QUALITY IMPROVEMENT IN DENTAL AND MEDICAL KNOWLEDGE, RESEARCH, SKILLS AND ETHICS FACING GLOBAL CHALLENGES

Edited by
Armelia Sari Widyarman, Muhammad Ihsan Rizal,
Moehammad Orliando Roeslan & Carolina Damayanti Marpaung

CRC Press
Taylor & Francis Group

QUALITY IMPROVEMENT IN DENTAL AND MEDICAL KNOWLEDGE, RESEARCH, SKILLS AND ETHICS FACING GLOBAL CHALLENGES

The proceedings of FORIL XIII 2022 Scientific Forum Usakti conjunction with International Conference on Technology of Dental and Medical Sciences (ICTDMS) include selected full papers that have been peer-reviewed and satisfy the conference's criteria. All studies on health, ethics, and social issues in the field of dentistry and medicine have been presented at the conference alongside clinical and technical presentations. The twelve primary themes that make up its framework include the following: behavioral epidemiologic, and health services, conservative dentistry, dental materials, dento-maxillofacial radiology, medical sciences and technology, oral and maxillofacial surgery, oral biology, oral medicine and pathology, orthodontics, pediatrics dentistry, periodontology, and prosthodontics. This proceeding will be beneficial in keeping dental and medical professionals apprised of the most recent scientific developments.

Taylor & Francis
Taylor & Francis Group
http://taylorandfrancis.com

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON TECHNOLOGY OF DENTAL AND MEDICAL SCIENCES (ICTDMS 2022), JAKARTA, INDONESIA, 8–10 DECEMBER 2022

Quality Improvement in Dental and Medical Knowledge, Research, Skills and Ethics Facing Global Challenges

Edited by

Armelia Sari Widyarman, Muhammad Ihsan Rizal, Moehammad Orliando Roeslan and Carolina Damayanti Marpaung
Universitas Trisakti, Indonesia

CRC Press
Taylor & Francis Group
Boca Raton London New York Leiden

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business
A BALKEMA BOOK

First published 2023
by CRC Press/Balkema
4 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

and by CRC Press/Balkema
2385 NW Executive Center Drive, Suite 320, Boca Raton FL 33431

CRC Press/Balkema is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
A catalog record has been requested for this book

ISBN: 978-1-032-51441-3 (hbk)
ISBN: 978-1-032-51466-6 (pbk)
ISBN: 978-1-003-40237-4 (ebk)

DOI: 10.1201/9781003402374

Typeset in Times New Roman
by MPS Limited, Chennai, India

Quality Improvement in Dental and Medical Knowledge, Research, Skills and Ethics Facing Global Challenges – Widyarman et al. (Eds)
© 2024 The Editor(s), ISBN 978-1-032-51441-3

Table of Contents

Dental materials

Dento-maxillofacial radiology

Medical sciences and technology

Oral and maxillofacial surgery

Oral biology

Oral medicine and pathology

Orthodontics

Pediatric dentistry

Periodontology

Prosthodontics

Quality Improvement in Dental and Medical Knowledge, Research, Skills and Ethics Facing Global Challenges – Widyarman et al. (Eds)

Preface

Faculty of Dentistry Universitas Trisakti (Usakti) presents FORIL XIII 2022 Scientific Forum Usakti conjunction with International Conference on Technology of Dental and Medical Sciences (ICTDMS) on December 8th–10th 2022. The theme of the conference is "Quality Improvement in Dental and Medical Knowledge, Research, Skills and Ethics Facing Global Challenges".

The triennial conference has served as a meeting place for technical and clinical studies on health, ethical, and social issues in field medical and dentistry. It is organized around 12 major themes, including behavioral, epidemiologic, and health services, conservative dentistry, dental materials, dento-maxillofacial radiology, medical sciences and technology, oral and maxillofacial surgery, oral biology, oral medicine and pathology, orthodontics, pediatrics dentistry, periodontology, and prosthodontics.

The most recent findings in fundamental and clinical sciences related to medical and dental research will be presented in the conference that will be published as part of the conference proceeding. This proceeding will be useful for keeping dental and medical professionals up to date on the latest scientific developments.

Dr. Aryadi Subrata
Chairman FORIL XIII conjunction with ICTDMS

Taylor & Francis
Taylor & Francis Group
http://taylorandfrancis.com

Acknowledgements

Prof. Shinya Murakami, D.D.S., Ph.D. (*Department of Periodontology, Osaka University, Japan*)
Prof. Adrian Yap (*Department of Dentistry, Ng Teng Fong General Hospital, Singapore*)
Prof. Dr. Rosnah Binti Mohd Zain (*Department of Oro-Maxillofacial Surgical & Medical Sciences, Malaya University*)
Prof. Chaminda Jayampath Seneviratne, BDS (Hons)., M.Phil., Ph.D (*University of Queensland, Australia*)
Cortino Sukotjo, DDS, Ph.D., MMSc (*Department of Restorative Dentistry, University of Illinois at Chicago, United States*)
Prof. Dr. Nicola De Angelis (*Department of Periodontology, University of Genoa, Italy*)
Prof. Hirotaka Kuwata, D.D.S., Ph.D. (*Department of Oral Microbiology and Immunology, Showa University, Japan*)
Prof. Dr. drg. Tri Erri Astoeti, M.Kes (*Universitas Trisakti, Jakarta, Indonesia*)
Prof. drg. Rahmi Amtha, MDS, Ph.D, Sp.PM(K) (*Department of Oral Medicine, Universitas Trisakti, Jakarta, Indonesia*)
Prof. Dr. Siriwan Suebnukarn, D.D.S (*Thammasat University, Bangkok, Thailand*)

