable when eating and drinking.

Extraoral examination showed a symmetrical face, no lip abnormalities, left and right submandibular glands were not palpable and painless. Intraoral examination revealed caries on the occlusal surface of tooth 26 (Figure 1). The results of clinical examination with thermal and instrument tests showed vitality (+) and percussion (-). The diagnosis made on tooth 26 was reversible pulpitis with normal apical tissue. The treatment plan that will be carried out is the treatment of composite class 1 restorations. The prognosis in this case is good.



Figure 1: Dental Intraoral Clinical Photo of Tooth Number 26

On the first visit, a subjective examination, an objective examination, and clinical photos were taken. The results of the examination were used to determine the diagnosis and treatment plan. The patient is then given information about the condition of his teeth and all the treatment measures to be

taken as well as any complications that may occur. After understanding and agreeing, the patient was asked to sign an informed consent sheet. In this case, the diagnosis based on all examinations was reversible pulpitis with normal apical tissue of tooth 26 with a treatment plan for composite class I restorations.

The first step is to select the composite shade that will be used before preparation. The shade chosen is A2 body. After selecting the shade, tooth 26 was isolated using a cotton roll placed in the mucobuccal fold. Then caries removal was carried out using a round bur and fissured with a high-speed hand piece to open the tooth cavity and remove soft structure of tooth tissue (Figure 2).



Figure 2: Cavity in Occlusal Tooth Number 26

Furthermore, carious lesions that are at the bottom of the cavity and are deep enough can be removed using carbide burs and excavators. Then the walls and floor of the cavity were smoothed using a flat end fissure bur. Make sure all the weak tissue and infected dentine is removed. The only dentin that can be left is affected dentin. The results of caries tissue removal and cavity preparation can be seen in Figure 3.



Figure 3: Caries Removal and Preparation Cavity Class I Tooth Number 26

The clinical appearance of the patient can be seen from the deep enough cavity on the pulp floor. The results of measuring the depth of the cavity using the William Periodontal Probe which is then compared with the length of the occlusal to the CEJ shows that the depth of caries in the

patient is quite deep and leaves thin dentine. So, it was decided to do indirect pulp capping treatment using calcium hydroxide (Hydcal) material. Material manipulation can be done by mixing the base and catalyst in a 1:1 ratio. Then the paste is applied in a thin layer to the deepest part of the cavity using the applicator tip as shown in Figure 4.



Figure 4: Material Application of $\text{Ca}(\text{OH})_2$ for Indirect Pulp Capping of Tooth Number 26

The pulp capping material that has been applied is then covered with a base, namely GIC type III base (Fuji), which is manipulated on a paper pad according to the manufacturer's instructions. After that, cover with a temporary patch (Ceivitron) as shown in Figure 5. The patient was instructed to return for control 8 weeks later.



Figure 4: Application of Type III GIC (base) and Temporary Restoration on Tooth Number 26

At the second visit, the patient came back for control after the application of the pulp capping material. Re-examine subjective and objective. The patient had no complaints about the teeth being treated, no history of pain or aches. Objective examination also showed a normal response to the local status.

Based on the results of the controls showing good results, the treatment can be continued with follow-up with composite class I restorations. Previously, the temporary filling, GIC base, and $\text{Ca}(\text{OH})_2$ liner were dismantled. Furthermore, it was re-evaluated whether there was soft dentin that was not remineralized and did not support restoration, the soft dentine was then taken again using an excavator. The technique used is step-wise excavation. After making a bevel at the preparation margin using a diamond bur, the cavity was cleaned and disinfected with 2% chlorhexidine gluconate, and dried. Before carrying out the restoration, the

work area was isolated using a cotton roll in the mucobuccal fold area. Then apply a thin layer of type III (Fuji) GIC base on the cavity base.



