Review Article

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20212632

Iatrogenic damage in restorative tooth preparation and management

Thuraya Abdulrahim Basudan^{1*}, Khalid Shami Alghaythi², Ali Abdullah Abuhabshah³, Abdullah Khaled Bin Muhareb⁴, Mastour Safar Alshahrani⁵, Noura Fahad Alabdulaziz⁶, Mohammed Saeed Algthaiae⁷, Maram Abdulshakur Alzaidi⁸, Alaa Mohammad Alandonisi⁹, Maryam Talal Alareshi¹⁰, Lama Mohammed Bazuhair¹¹

Received: 06 June 2021 Accepted: 21 June 2021

*Correspondence:

Dr. Thuraya Abdulrahim Basudan, E-mail: tbasudan@moh.gov.sa

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Iatrogenic damage in restorative teeth preparation and management constitute a significant issue that dentists and surgeons might face during and after restoration procedures. Many presentations can be observed for the injured enamel following iatrogenic damage as the presence of fine scratches, 1 mm wide vertical grooves, extensive damage and indentations. Following the occurrence of such complications, subsequent changes to the properties of the affected areas can significantly increase the risk of developing dental caries. It is essential to shedding more light on such phenomena to increase awareness among dentists and physicians and to enhance the potential outcomes. Accordingly, in this literature review, the aim was to discuss the iatrogenic damage in restorative teeth preparation and management as per evidence from the current studies in the literature. At first, the discussion was around the different types of iatrogenic injuries based on the affected regions and the incidence of adjacent teeth injury during restoration was high. Moreover, it had been discussed the potential mechanisms and contributing factors that might flare up the injury and increase the risk of significant damage induction. Hypersensitivity and using rough materials are two common factors that may induce inflammation and induce damage. Further investigations might be needed for the implication of safe practices for surgeons and dentists to enhance the outcomes.

Keywords: Iatrogenic, Damage, Dentistry, Restoration

INTRODUCTION

Iatrogenic damage in restorative teeth preparation and management constitute a significant issue that dentists and surgeons might face during and after restoration procedures. Moreover, previous studies have demonstrated that adjacent damage is inevitable during class II and conventional full-crown preparations.¹⁻³ Previous investigations have reported that the risk of

¹Department of Restorative Dentistry, East Jeddah Hospital, Jeddah, Saudi Arabia

²College of Dentistry, University of Hail, Hail, Saudi Arabia

³College of Dentistry, King Khalid University, Abha, Saudi Arabia

⁴General Dentist, Ministry of Health, Al-Jouf, Saudi Arabia

⁵General Dentist, Ministry of Health, Khamis Mushait, Saudi Arabia

⁶College of Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia

⁷General Dentist, Ministry of Health, Riyadh, Saudi Arabia

⁸College of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia

⁹College of Dentistry, Umm Al-Qura University, Mecca, Saudi Arabia

¹⁰College of Dentistry, Alfarabi Colleges, Jeddah, Saudi Arabia

¹¹College of Dentistry, Ibn Sina National College, Jeddah, Saudi Arabia

adjacent dental injuries is hugely variable and can range between 49-97% among previous *in vivo* and *in vitro* investigations.^{4,5} Many presentations can be observed for the injured enamel following iatrogenic damage as the presence of fine scratches, 1 mm wide vertical grooves, extensive damage and indentations.^{4,5} Following the occurrence of such complications, subsequent changes to the properties of the affected areas can significantly increase the risk of developing dental caries.⁶⁻⁹ Besides, it was also reported that removal of the outer parts of the affected enamels and their potential exposure can also significantly be associated with more frequent solubility of water-soluble and acid-like substances that can also lead to the development of further complications.⁶

Moreover, it has been reported that many factors can contribute to the potential iatrogenic damage during restoration. However, it appears that the factors are mainly related to the performing surgeons and their experience in performing successful procedures. ^{10,11} Therefore, it was essential to shedding more light on such phenomena to increase awareness among dentists and physicians and enhance the potential outcomes. Accordingly, in this literature review, the aim was to discuss the iatrogenic damage in restorative teeth preparation and management as per evidence from the current studies in the literature.