Taylor & Francis
Taylor & Francis Group
http://taylorandfrancis.com

Committee Members

Scientific Committee

Prof. Dr. drg. David Buntoro Kamadjaja, Sp.BM(K) (*Oral Maxillofacial Surgeon, Universitas Hassanudin, Makasar, Indonesia*)
Prof. Dr. drg. Diah Savitri Ernawati, Sp.PM(K)., M.Si (*Oral Medicine, Universitas Airlangga, Surabaya, Indonesia*)
Prof. Dr. drg. Maria Francisca Lindawati Soetanto, Sp.Pros(K) (*Prosthodontic, Universitas Indonesia, Jakarta, Indonesia*)
Prof. drg. Boy Muchlis Bachtiar, M.S., Ph.D., PBO (*Oral Biology, Universitas Indonesia, Jakarta, Indonesia*)
Prof. Dr. drg. Inne Suherna Sasmita, Sp.KGA(K) (*Pediatric Dentistry, Universitas Padjajaran, Bandung, Indonesia*)
Prof. drg. Sondang Pintauli, Ph.D (*Public Health, Universitas Sumatera Utara, Indonesia*)
Prof. Dr. drg. Miesje Karmiati Purwanegara, S.U., Sp.Orto (*Orthodontic, Universitas Indonesia, Indonesia*)
Prof. Dr. drg. Sri Lelyati, S.U, Sp.Perio (K) (*Periodontic, Universitas Indonesia, Indonesia*)
drg. Diatri Nari Ratih, M.Kes., Ph.D., Sp.KG(K) (*Conservative Dentistry, Universitas Gadjah Mada, Indonesia*)

Organizing Committee

Drg. Aryadi Subrata, Sp.KG(K), (*Conservative Dentistry, Universitas Trisakti, Jakarta, Indonesia*)
Dr. drg. Armelia Sari W., M.Kes., PBO (*Microbiology Oral, Universitas Trisakti, Jakarta, Indonesia*)
Dr. drg. Anggraeny Putri Sekar Palupi, Sp.BM (*Oral Maxillofacial Surgeon, Universitas Trisakti, Jakarta Indonesia*)
Dr. drg. Muhammad Ihsan Rizal, M.Kes (*Oral Biology, Universitas Trisakti, Jakarta, Indonesia*)
drg. Isya Hanin, Sp.Pros (*Prosthodontic, Universitas Trisakti, Jakarta, Indonesia*)
drg. Muhammad Orliando Roeslan, M.Kes., PhD (*Oral Biology, Universitas Trisakti, Jakarta, Indonesia*)
drg. Dina Ratnasari, Sp.KG(K) (*Conservative Dentistry, Universitas Trisakti, Jakarta, Indonesia*)
drg. Carolina Damayanti Marpaung, Sp.Pros, PhD (*Prosthodontic, Universitas Trisakti, Jakarta, Indonesia*)

Taylor & Francis
Taylor & Francis Group
http://taylorandfrancis.com

Quality Improvement in Dental and Medical Knowledge, Research, Skills and Ethics Facing Global Challenges – Widyarman et al. (Eds)
© 2024 The Author(s), ISBN 978-1-032-51441-3

Fiber reinforced composite in endodontically treated tooth: A case report

J. Setiawan
Post Graduate of Conservative Dentistry, Faculty of Dentistry, Trisakti University, Jakarta, Indonesia

T. Ariwibowo & M.F. Amin
Department of Conservative Dentistry, Faculty of Dentistry, Trisakti University, Jakarta, Indonesia

ABSTRACT: Restoration of endodontically treated tooth has always been a matter of restorative practice in dentistry. Endodontically treated tooth has a tendency to fracture because of the pulp is removed and significant loss of dental structure. Biomimetic restoration using fiber-reinforced composite (FRC) as post-obturation material has the ability to resist fracture and good aesthetic. A 21-year-old male presented with discomfort in eating and has no symptoms. The patient has no history of systemic disease. The intraoral clinical examination showed deep caries on the right mandibular first molar, negative on vitality, percussion, and bite test. A radiographic examination was done and showed the image of chronic apical periodontitis. The access cavity was prepared under rubber dam isolation. Root canal preparation was done by crown-down technique followed by irrigation using 5.25% sodium chloride and intracanal medicament with calcium hydroxide. The obturation procedure was conducted after seven days, using a warm vertical compaction technique and calcium hydroxide-based sealer. Considering the remaining hard tissue, a direct composite using FRC as dentine-replacing material was done. Direct restoration using FRC can be an option for restoration of the mandibular right second molar tooth with endodontic treatment.

1 INTRODUCTION

Root canal treatment aims to treat pulp necrosis and damaged teeth so that the teeth can still function (Kalalo *et al.* 2022). Root canal treatment significantly reduces the tooth's strength (Shah *et al.* 2021). Caries lesions, cavity preparation for access opening, trauma, and root canal preparation frequently cause structural loss, such as loss of tooth structure, including cusps, ridges, and pulp chamber's arched roof. Endodontically treated tooth may also fracture for a variety of reasons, including the use of chemicals and intracanal medications, as well as non-iatrogenic factors such as the occurrence of repeated pathology, teeth position, and the impact of aging on the dentine tissues (Garlapati *et al.* 2017; Torabinejad *et al.* 2020). Teeth are prone to occlusal loading because of normal oral functions like chewing, biting, and some parafunctional habits (Shah *et al.* 2021). Therefore, in order to avoid tooth fractures, it is crucial to equip them with sufficient and acceptable restorative materials after endodontic treatment (Garlapati *et al.* 2017).

In order to allow for a reliable restoration, the tooth must still have enough good tooth structure after root canal therapy (Torabinejad *et al.* 2020). Obturated teeth can be fixed directly by putting a restorative material within the tooth, or indirectly by producing a composite resin, cast metal, or ceramic restoration (Belli *et al.* 2015). Dental restorations are created to restore the teeth's aesthetic functionality and serve as a gauge of the procedure's success (Kalalo *et al.* 2022; Ng *et al.* 2010). Not every tooth that has had a root canal needs

DOI: 10.1201/9781003402374-29

to be restored with a complete crown. The tooth can be promptly repaired with a composite resin to get good results if there is still a lot of hard tissue present (Torabinejad *et al.* 2020). The study of the structure and operation of dental tissues as models for the design and production of materials, as well as procedures for the restoration of teeth, is known as biomimetic restorative dentistry (Garoushi *et al.* 2018). The goal of restorative treatment is not able to distinguish between the natural tooth and artificial tooth because of its perfection, such as composite (Paschoal *et al.* 2014). Composite resin has several advantages, such as aesthetic properties because it can be customized to match the color of a patient's teeth and is more conservative to the tooth structure due to its adhesive system without needing extensive tooth preparation (Elfakhri *et al.* 2022).

Because posterior teeth are subjected to severe masticatory loads, the composite resin used for restorations on them needs to be wear- and fracture-resistant as well as have a good radiopaque effect on the radiography picture (Ritter *et al.* 2018). As previously stated, endodontically treated teeth are prone to breakage, which can be minimized by utilizing fiber-reinforced composite (FRC) materials (Garlapati *et al.* 2017). The combination of composite resin with FRC is performed on posterior teeth because the fiber will increase the strength of the composite resin restoration (Valizadeh *et al.* 2020). In comparison to other materials, using FRC in combination with composite resin can lead to a smaller micro gap (Garoushi *et al.* 2018).