Figure 6: The Result after Removing Temporary Restoration, Base, and Liner

The next step was a composite class I restoration on tooth 26. First, applied etching with 37% phosphoric acid (Any-Etch) for 20 seconds on the enamel and 15 seconds on the dentin, then rinsing. After that, dry enough until the cavity is moist. Then applied bonding and light cure for 20 seconds. Next, composite applied by forming cusp by cusp with incremental technique using shade A2 body (3M Filtek ESPE). Each composite layer was light cured for 20 seconds. Next, the occlusal contacts were examined on tooth 46 using articulating paper and excess composite was removed using a finishing bur.



Figure 7: Composite Restoration on Tooth Number 26

The patient came back and admitted that he had no complaints about the teeth being treated. Finishing the restoration was again carried out using fine finishing burs then polishing using blue rubber burs, followed by yellow rubber burs. The final result of the restoration ensures that all surfaces are smooth, there are no steps, and there are no underfilled or overfilled parts.



Figure 8: Final Result after Polishing Composite Restoration on Tooth Number 26

3. Discussion

Indirect pulp capping treatment was chosen after carrying out a thorough clinical examination. The clinical examination should show no pulpal exposure, the sensibility test shows a positive response and radiography excludes peri-radicular pathology. In this case, when caries removal was performed the patient's cavity was found to be quite deep and leaving thin dentine. Cavity depth can be assessed using conventional or radiographic techniques. Large, well-defined cavities are easily detected by visual inspection and probing with a dental probe. Meanwhile, in hidden and inaccessible cavities, radiographic imaging, or light fluorescence based, can be used to assess the depth of the cavity.[9,10] In this case, a probe was used to assess the depth of the cavity. The depth of the cavity is known by comparing the depth of the cavity base with the height of the crown from cusp to CEJ.

Treatment of deep caries includes indirect pulp capping and direct pulp capping, while treatment of very deep caries includes pulpotomy or pulpectomy (root canal treatment).[11,12] In this case, the treatment of choice is indirect pulp capping, according to indications wherein indirect pulp capping treatment is performed on teeth with deep cavities that leave a thin layer of dentin, which if the dentin is removed carries the risk of pulp exposure.

The indirect pulp capping performed in this case aims to encourage remineralization and formation of new dentin with the aim of protecting the pulp from damage or further infection.[13] Initial carious lesions occur due to loss of crystallinity, carbonate, magnesium, and other inorganic dentine materials, which cause rapid destruction of dentin tissue and pose a risk of pulp exposure and bacterial contamination. Pulp capping agents, such as calcium hydroxide, are able to form dentinal bridges and induce remineralization through deposition of apatite crystals through the continued release of Ca^{2+} and OH^- ions.[14]

Indirect pulp capping can be done in one visit using the selective caries removal technique or in two visits using the stepwise approach/stepwise excavation technique.[11] In this case, indirect pulp capping was chosen in two visits using the

stepwise approach technique. At the first visit, caries was removed from the cavity and only necrotic and contaminated dentine was removed from the pulp wall or infected dentin, while affected dentine which was damaged but not contaminated with bacteria was left behind, followed by application of bioactive materials and fillings. After this period, the cavity is reopened, the remineralization is evaluated, the remaining soft carious tissue is completely removed, and the final restoration is performed. The goal of this treatment is to reduce the risk of pulp exposure by stimulating tertiary dentin deposition.

There are several choices of materials for pulp capping. Materials that are often used today are calcium hydroxide as the gold standard, Mineral Trioxide Aggregate (MTA), resin modified calcium silicate-based liner (TheraCal LC), and bioceramic nanotechnology (Biodentine and BioAggregat). The material chosen in this case is calcium hydroxide, because this material has the ability to form a dentinal bridge, has good antibacterial properties, is easy to manipulate and apply, and is relatively affordable.[15,16] Although calcium hydroxide has been abandoned recently due to poor marginal seal, dissolution, and degradation over time, as well as having a tunnel-like defect.[17] This material is considered to be a good pulp capping agent with a high success rate. Research conducted by Alqahtani et al. demonstrated the success of calcium hydroxide as a direct and indirect pulp capping agent for permanent teeth reaching 84.5%.[18] This was supported by the results of a study by Kaul et al. in 2019 showed a success rate of calcium hydroxide of 91.66% as an indirect pulp capping agent on permanent molars after 16 months.[19]