METHODS

This literature review was based on an extensive literature search in Medline, Cochrane and Embase databases on 15 May 2021 by using the medical subject headings (MeSH) or a combination of all possible related terms. This was followed by the manual search for papers in Google Scholar and the reference lists are included at the end of this papers. Papers are around the discussion of the iatrogenic damage in restorative teeth that were screened for relevant information. There were no limits on date, language, age of participants or publication type.

DISCUSSION

Incidence of iatrogenic damage

Adjacent teeth

Many previous investigations have reported on the iatrogenic damage in restorative tooth preparation and management procedures. An old investigation by Moopnar et al previously reported the incidence of adjacent tooth damage during crown-prepared abutments to be 73.8% among a total of 652 in vivo tooth surfaces that were observed and examined in the study period, which was early strong evidence about the potential damage that can happen to these teeth during these preparations. Following this investigation, another one was published by Long et al in 1988 and included 45 extracted teeth from crown-related and MOD cavity-related preparations to find that all of these teeth were

significantly damaged following the procedure.³ Moreover, the observed damage that was done to these teeth was classified into three categories including score lines, abrasions and nicks. Based on the findings of this investigation, the authors concluded that it is recommended that dentists and surgeons should care for proximal teeth during restorative preparations and management procedures. In a more recent investigation by Meideros et al the authors reported that among the teeth of 26 that were retrospectively included in their study.4 Consequently, up to 60% of them showed significant degrees of iatrogenic damage to the underlying and adjacent teeth when performing class II restoration procedures. Another investigation by Lussi et al also reported that conventional instruments were used for class II preparations in 134 procedures to find that all of the examined teeth within the intervention group were subjected to deep damage which was also noticed to be less severe and less frequent than other control groups.¹ In 1992, Qvist et al also reported that the incidence of iatrogenic tooth damage following class II preparation procedures in 190 proximal teeth was 64% and 69% for the observed primary and permanent teeth, respectively.⁵ Moreover, the authors reported that such iatrogenic damage can significantly increase the risk of requiring future procedures for these teeth by 3.5 and 2.5 folds for primary and permanent teeth more than the non-damaged ones. During class V composite restorations, the damage was also reported to be significant for the adjacent teeth. 15-18

Pulp

Many studies have previously reported that pulp damage is a potentiality that might occur as a result of many reasons during or after management and preparation of teeth-related preparation procedures. Complete crown preparation has been previously reported to significantly contribute to the damage of the pulp. Following teeth preparation by multiple years, previous studies have also demonstrated that pulp degeneration is a potential event. 19,20 Accordingly, dentists and surgeons should care for such events by adequate considerations during such procedures. Reducing the risk can be done by rather using suitable materials and techniques that have been reported to pose less potentiality to cause damage over other modalities. Moreover, considering the morphology of the pulp can also decrease the risk of inducing damage to the pulp, as it has been previously reported that old aging is associated with reduced sizes of the pulp chambers. Insertion within the sublingual boundaries can significantly increase the risk of inducing damage because of the difficult management of such regions.²¹

Soft tissues

The term biologic width refers to an important regional market for dentists and surgeons to consider to help them avoid the development of dental damage and induction of complications and adverse events.²²⁻²⁴ However, the

definition and width of this region are still controversial among studies in the literature. For instance, a previous investigation by Gargiulo et al previously reported that the biological width is equal to 2.04 mm.²⁵ A previous investigation by Vacek et al also reported that the average biological width for their population was similar to that reported by the previous study.²⁶ Nevertheless, they also reported that some of the patients had different measurements. Therefore, dentists should consider such phenomena when dealing with their patients. Additionally, previous studies have also demonstrated that the biological width can be hugely variable depending on the morphology of the patient, as it has been observed that the estimated width can range from 0.75-4.3 mm.^{27,28} Bone loss and inflammation can be significantly observed if the performing surgeon violated the biologic width and the restorative margin has been mistakenly placed within the area of the attachment when the restoration is aimed (Figure 1). Soft tissue damage can also be present and can lead to unpleasant events for the patient. Cheeks and tongue can both be affected during restoration. While preparing for the labial and buccal surfaces, damage to the lips and cheeks can be associated. In addition, when preparing the mandibula molars and lingual surfaces are approached, damage to the tongue can be significantly observed. Careful retraction, aspirator tip, ejection of the flanged saliva and using a mouth mirror can all aid in the risk reduction of tongue damage during restoration procedures. Carefully approaching the preparation of the mandibular molars is recommended to avoid the development of complications and not to represent any damage on the tongue of the patient.²⁹