2 CASE REPORT

A 21-year-old male patient who came to RSGM-P Universitas Trisakti presented with chief complaints of discomfort in eating and has no other symptoms. The patient has no history of systemic disease. The intraoral clinical examination showed deep caries on the right mandibular first molar, negative on vitality, percussion, and bite test. A radiographic examination was done and showed the image of chronic apical periodontitis (Figure 1). Tooth #46 was diagnosed with pulp necrosis with asymptomatic apical periodontitis. Root canal treatment was planned and informed consent was achieved.

Figure 1. Preoperative clinical photograph and radiograph.

3 CASE MANAGEMENT

On the first visit, tooth #46 was isolated using a rubber dam *(Rubber dam, Duradam, Malaysia)* for moisture control and better access. The carious tooth was removed using round high-speed bur and carbide bur *(Mani Inc, Japan)*. The access cavity was prepared using endo access bur and refined using Endo Z bur *(Mani Inc, Japan)*. Canals were negotiated using pre-curved k-file #6 (Dentsply, Switzerland) until apical foramen and working length were determined using the apex locator *(Tri Auto ZX II, Morita, Japan)*. Periapical radiographs were then performed to confirm the measured working length. The preparation was then continued with k-file #8, #10, #15, and NiTi rotary *(M3 Pro Gold, UDG, China)* up to #25/.06 according to the root canal. K-file #8 was used to check apical patency while switching between shaping files and irrigation processes. The canals were thoroughly irrigated with 5,25% sodium hypochlorite (NaOCl) (*NaOCl, Onemed, Indonesia*) and 17% Ethylenediaminetetraacetic acid (EDTA), using a closed-ended tip of 30G and were dried with paper points. Gutta-percha master cone #25/.06 (*UDG, China*) fitting was done in accordance with the working length and was confirmed with a periapical radiograph. Intracanal medicament was then applied using calcium hydroxide ($Ca(OH)_2$) (*UltraCal, Ultradent, USA*) for 1 week.

On the second visit, the canals were extensively rinsed with 5,25% sodium hypochlorite (NaOCl), 17% ethylenediaminetetraacetic acid (EDTA) (*Prevest, USA*), and 2% chlorhexidine gluconate *(CHX, Onemed, Indonesia)*. An active irrigation system was used *(Endoactivator, Dentsply, Switzerland)*. The canals then being dried with paper points. Obturation was carried out using a gutta percha master cone and a calcium hydroxide-based sealer *(Sealapex, Kerr, USA)* utilizing a warm vertical condensation approach and confirmed with a periapical radiograph (Figure 2a and b)

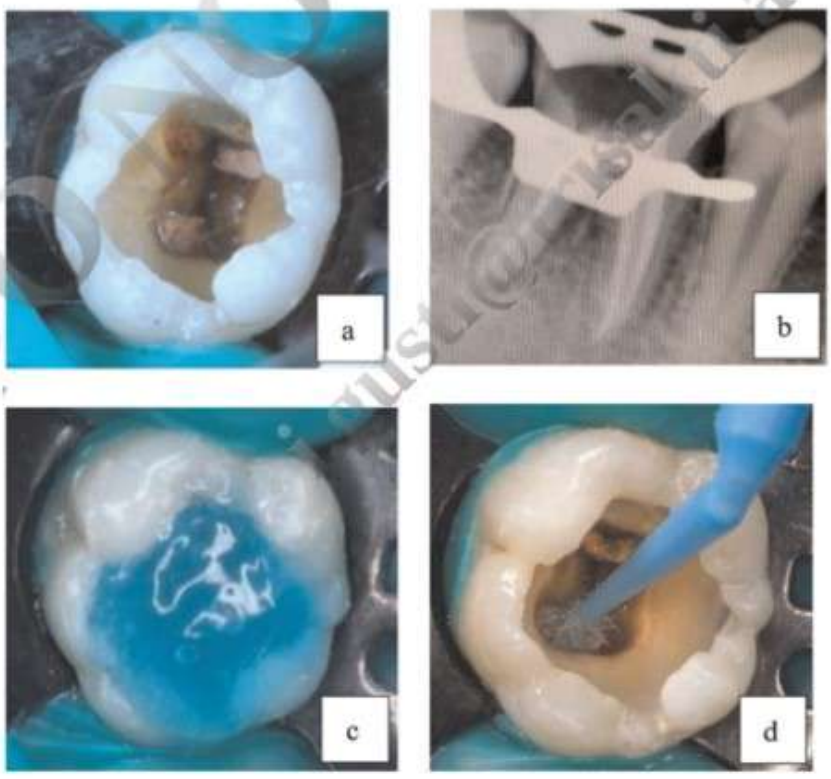


Figure 2. a. Obturation, b. Obturation radiograph, c. Etching, d. Bonding.

Restoration using Class I composite resin and fiber-reinforced composite follows. About 37% phosphoric acid was used to etch the cavities on the email for 15 seconds and the prepared dentin for 10 seconds (Figure 2c). After that, the area was washed with water. The entire cavity was lightly coated with the seventh generation of the bonding material *(Optibond, Kerr, USA)* (Figure 2d). The cavity was exposed to the wind for 10 seconds, followed by 20 seconds of light curing. Application of orifice barrier using bulk fill flow composite *(Tetric Ceram, Ivoclar Vivadent, Germany)* and filled with about 2 mm then polymerized using a light cure for 20 seconds (Figure 3a). The cavity was coated with fiber-reinforced composite *(EverX, GC, Japan)*, which was allowed to cure for 20 seconds (Figure 3b). Bulk fill shade A3 with a low shrinkage flowable base *(Xtra base, VOCO, Germany)* was applied, smoothed with a composite carving tool, and polymerized with a light cure for 20 seconds (Figure 3c). Composite resin filling with an incremental layering technique with shade A2 *(Filtek TM Z250, 3M Espe, Germany)*, and shaped according to tooth anatomy #46 cusp per cusp and polymerization one by one with light cure for 20 seconds (Figure 3d). Application of glycerin gel on the tooth surface and polymerization with a light cure for 20 seconds (Figure 3e). Occlusion and articulation were checked using articulating paper. Finishing and polishing were done with a fine-finishing, flame bur *(Mani, Japan)*, and a twist composite polisher *(Eve Diacomp, VDDI, Germany)* confirmed with a periapical radiograph (Figure 4).

