Case Report

Design modification of a porcelain-fused-to-metal (PFM) adhesive bridge for a mandibular molar with a short clinical crown: A case report

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Received: 19 January 2026
Revised: 16 February 2026
Accepted: 20 March 2026
Published: 31 March 2026
DOI: 10.24198/pjd.vol38no1.66158

p-ISSN 1979-0201
e-ISSN 2549-6212

Citation:
Amelia A, Bonifacius S, Rakhmatia YD. Design modification of a porcelain-fused-to-metal (PFM) adhesive bridge for a mandibular molar with a short clinical crown: A case report. Padjadjaran J. Dent. March 2026;38(1):168–176.

ABSTRACT

Introduction: Replacement of a single missing posterior tooth can be effectively achieved using a fixed dental prosthesis (FDP). Resin-bonded FDPs provide a conservative alternative to conventional full-coverage FDPs because they require minimal tooth reduction and preserve the remaining tooth structure while maintaining function and aesthetics. However, short clinical crowns and lingually inclined mandibular molars may compromise retention, resistance, and the path of insertion. This case report describes the use of a modified porcelain-fused-to-metal (PFM) resin-bonded FDP with onlay metal wings and adhesive bonding to manage a mandibular molar with a short clinical crown and a lingually inclined abutment. **Case report:** A 25-year-old male patient was referred to the Prosthodontics Clinic for replacement of a missing mandibular right first molar. The tooth had been extracted approximately one year previously. Intraoral examination showed that tooth 47 was lingually inclined and had a short clinical crown. Panoramic radiography showed adequate bone support and no pathological findings, indicating that the abutment teeth were suitable for prosthetic treatment. The treatment plan involved a modified PFM adhesive bridge with a sanitary pontic replacing tooth 46 and onlay metal wings on teeth 45 and 47. Retention was achieved through a combination of mechanical interlocking, chemical bonding, and adhesive cementation. At the one-week follow-up after FDP insertion, the prosthesis demonstrated satisfactory fit and occlusion, and the patient reported no discomfort or functional problems. **Conclusion:** A modified onlay-wing design for a lingually inclined abutment with a short clinical crown, combined with adhesive resin cementation to a metal framework, may provide a simplified and predictable approach for replacing a mandibular molar using a resin-bonded FDP.

KEYWORDS

Adhesive bridge; porcelain-fused-to-metal; resin-bonded fixed dental prosthesis; short clinical crown; onlay wing

INTRODUCTION

Replacement of missing teeth is essential not only in the anterior region but also in the posterior segment, where tooth loss may compromise arch integrity and lead to tilting or migration of adjacent teeth.[1,2] Prosthesis selection should consider biomechanical, periodontal, aesthetic, financial, and patient-related factors, with an emphasis on simplified treatment. For many patients, a fixed partial denture (FPD) remains a preferred option because appropriately designed retainers and abutments can provide predictable long-term functional outcomes.[3,4]

A resin-bonded fixed partial denture (RBFDP) is a conservative alternative indicated for defect-free abutment teeth when replacing a single missing tooth. This prosthesis requires abutment support on both the mesial and distal sides of the edentulous space and incorporates a pontic form suitable for ridges with moderate resorption and no major soft-tissue defects.[5] Because the preparation is shallow and confined primarily to enamel, RBFDPs are particularly advantageous in younger patients, in whom teeth with large pulp chambers may be unsuitable for conventional full-coverage preparations.[6]

Resin-bonded bridges have evolved substantially since their initial description, particularly in relation to metal surface treatment, resin cements, and framework design, resulting in improved clinical longevity.[7] Contemporary metal-framed RBFDPs are commonly fabricated using non-perforated, sandblasted, non-precious metal substructures cemented with chemically active resin cements, which provide improved bonding and resistance to debonding.[8]

Mandibular molars with short clinical crowns and lingually inclined abutments present considerable clinical challenges when planning posterior RBFDPs. These anatomical limitations reduce the available enamel surface for bonding and compromise the path of insertion, thereby diminishing both retention and resistance form. In addition, the high occlusal load in the posterior region further increases the risk of debonding. Together, these factors make it difficult to achieve predictable long-term stability using conventional retainer designs and may require alternative approaches, such as modified onlay-wing configurations.