Calcium hydroxide which was introduced by Herman in 1920 is still used and is considered the gold standard material for pulp capping treatment.[17] Calcium hydroxide consists of 2 pastes, namely base and catalyst. The base paste consists of glycol salicylate (40%) as the main active ingredient, titanium dioxide, calcium sulphate, and calcium tungstate as inert fillers, pigments and radiopaque agents. While the composition of the catalyst paste is calcium hydroxide (50%) and zinc oxide (10%) which function as the main active ingredients, zinc stearate (0.5%) as an accelerator, and ethyl toluene sulphonamide (39.5%) functions as a carrier for oil compounds.[20]

Upon receiving a stimulus, the pulp reacts in three ways: intratubular calcification, deposition of peritubular dentine, and formation of tertiary dentin. Application of calcium hydroxide near the pulp also triggers a similar reaction, especially the formation of tertiary dentin to reduce the permeability of the dentin and increase the distance between the irritant and the pulp. Tertiary dentin is divided into two, namely reactionary and reparative dentin, depending on the cells that form it. The indirect pulp capping procedure induces the formation of reactionary dentine formed by odontoblast cells. Calcium hydroxide is very alkaline (pH 11-13) so it has good antibacterial activity and plays a role in tertiary dentine formation. There is a release of hydroxyl ions from calcium hydroxide which then denatures proteins and hydrolyzes lipopolysaccharides so that the cell walls of the bacteria are damaged. Meanwhile, calcium ions stimulate the formation of dentinal bridges. Thickening of this dentin

structure can be observed in the fourth week or so.[15,16,21]

In the indirect pulp capping procedure, glass ionomer cement is placed over calcium hydroxide. In previous studies it was stated that ionomer cement helps resist caries and provides antimicrobial effects. Glass ionomers release fluoride ions and have a variable thermal expansion which is very close to that of the tooth structure and is biocompatible. Permanent restorations can be made with composite resin restorations so as to provide adequate masticatory strength and aesthetic results. Restorations with resin composites should be located in such a way that negligible or minimum microleakage is anticipated.[8]

4. Conclusion

Indirect pulp capping therapy is a safe, economical and proven curative treatment option in teeth that do not involve pulpal exposure and with healthy peri-radicular tissue. The key determinants of the success of indirect pulp capping are accurate case selection, adequate isolation, cavity disinfection, caries restriction and selection of appropriate pulp capping materials.