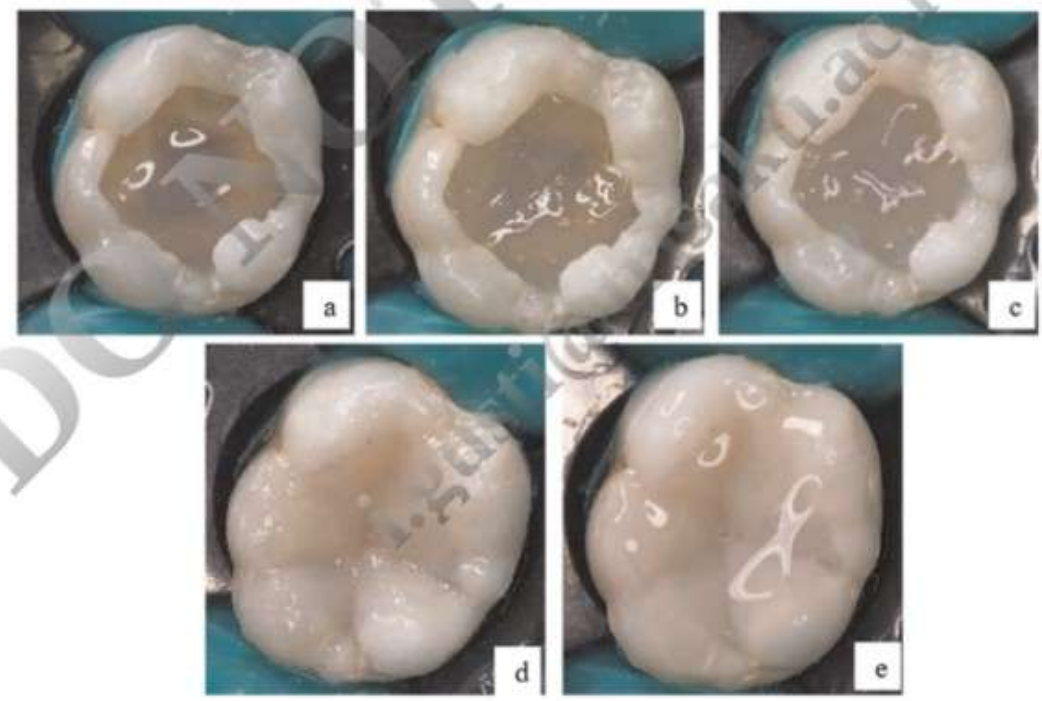


Figure 3. a. Coronal seal, b. Fiber-reinforced composite, c. Low shrinkage flowable base composite bulk fill, d. Composite restoration using packable composite, e. Application of glycerin gel.

Figure 4. Postoperative clinical photograph and radiograph.

4 DISCUSSION

Endodontically treated teeth have decreased coronal and radicular tissue due to dental cavities, operational procedures, root canal preparation, and prior restoration and restorative operations that necessitate considerable reduction of the tooth, resulting in further tissue loss (Belli *et al.* 2015). Access cavity preparation during endodontic therapy affects the structural viability of the dental tissues and further weakens the tooth, making it more brittle and susceptible to fracture (Garlapati *et al.* 2017; Torabinejad *et al.* 2020). The amount of dental tissue still present is crucial because fracture resistance is impacted by disrupted marginal integrity or significant cavities (Shah *et al.* 2021). If the tooth has dentin walls surrounding the access cavity, the structure will weaken minimally (Torabinejad *et al.* 2020). This discovery highlights the need of preserving as much healthy tissue as practicable during endodontic and restorative operations, as the structural stability of a tooth is strongly dependent on its anatomical form and quantity (Nicola *et al.* 2016). The majority of molars will not require posts for restoration since they have relatively big pulp chambers that provide retention and resistance (Torabinejad *et al.* 2020). In this case, the cavity of the right mandibular first molar was Class I, and the remaining dentin was adequate so biomimetic direct restoration was chosen for the final restoration using composite and no post was required.

The use of composite as a biomimetic restoration in the treatment of posterior teeth has proven to be very effective (Manhart 2013). Due to their excellent aesthetics, minimally invasive tooth preparations, and acceptable durability, composite resins are commonly used in dental practices (Paschoal *et al.* 2014). However, an important consideration during post-endodontic restoration is needed, using of the proper material that can resist fracture to restore teeth that have completed endodontic treatment (Valizadeh *et al.* 2020).

Fiber-reinforced composite (FRC) materials are used to help protect endodontically treated teeth that are prone to breakage (Garlapati *et al.* 2017). Composites reinforced with polyethylene fibers assist in altering the stress pattern and transferring stresses. Glass fibers provide adequate aesthetics and reinforcement capabilities (Shah *et al.* 2021). FRC offers strong flexure strength and fatigue strength, a modulus of elasticity similar to dentin, good aesthetic characteristics, is not corrosive, is biocompatible, and can distribute pressure more

uniformly under pressure to prevent fracture (Cheung 2005). When compared to composite alone, FRC has better fracture toughness (2.9 MPa m1/2), flexural strength (124 MPa), and modulus (9.5 GPa) (Garoushi *et al.* 2018). EverX posterior is a novel material with irregular and discontinuous fibers that improve the capacity to support a load, act as a replacement for dentin, minimize crack initiation and strengthen the structure (Shah *et al.* 2021). Higher crack resistance is achieved when flowable composites are combined with fiber than when flowable composites are used alone (Garoushi *et al.* 2013).