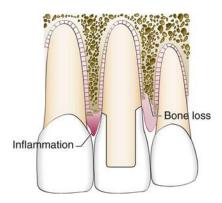


Figure 1: Bone loss and inflammation secondary to violation of the biological width.²⁹

Mechanism and contributing events

Many contributing factors have been previously reported among studies in the literature to contribute to the development of iatrogenic damage and impact the prognosis. Tooth hypersensitivity to the applied dental materials has been previously reported to occur secondary to the application and use of cheap dental alloys when performing restoration procedures.³⁰ Previous studies have also expressed that nickel, which is used in alloys, is

the main substance that contributes to the underlying inflammation. However, the frequency of inflammation following the use of nickel is still controversial among studies in the literature.31 On the other hand, using precious alloys has been reported to be associated with fewer complications secondary to the development of potential hypersensitivity. Furthermore, it has also been reported that the roughness of the used material is a more significant contributor to the development of a hypersensitivity reaction more than the material of the applied alloy.³² Gingival inflammation and plaque formation can be significantly associated with the application of rough alloys. Therefore, it can contribute to the development of related complications.³² Accordingly, subgingival roughness of the surfaces should be avoided to obtain better outcomes, as evidence also shows that gold and resin were also associated with similar rates of formation and similar frequencies plaque complications. During restoration, inadequate cleaning of any underlying debris can lead to the development of negative periodontal responses.³² Many sources have been found as major contributors to the underlying debris as impression materials, retraction cord, permanent or temporary cement and provisional materials. Adequate examination and diagnosis of the secondary underlying inflammation are essential with rapid removal of any detected foreign bodies to avoid the development of further adverse events. Besides, anesthesia should be considered when patients are not comfortable during the procedure and tissue response should be adequately monitored to ensure that the enhanced outcomes have been achieved. Preservation of the safety of the periodontium has also been previously correlated with the applied crown contour for the restorative procedures.³³ The proper use of efficacious contours can significantly lead to enhanced outcomes, such as enhancing the gingival form, maintaining adequate hygiene ,and providing adequate visual on the tooth in the anesthetized areas. Previous in vivo and in vitro investigations have indicated that over contouring is significantly associated with the development of inflammation and teeth damage during restoration while it has also been reported that under contouring is not associated with such adverse events.³⁴ Inadequate tooth restoration has been reported to be the most common factor that can significantly lead to over contouring as a result of the bulk formation to provide enough room for the restoration material. It has also been previously recommended that using flatter contours should be used when anesthetic decisions are not critical. Many other factors have also been reported to be associated with the development of iatrogenic damage as factors related to applying a rubber dam, placing the matrix, cavity preparation, marginal fit and provisional restoration. 10,35-37

Subsequent events to the iatrogenic damage

As it is widely known that tooth restoration can be associated with significant damage to the teeth where the procedures were performed and with the significant increase in the accumulation of caries. Many concerns have been aroused that such events might furtherly add to the damage of the adjacent teeth and can contribute to the development of significant damage to them. In a longterm follow up prospective investigation for four years, Vanderas et al reported that the presence of interproximal caries primary second molas and the permanent first molars was significantly associated with an elevated risk of increased mesial caries lesions on the latter teeth, being adjacent to the primary second molars that underwent restorative procedures.³⁸ A previous investigation by Xue et al also previously reported that the natural presence of dental enamels on the surface of the teeth at risk can significantly act as a protection against the development of caries and other related adverse events.³⁹ Moreover, the authors also reported that in vitro demineralization of the teeth can significantly be correlated with the features of the naturally developed white spot lesions.