References

- [1] Badan Penelitian dan Pengembangan Kesehatan. Riset Kesehatan Dasar (RISKESDAS) 2018. Lap Nas 2018. 2018;1–384.
- [2] Barros MMAF, De Queiroz Rodrigues MI, Muniz FWMG, Rodrigues LKA. Selective, stepwise, or nonselective removal of carious tissue: which technique offers lower risk for the treatment of dental caries in permanent teeth? A systematic review and meta-analysis. *Clin Oral Investig.* 2020 Feb;24(2):521–32.
- [3] Jamal TR. Stepwise Excavation A Conservative Community-Based Dental Treatment of Deep Caries to Preserves the Tooth Vitality. In 2015.
- [4] Parisay I, Ghoddsi J, Forghani M. A review on vital pulp therapy in primary teeth. *Iran Endod J [Internet].* 2014/12/24. 2015;10(1):6–15. Available from: <https://pubmed.ncbi.nlm.nih.gov/25598803>
- [5] Ortega-Verdugo P, Warren JJ, Kolker JL, Carter KD, Guzmán-Armstrong S, Gomez MR. Retrospective analysis of factors associated with the success of stepwise excavation procedure in deep carious lesions. *J Am Dent Assoc [Internet].* 2018;149(6):442–50. Available from: <https://www.sciencedirect.com/science/article/pii/S0002817718300084>
- [6] Rao A. Principles and Practice Of Pedodontics. Jaypee Brothers, Medical Publishers Pvt. Limited; 2012.
- [7] Asnani KH. Essentials of Pediatric Dentistry [Internet]. Jaypee Brothers, Medical Publishers Pvt. Limited; 2010. Available from: <https://books.google.co.id/books?id=aqShuAAACAAJ>
- [8] Rathi, S., Nikhade, P., Jaiswal, A., Jaiswal, A., Chandak, M., & Rathi, C. (2020). Management of Deep Carious Lesion with Single Visit Indirect Pulp Capping: A Case Report. *Indian Journal of Forensic Medicine & Toxicology*, 14(4), 6709-6713.
- [9] Lian L, Zhu T, Zhu F, Zhu H. Deep learning for caries detection and classification. *Diagnostics.* 2021;11(9).
- [10] Kamburoglu K, Kurt H, Kolsuz E, Öztas B, Tatar I, Çelik HH. Occlusal caries depth measurements obtained by five different imaging modalities. *J Digit Imaging.* 2011;24(5):804–13.
- [11] Bjørndal L, Simon S, Tomson PL, Duncan HF. Management of deep caries and the exposed pulp. *Int Endod J.* 2019;52(7):949–73.
- [12] Duncan HF, Galler KM, Tomson PL, Simon S, El-Karim I, Kundzina R, et al. European Society of Endodontology position statement: Management of deep caries and the exposed pulp. *Int Endod J.* 2019;52(7):923–34.
- [13] Torabinejad M, Fouad AF, Shabahang S. *Endodontics Principles and Practice.* Sixth Edit. Elsevier; 2021.
- [14] Di Foggia M, Prati C, Gandolfi MG, Taddei P. An in vitro study on dentin demineralization and remineralization: Collagen rearrangements and influence on the enucleated phase. *J Inorg Biochem.* 2019;193(December 2018):84–93. Available from <https://doi.org/10.1016/j.jinorgbio.2019.01.004>
- [15] Song M, Yu B, Kim S, Hayashi M, Smith C, Sohn S, et al. Clinical and Molecular Perspectives of Reparative Dentin Formation: Lessons Learned from Pulp-Capping Materials and the Emerging Roles of Calcium. *Dent Clin North Am.* 2017;61(1):93–110.
- [16] Njeh A, Uzunoğlu E, Ardila-Osorio H, Simon S, Bernal A, Kellermann O, et al. Reactionary and reparative dentin formation after pulp capping: Hydrogel vs. Dycal. *Evidence-Based Endod.* 2016;1(1):1–9.
- [17] Selvendran K, Ahamed A, Krishnamurthy M, Kumar V, Raju V. Comparison of three different materials used for indirect pulp capping in permanent molars: An in vivo study. *J Conserv Dent.* 2022;22(1):68–71
- [18] Alqahtani AR, Yaman P, McDonald N, Dennison J. Efficacy of calcium hydroxide and resin-modified calcium silicate as pulp-capping materials: a retrospective study. *Gen Dent.* 2020;68(6):50–4.
- [19] Kaul S, Kumar A, Jasrotia A, Gorkha K, Kumari S, Jeri SY. Comparative Analysis of Biodentine, Calcium Hydroxide, and 2% Chlorhexidine with Resinmodified Glass Ionomer Cement as Indirect Pulp Capping Materials in Young Permanent Molars. *J Contemp Dent Pract.* 2021;22(5):511–6.
- [20] Sofiani E, Fajriyani R. Evaluasi Klinis Keberhasilan Indirect Pulp Capping Dengan Kalsium Hidroksida Tipe Hard-Setting Pada Rsgm Universitas Muhammadiyah Yogyakarta. *B-Dent J Kedokt Gigi Univ Baiturrahmah.* 2021;8(1):64–70.
- [21] Song M, Yu B, Kim S, Hayashi M, Smith C, Sohn S, et al. Clinical and Molecular Perspectives of Reparative Dentin Formation: Lessons Learned from Pulp-Capping Materials and the Emerging Roles of Calcium. *Dent Clin North Am.* 2017;61(1):93–110.

Author Profile



Nurma Murti Hapsari received the bachelor of dental medicine in Padjadjaran University and master of management degrees in University of Islam Bandung in 2021 and 2023, respectively. During 2021–now, she is dental clinical student in RSGM Unpad.