Based on prior research, this case is using the combination of flowable composite, FRC, and packable composite. A substructure of continuous two-direction or short random FRC inserted beneath the particle filler composite resin can increase its capacity to support a load (Belli *et al.* 2015). It is composed of a resin matrix, random orientation E-glass fibers, and inorganic particle fillers (Garoushi *et al.* 2018). These fibers control stress by absorbing and distributing stresses to the tooth when a heavy load is applied to the dental tissue. This is achievable because of the monoblock produced between dentin and restorative material (Garlapati *et al.* 2017). It was also mentioned that fibers impact the reduction of the C-factor and the improvement of micro tensile bond strength (Valizadeh *et al.* 2020). The inclusion of glass fibers within the resin composite may vary the material's elastic modulus, hence altering the stress distribution and transmission to residual hollow walls. In addition, as the tensile properties of the restorative material at the restoration contact increase, the deformation of dental structures reduces (Scotti *et al.* 2016). On the other hand, the bulk-fill material that was used in this case has the ability to accelerate the application and reduce chairside time and polymerization shrinkage, hence reducing the micro gap risk on the margins and enhancing the material's adaptability (Garoushi *et al.* 2018). The final layer of this restoration is using a nanohybrid composite with incremental techniques to create a biomimetic restoration. The nanohybrid composite has been demonstrated in several studies to be the best alternative when it is used as a single restorative for replicating anatomy and when it is combined with FRC, it will give more longevity if the tooth structure is damaged (Ruprai *et al.* 2022).

5 CONCLUSION

Composite resin restoration with fiber-reinforced composite may be a choice for the biomimetic restoration of the right mandibular first molar tooth that has been endodontically treated in order to improve the mastication strength of posterior teeth.

REFERENCES

Belli, S., Eraslan, O., & Eskitascioglu, G. 2015. Direct restoration of endodontically treated teeth: a brief summary of materials and techniques. *Current Oral Health Reports* 2: 182–189.

Cheung, W. 2005. A review of the management of endodontically treated teeth: Post, core and the final restoration. *The Journal of the American Dental Association* 136(5): 611–619.

Elfakhri, F., Alkahtani, R., Li, C., & Khaliq, J. 2022. Influence of filler characteristics on the performance of dental composites: A comprehensive review. *Ceramics International*.

Garlapati, T.G., Krithikadatta, J., & Natanasabapathy, V. 2017. Fracture resistance of endodontically treated teeth restored with short fiber composite used as a core material—An in vitro study. *Journal of Prosthodontic Research* 61(4): 464–470.

Garoushi, S., Gargoum, A., Vallittu, P.K., & Lassila, L. 2018. Short fiber-reinforced composite restorations: a review of the current literature. *Journal of Investigative and Clinical Dentistry* 9(3): e12330.

Garoushi, S., Mangoush, E., Vallittu, M., & Lassila, L. 2013. Short fiber reinforced composite: a new alternative for direct onlay restorations. *The Open Dentistry Journal* 7: 181.

Kalalo, W.W., Johanna, A., & Supit, A.S.R. 2022. Restoration of Post Root Canal Treatment. *E-GiGi* 10(1): 75–80.

Manhart, J. 2013. The use of composite combinations in posterior teeth. *J Int Dentistry* 8(4): 20–32.

Ng, Y., Mann, V., & Gulabivala, K. 2010. Tooth survival following non-surgical root canal treatment: a systematic review of the literature. *International Endodontic Journal* 43(3): 171–189.

Paschoal, M.A., Santos-Pinto, L., Nagle, M., & Ricci, W.A. 2014. Esthetic and function improvement by direct composite resins and biomimetic concept. *J Contemp Dent Pract* 15(5): 654–658.

Ritter, A., Boushell, L.W., & Walter, R. 2018. *Sturdevant's Art and Science of Operative Dentistry-(2018)*.

Ruprai, S., Shin, S., & Dang, J. 2022. Biomimetic approach in tooth conservation and fracture resistance: A short descriptive review of current biomaterials and techniques. *Int J Orl Health* 2(1): 1–6.

Scotti, N., Forniglia, A., Tempesta, R.M., Comba, A., Saratti, C.M., Pasqualini, D., Alovisi, M., & Berutti, E. 2016. Effects of fiber-glass-reinforced composite restorations on fracture resistance and failure mode of endodontically treated molars. *Journal of Dentistry* 53: 82–87.

Shah, E.H., Shetty, P., Aggarwal, S., Sawant, S., Shinde, R., & Bhol, R. 2021. Effect of fibre-reinforced composite as a post-obturation restorative material on fracture resistance of endodontically treated teeth: a systematic review. *The Saudi Dental Journal* 33(7): 363–369.

Torabinejad, M., Fouad, A., & Shabahang, S. 2020. *Endodontics e-book: Principles and practice*. Elsevier Health Sciences.

Valizadeh, S., Ranjbar Omrani, L., Deliperi, S., & Sadeghi Mahounak, F. 2020. Restoration of a nonvital tooth with fiber reinforce composite (wallpapering technique). *Case Reports in Dentistry* 2020.

Fiber Reinforced Composite in Endodontically Treated Tooth: Case Report

by Meiny Faudah Amin

Submission date: 07-Jan-2025 09:30AM (UTC+0700)
Submission ID: 2380788124
File name: FORIL_JOCELINE_SETIAWAN.docx (2.68M)
Word count: 2369
Character count: 13716

Fiber Reinforced Composite in Endodontically Treated Tooth: Case Report

Joceline Setiawan[1], Taufiq Ariwibowo[2*], Meiny Faudah Amin[3]

[1,2,3] Department of Conservative Dentistry, Faculty of Dental Medicine, Universitas Trisakti, Jakarta, Indonesia

*Correspondence author

Email Address:

Corresponding author: taufiq@trisakti.ac.id

ABSTRACT

Background(s): Restoration of endodontically treated tooth has always been a matter of restorative practice in dentistry. Endodontically treated tooth has a tendency to fracture because of pulp is removed and significant loss of dental structure. Biomimetic restoration using fiber reinforced composite (FRC) as post-obturation material has the ability to resist fracture and good aesthetic.

Case report(s): A 21-year-old male presented with discomfort in eating and has no symptoms. The patient has no history of systemic disease. The intraoral clinical examination showed deep caries on the right mandibular first molar, negative on vitality, percussion, and bite test. A radiographic examination was done and showed the image of chronic apical periodontitis.

Case Management(s): The access cavity was prepared under rubber dam isolation. Root canal preparation was done by crown-down technique followed by irrigation using 5.25% sodium chloride and intracanal medicament with calcium hydroxide. The obturation procedure was conducted after seven days, using a warm vertical compaction technique and calcium hydroxide-based sealer. Considering the remaining hard tissue, a direct composite using FRC as dentine-replacing material was done.

Conclusion(s): Direct restoration using FRC can be an option for restoration of the mandibular right second molar tooth with endodontically treated.