CONCLUSION

We have discussed the iatrogenic damage during and after restorative tooth preparation and management procedures. At first, it has been discussed the different types of iatrogenic injuries based on the affected regions and the incidence of adjacent teeth injury during restoration is high. Moreover, we have discussed the potential mechanisms and contributing factors that might flare up the injury and increase the risk of significant damage induction. Hypersensitivity and using rough materials are the two most common factors that may induce inflammation and induce damage. Further investigations might be needed for the implication of safe practices for surgeons and dentists to enhance the outcomes.

Funding: No funding sources Conflict of interest: None declared Ethical approval: Not required

REFERENCES

- Lussi A, Gygax M. Iatrogenic damage to adjacent teeth during classical approximal box preparation. J Dent. 1998;26(5-6):435-41.
- Lussi A, Kronenberg O, Megert B. The effect of magnification on the iatrogenic damage to adjacent tooth surfaces during class II preparation. J Dent. May;31(4):291-6.
- 3. Long TD, Smith BG. The effect of contact area morphology on operative dental procedures. J Oral Rehab. 1988;15(6):593-8.
- 4. Medeiros VA, Seddon RP. Iatrogenic damage to approximal surfaces in contact with Class II restorations. J Dent. 2000;28(2):103-10.
- Qvist V, Johannessen L, Bruun M. Progression of approximal caries in relation to iatrogenic preparation damage. J Dent Res. 1992;71(7):1370-3.

- 6. Kuhar M, Cevc P, Schara M, Funduk N. Enhanced permeability of acid-etched or ground dental enamel. J Prosthet Dent. 1997;77(6):578-82.
- 7. Cevc P, Schara M, Ravnik C, Skaleric U. Study of the arrangement of crystallites in gamma-irradiated human enamel by electron paramagnetic resonance. J Dent Res. 1976;55(4):691-5.
- 8. Kuhar M, Cevc P, Schara M, Funduk N. In vitro permeability and scanning electron microscopy study of acid-etched and ground enamel surfaces protected with dental adhesive coating. J Oral Rehabil. 1999;26(9):722-30.
- 9. Twesme DA, Firestone AR, Heaven TJ, Feagin FF, Jacobson A. Air-rotor stripping and enamel demineralization in vitro. Am J Orthod Dentofacial Orthop. 1994;105(2):142-52.
- 10. Sirajuddin S, Narasappa KM, Gundapaneni V, Chungkham S, Walikar AS. Iatrogenic damage to periodontium by restorative treatment procedures: an overview. Open Dent J. 2015;9:217-22.
- 11. Milic T, George R, Walsh LJ. Evaluation and prevention of enamel surface damage during dental restorative procedures. Aust Dent J. 2015;60(3):301-8.
- 12. Hashan MR, Ghozy S, El-Qushayri AE, Pial RH, Hossain MA, AlKibria GM. Association of dengue disease severity and blood group: A systematic review and meta-analysis. Rev Med Virol. 2021;31(1):1-9.
- 13. El-Qushayri AE, Ghozy S, Abbas AS, Dibas M, Dahy A, Mahmoud AR, et al. Hyperimmunoglobulin therapy for the prevention and treatment of congenital cytomegalovirus: a systematic review and meta-analysis. Expert Rev Anti Infect Ther. 2021;19(5):661-9.
- 14. Moopnar M, Faulkner KD. Accidental damage to teeth adjacent to crown-prepared abutment teeth. Aust Dent J. 1991;36(2):136-40.
- 15. Mitchell CA, Pintado MR, Douglas WH. Iatrogenic tooth abrasion comparisons among composite materials and finishing techniques. J Prosthet Dent. 2002;88(3):320-8.
- 16. Jeffrey IW, Woolford MJ. An investigation of possible iatrogenic damage caused by metal rubber dam clamps. Int Endodont J. 1989;22(2):85-91.
- 17. Arman A, Cehreli SB, Ozel E, Arhun N, Cetinşahin A, Soyman M. Qualitative and quantitative evaluation of enamel after various stripping methods. American J Orthodont Dentofac Orthoped. 2006;130(2):131.
- 18. Zachrisson BU, Nyøygaard L, Mobarak K. Dental health assessed more than 10 years after interproximal enamel reduction of mandibular anterior teeth. American J Orthodont Dentofac Orthoped. 2007;131(2):162-9.
- 19. Baldissara P, Catapano S, Scotti R. Clinical and histological evaluation of thermal injury thresholds in human teeth: a preliminary study. J Oral Rehabil. 1997;24(11):791-801.