Keywords: fiber reinforced composite, endodontically treated tooth, biomimetic restoration

BACKGROUND(s)

Root canal treatment aims to treat pulp necrosis and damaged teeth so that the teeth can still function.[1] Root canal treatment significantly reduces the tooth's strength.[2] Caries lesion, cavity preparation for access opening, trauma, and root canal preparation frequently cause structural loss, such as loss of tooth structure, including cusps, ridges, and pulp chamber's arched roof.[3,4] Endodontically treated tooth may also fracture for a variety of reasons, including the use of chemicals and intracanal medications, as well as non-iatrogenic factors such as the occurrence of repeated pathology, teeth position, and the impact of aging on the dentine tissues.[3,4] Teeth are prone to occlusal loading because of normal oral functions like chewing, biting, and some parafunctional habits.[2] Therefore, in order to avoid tooth fractures, it is crucial to equip them with sufficient and acceptable restorative materials after endodontic treatment.[3]

In order to allow for a reliable restoration, the tooth must still have enough good tooth structure after root canal therapy.[4] Obturated teeth can be fixed directly by putting a restorative material within the tooth, or indirectly by producing a composite resin, cast metal, or ceramic restoration.[5] Dental restorations are created to restore the teeth's aesthetic functionality and serve as a gauge of the procedure's success.[1,6] Not every tooth that has had a root canal needs to be restored with a complete crown.[4] The tooth can be promptly repaired with a composite resin to get good results if there is still a lot of hard tissue present[4]. The study of the structure and operation of dental tissues as models for the design and production of materials, as well as procedures for the restoration of teeth, is known as biomimetic restorative dentistry.[7] The goal of restorative treatment is not able to distinguish between the natural tooth and artificial tooth because of its perfection, such as composite.[8] Composite resin has several advantages, such as aesthetic properties because it can be customized to match the color of a patient's teeth and is more conservative to the tooth structure due to its adhesive system without needing extensive tooth preparation.[9]

Since posterior teeth are subjected to severe masticatory loads, the composite resin used for restorations on them needs to be wear- and fracture-resistant as well as have a good radiopaque effect on the radiography picture.[10] As previously stated, endodontically treated teeth are prone to breakage, which can be minimized by utilizing fiber-reinforced composite (FRC) materials.[3] The combination of composite resin with FRC is performed on posterior teeth because the fiber will

increase the strength of the composite resin restoration.[11] In comparison to other materials, using FRC in combination with composite resin can lead to a smaller micro gap.[7]

CASE REPORT(s)

A 21-year-old male patient who came to RSGM-P Universitas Trisakti presented with chief complained of discomfort in eating and has no other symptoms. The patient has no history of systemic disease. The intraoral clinical examination showed deep caries on the right mandibular first molar, negative on vitality, percussion, and bite test (Figure 1A). A radiographic examination was done and showed the image of chronic apical periodontitis (Figure 1B). Tooth #46 was diagnosed with pulp necrosis with asymptomatic apical periodontitis. Root canal treatment was planned and informed consent was achieved.

On the first visit, tooth #46 was isolated using a rubber dam (Rubber dam, Duradam) for moisture control and better access. The carious tooth was removed using round high-speed bur and carbide bur (Mani, Japan). Access cavity was prepared using endo access bur and refined using Endo Z bur (Mani, Japan). Canals were negotiated using pre-curved k-file #6 (Dentsply, Switzerland) until apical foramen and working length were determined using the apex locator (Tri Auto ZX II, Morita). Periapical radiographs were then performed to confirm the measured working length. The preparation was then continued with k-file #8, #10, #15, and NiTi rotary (M3 Pro Gold, Hympari) up to #25/.06 according to the root canal. K-file #8 was used to check apical patency while switching between shaping files and irrigation processes. The canals were thoroughly irrigated with 5,25% sodium hypochlorite (NaOCl) (NaOCl, Onemed) and 17% Ethylenediaminetetraacetic acid (EDTA), using a closed-ended tip of 30G (Endo Needle, OneMed) and were dried with paper points. Gutta-percha master cone #25/.06 (UDG, Hympari) fitting was done in accordance with the working length and was confirmed with a periapical radiograph. Intracanal medicament was then applied using calcium hydroxide ($Ca(OH)_2$) (UltraCal, Ultradent) for 1 week.

On the second visit, the canals were extensively rinsed with 5,25% sodium hypochlorite (NaOCl), 17% ethylenediaminetetraacetic acid (EDTA), and 2% chlorhexidine gluconate (NaOCl, Onemed). An active irrigation system was used (Endoactivator, Dentsply). The canals then being

dried with paper points. Obturation was carried out using a gutta percha master cone and a calcium hydroxide-based sealer (Sealapex, Kerr) utilizing a warm vertical condensation approach and confirmed with a periapical radiograph (Figure 2A,B).

Restoration using Class I composite resin and fiber reinforced composite follows. 37% phosphoric acid was used to etch the cavities on the email for 15 seconds and the prepared dentin for 10 seconds (Figure 2C). After that, the area was washed with water. The entire cavity was lightly coated with the seventh generation of the bonding material (Kerr, Ivoclar) (Figure 2D). The cavity was exposed to the wind for 10 seconds, followed by 20 seconds of light curing. Application of orifice barrier using bulk fill flow composite (Tetric Ceram, Ivoclar Vivadent) and filled with about 2 mm then polymerized using a light cure for 20 seconds (Figure 2E).. The cavity was coated with fiber-reinforced composite (EverX, GC), which was allowed to cure for 20 seconds (Figure 2F). Bulk fill shade A3 with a low shrinkage flowable base (Xtra base, VOCO) was applied, smoothed with a composite carving tool, and polymerized with a light cure for 20 seconds (Figure 2G). Composite resin filling with an incremental layering technique with shade A2 (Filtek TM Z250, 3M), and shaped according to tooth anatomy #46 cusps per cusp and polymerization one by one with light cure 20 seconds (Figure 2H). Application of glycerin gel on the tooth surface and polymerization with a light cure for 20 seconds (Figure 2I). Occlusion and articulation were checked using articulating paper. Finishing and polishing with a fine-finishing burr with a flame (Mani, Japan) and a twist composite polisher (Eve Diacomp, Fondaco) (Figure 3J).

DISCUSSION(s)

Endodontically treated teeth have decreased coronal and radicular tissue due to dental cavities, operational procedures, root canal preparation, and prior restoration and restorative operations that necessitate considerable reduction of the tooth, resulting in further tissue loss.[5] Access cavity preparation during endodontic therapy affects the structural viability of the dental tissues and further weakens the tooth, making it more brittle and susceptible to fracture.[3,4] The amount of dental tissue still present is crucial because fracture resistance is impacted by disrupted marginal integrity or significant cavities.[2] If the tooth has dentin walls surrounding the access cavity, the structure will weaken minimally.[4] This discovery highlights the need of preserving as

much healthy tissue as practicable during endodontic and restorative operations, as the structural stability of a tooth is strongly dependent on its anatomical form and quantity.[12] The majority of molars will not require posts for restoration since they have relatively big pulp chambers that provide retention and resistance.[4] In this case, the cavity of the right mandibular first molar was Class I, and the remaining dentin was adequate so direct restoration was chosen for the final restoration using a combination of composite and fiber-reinforced composite (FRC).

The use of composite as a biomimetic restoration in the treatment of posterior teeth has proven to be very effective.[13] Due to their excellent aesthetics, minimally invasive tooth preparations, and acceptable durability, composite resins are commonly used in dental practices.[8] However, an important consideration during post-endodontic restoration is needed, using of the proper material that can resist fracture to restore teeth that have completed endodontic treatment.[11] FRC materials are used to help protect endodontically treated teeth that are prone to breakage.[3] Composites reinforced with polyethylene fibers assist in altering the stress pattern and transferring stresses. Glass fibers provide adequate aesthetics and reinforcement capabilities.[2] FRC offers strong flexure strength and fatigue strength, a modulus of elasticity similar to dentin, good aesthetic characteristics, is not corrosive, is biocompatible, and can distribute pressure more uniformly under pressure to prevent fracture.[14] When compared to composite alone, FRC has better fracture toughness (2.9 MPa m1/2), flexural strength (124 MPa), and modulus (9.5 GPa).[7] EverX posterior is a novel material with irregular and discontinuous fibers that improve the capacity to support a load, act as a replacement for dentin, minimize crack initiation and strengthen the structure.[2] Higher crack resistance is achieved when flowable composites are combined with fiber than when flowable composites are used alone.[15] Based on prior research, in this case is using the combination of flowable composite, FRC, and packable composite. A substructure of continuous two-direction or short random FRC inserted beneath the particle filler composite resin can increase its capacity to support a load.[5] It is composed of a resin matrix, random orientation E-glass fibers, and inorganic particle fillers.[7] These fibers control stress by absorbing and distributing stresses to the tooth when a heavy load is applied to the dental tissue. Due to the monoblock produced between dentin and restorative material, this is achievable.[3] It was also mentioned that fibers impact the reduction of the C-factor and the improvement of micro tensile bond strength.[11] On the other hand, the bulk-fill material that was used in this case has the ability to accelerate the application and

reduce chairside time and polymerization shrinkage, hence reducing the micro gap risk on the margins and enhancing the material's adaptability.[7] The inclusion of glass fibers within the resin composite may vary the material's elastic modulus, hence altering the stress distribution and transmission to residual hollow walls.[12] In addition, as the tensile properties of the restorative material at the restoration contact increase, the deformation of dental structures reduces.[12]

CONCLUSION(s)

Composite resin restoration with fiber-reinforced composite may be a choice for the biomimetic restoration of the right mandibular first molar tooth that has been endodontically treated in order to improve the mastication strength of posterior teeth.

ACKNOWLEDGEMENT

This case report was supported by the Faculty of Dentistry, Universitas Trisakti. There are no conflicts of interest to declare. The publication of this manuscript is supported by Universitas Trisakti

REFERENCES

1. Kalalo WW, Khoman JA, Supit ASR. Restoration of Post Root Canal Treatment. e-GiGi. 2022 Feb 24;10(1):75.

2. Shah EH, Shetty P, Aggarwal S, Sawant S, Shinde R, Bhol R. Effect of fibre-reinforced composite as a post-obturation restorative material on fracture resistance of endodontically treated teeth: A systematic review. Vol. 33, Saudi Dental Journal. Elsevier B.V.; 2021. p. 363–9.

3. Garlapati TG, Krithikadatta J, Natanasabapathy V. Fracture resistance of endodontically treated teeth restored with short fiber composite used as a core material—An in vitro study. J Prosthodont Res. 2017 Dec 1;61(4):464–70.

4. Torabinejad M, Fouad AF, Shabahang S. ENDODONTICS PRINCIPLES AND PRACTICE. Sixth. Elsevier; 2020. 350–364 p.

5. Belli S, Eraslan O, Eskitascioglu G. Direct Restoration of Endodontically Treated Teeth: a Brief Summary of Materials and Techniques. Vol. 2, Current Oral Health Reports. Springer Science and Business Media B.V.; 2015. p. 182–9.

6. Ng YL, Mann V, Gulabivala K. Tooth survival following non-surgical root canal treatment: A systematic review of the literature. Vol. 43, International Endodontic Journal. 2010. p. 171–89.

7. Garoushi S, Gargoum A, Vallittu PK, Lassila L. Short fiber-reinforced composite restorations: A review of the current literature. Vol. 9, Journal of investigative and clinical dentistry. 2018. p. e12330.

8. Paschoal MA, Santos-Pinto L, Nagle M, Ricci WA. Esthetic and function improvement by direct composite resins and biomimetic concept. Journal of Contemporary Dental Practice. 2015;15(5):654–8.

9. Elfakhri F, Alkahtani R, Li C, Khaliq J. Influence of filler characteristics on the performance of dental composites: A comprehensive review. Vol. 48, Ceramics International. Elsevier Ltd; 2022. p. 27280–94.

10. Ritter A, Boushell LW, Walter R. Sturdevant's Art and Science of Operative Dentistry - 7th Edition (2018). 2018.

11. Valizadeh S, Ranjbar Omrani L, Deliperi S, Sadeghi Mahounak F. Restoration of a Nonvital Tooth with Fiber Reinforce Composite (Wallpapering Technique). Case Rep Dent. 2020;2020.

12. Nicola S, Alberto F, Riccardo MT, Allegra C, Massimo SC, Damiano P, et al. Effects of fiber-glass-reinforced composite restorations on fracture resistance and failure mode of endodontically treated molars. J Dent. 2016 Oct 1;53:82–7.