- 20. Ohashi Y. Research related to anterior abutment teeth of fixed partial denture. Shikagakuho. 1968;68:726.
- 21. McKee JR. Comparing condylar position repeatability for standardized versus nonstandardized methods of achieving centric relation. J Prosthet Dent. 1997;77(3):280-4.
- 22. Parma-Benfenali S, Fugazzoto PA, Ruben MP. The effect of restorative margins on the postsurgical development and nature of the periodontium. Part I. Int J Periodontics Restorative Dent. 1985;5(6):30-51.
- 23. Olsson M, Lindhe J. Periodontal characteristics in individuals with varying form of the upper central incisors. J Clin Periodontol. 1991;18(1):78-82.
- 24. Maynard JG, Wilson RD. Physiologic dimensions of the periodontium significant to the restorative dentist. J Periodontol. 1979;50(4):170-4.
- 25. Gargiulo AW, Wentz FM, Orban B. Dimensions and relations of the dentogingival junction in humans. J Periodontol. 1961;32(3):261-7.
- 26. Vacek JS, Gher ME, Assad DA, Richardson AC, Giambarresi LI. The dimensions of the human dentogingival junction. Int J Periodontics Restorative Dent. 1994;14(2):154-65.
- 27. Sorensen JA. A rationale for comparison of plaqueretaining properties of crown systems. J Prosthet Dent. 1989;62(3):264-9.
- 28. Perel ML. Axial crown contours. J Prosthet Dent. 1971;25(6):642-9.
- 29. Spear FM, Cooney JP. Restorative Interrelationships. Pocket Dentistry. Hanoi: Nguyen Phat Hanoi Joint Stock Company.
- 30. Pierce LH, Goodkind RJ. A status report of possible risks of base metal alloys and their components. J Prost Dent. 1989;62(2):234-8.
- 31. Peltonen L. Nickel sensitivity in the general population. Contact Dermatitis. 1979;5(1):27-32.

- 32. Swartz ML, Phillips RW. Comparison of bacterial accumulations on rough and smooth enamel surfaces. J Periodontol. 1957;28(4):304-7.
- 33. Hochman N, Yaffe A, Ehrlich J. Crown contour variation in gingival health. Compend Contin Educ Dent. 1983;4(4):360-1.
- 34. Parkinson CF. Excessive crown contours facilitate endemic plaque niches. J Prosthet Dent. 1976;35(4):424-9.
- 35. Felton DA, Kanoy BE, Bayne SC, Wirthman GP. Effect of in vivo crown margin discrepancies on periodontal health. J Prosthet Dent. 1991;65(3):357-64.
- 36. Marcum JS. The effect of crown marginal depth upon gingival tissue. J Prosthet Dent. 1967;17(5):479-87.
- 37. Yuodelis RA, Faucher R. Provisional restorations: an integrated approach to periodontics and restorative dentistry. Dent Clinic North Am. 1980;24(2):285-303.
- 38. Vanderas AP, Kavvadia K, Papagiannoulis L. Development of caries in permanent first molars adjacent to primary second molars with interproximal caries: four-year prospective radiographic study. Pediat Dent. 2004;26(4):362-8.
- 39. Xue J, Li W, Swain MV. In vitro demineralization of human enamel natural and abraded surfaces: a micromechanical and SEM investigation. J Dent. 2009;37(4):264-72.

Cite this article as: Basudan TA, Alghaythi KS, Abuhabshah AA, Muhareb AKB, Alshahrani MS, Alabdulaziz NF, et al. Iatrogenic damage in restorative tooth preparation and management. Int J Community Med Public Health 2021;8:3708-12.