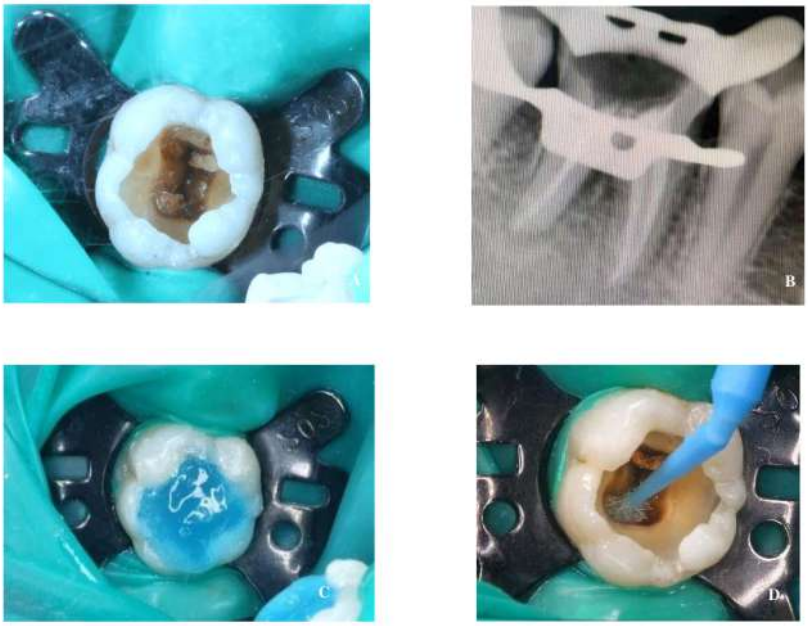
13. Manhart J. The use of composite combinations in posterior teeth. International Dentistry-African Edition. 2013;3(2):18–29.

14. Cheung W. A review of the management of endodontically treated teeth: Post, core and the final restoration. Journal of the American Dental Association. 2005;136(5):611–9.

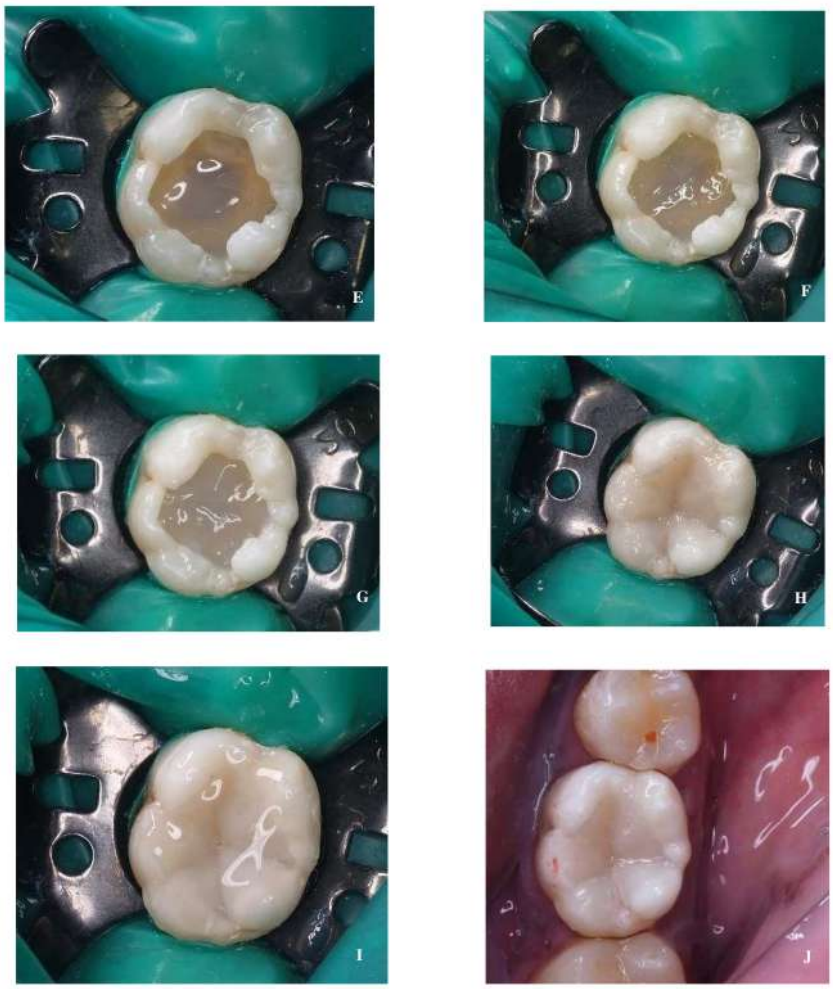
15. Garoushi S, Mangoush E, Vallittu P, Lassila L. Short Fiber Reinforced Composite: a New Alternative for Direct Onlay Restorations. 2013.

FIGURES

Figure 1A. Preoperative Intraoral (occlusal view), **B.** Preoperative radiograph



Gambar 2A. Obturation, **B.** Obturation radiograph, **C.** Etching, **D.** Bonding,



Gambar 3E. Coronal seal, **F.** Fiber-reinforced composite **G.** Low shrinkage flowable base composite bulk fill, **H.** Composite restoration using packable composite

Fiber Reinforced Composite in Endodontically Treated Tooth: Case Report

ORIGINALITY REPORT

11%	7%	7%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	zombiedoc.com Internet Source	2%
2	Sufyan Garoushi, Ausama Gargoum, Pekka K. Vallittu, Lippo Lassila. "Short fiber-reinforced composite restorations: A review of the current literature", Journal of Investigative and Clinical Dentistry, 2018 Publication	2%
3	link.springer.com Internet Source	2%
4	www.jstage.jst.go.jp Internet Source	1%
5	Nicola, Scotti, Forniglia Alberto, Riccardo Michelotto Tempesta, Allegra Comba, Massimo Saratti Carlo, Damiano Pasqualini, and Elio Berutti. "Effects of fiber-glass-reinforced composite restorations on fracture resistance and failure mode of endodontically treated molars", Journal of Dentistry, 2016. Publication	1%

6	Satheesh B. Haralur, Asim Nasser A. Alasabi, Sultan A. Abohathrah Al Qahtani, Saeed Musleh S. Alqahtani. "Influence of irrigating agents on fiber postpush-out bond strength to radicular dentin sections with the different adhesive system", European Journal of Dentistry, 2019 Publication	1 %
7	jurnal.unpad.ac.id Internet Source	1 %
8	Submitted to Institute of International Studies Student Paper	1 %

Exclude quotes	On	Exclude matches	< 15 words
Exclude bibliography	On		