Recent advances in adhesive dentistry offer improved micromechanical retention, optimised resin-monomer systems, and adjunctive treatments such as laser-assisted surface conditioning, all of which may enhance the performance of RBFDPs.[9]

These improvements have contributed to a considerable reduction in debonding rates, which have historically been among the most common causes of RBFDP failure.[10] RBFDPs have therefore emerged as a promising treatment modality, providing improved aesthetics together with favourable fracture resistance and biocompatibility.[11,12] Various wing design modifications, including gingival retention grooves, anti-rotation extensions, and broader retainer coverage, have been introduced to distribute stress more effectively and enhance bonding, particularly in short clinical crowns and lingually inclined molars.[13,14]

Tooth preparation designed to improve retainer retention remains an important factor affecting the survival and longevity of fixed partial dentures. The amount of enamel available for bonding, the adhesive protocol, and variations in preparation technique all contribute to clinical performance.[15] Advances in digital dentistry have also made it possible to fabricate more precise frameworks, improving fit and reducing adjustment time during cementation.[16] These developments represent a shift from conventional cement-retained full-coverage restorations towards adhesively retained, minimally invasive tooth replacement modalities that conserve natural tooth structure and support predictable long-term clinical outcomes.

Despite these advances, most reports on posterior RBFDPs describe cases with favourable abutment anatomy. Cases involving mandibular molars with short clinical crowns and pronounced lingual inclination are rarely documented, despite their significant biomechanical implications. These anatomical limitations restrict the available bonding area, compromise the path of insertion, and reduce both retention and resistance, thereby challenging the success of conventional retainer designs. Only a few studies have described the use of modified onlay-wing configurations to address these constraints in the posterior region. This scarcity of evidence highlights a knowledge gap regarding the optimisation of such modifications for complex posterior conditions.

The novelty of the present case lies in the unusual clinical condition and the customised technique used to manage it. The patient presented with a mandibular molar abutment with a short clinical crown and marked lingual inclination, which limited the enamel available for bonding and complicated the path of insertion for an RBFDP. To overcome these limitations, a modified onlay-wing design was used to increase the bonding area, improve retention and resistance, and accommodate the unfavourable abutment angulation. This report aims to demonstrate how a modified resin-bonded FDP with onlay metal wings and adhesive bonding can be used to manage short clinical crowns and lingually inclined abutments.

Case Report

A 25-year-old male patient presented to the Prosthodontics Clinic at the Dental and Oral Hospital, Universitas Padjadjaran, with a primary complaint of difficulty chewing on the lower right side due to a missing mandibular molar. The patient reported no systemic disease, medication use, or medical condition that could affect dental treatment. Teeth 14, 36, and 46 had been extracted approximately one year previously. The patient attended regular dental visits and had no history of periodontal therapy. He had no previous experience with denture use and preferred a fixed dental prosthesis to improve comfort and mastication. The patient also wished to avoid excessive reduction of healthy tooth structure. Extraoral clinical examination revealed no abnormalities. Written informed consent was obtained from the patient for all clinical procedures and for publication of this case report, including the use of de-identified clinical images.

Intraoral examination revealed the absence of teeth 14, 36, and 46, and the patient presented with Class I Angle malocclusion. Radiographic evaluation confirmed the absence of teeth 14, 36, and 46. Tooth 47 was lingually inclined and had a short clinical crown. The root, alveolar crest–furcation, and periapical conditions of teeth 45 and 47 were within normal limits. Based on the patient's history, clinical findings, and radiographic assessment, the diagnosis was partial edentulism in the mandibular right posterior region (missing tooth 46), with a lingually inclined abutment (tooth 47) and a short clinical crown. The prognosis was considered favourable because of adequate bone support, absence of periapical pathology, and the potential to achieve sufficient retention using a modified prosthetic design. The treatment plan involved replacement of the missing tooth with a modified resin-bonded FDP, specifically a porcelain-fused-to-metal (PFM) adhesive bridge with a sanitary pontic replacing tooth 46 and onlay metal wings on teeth 45 and 47, using adhesive bonding techniques to enhance retention.

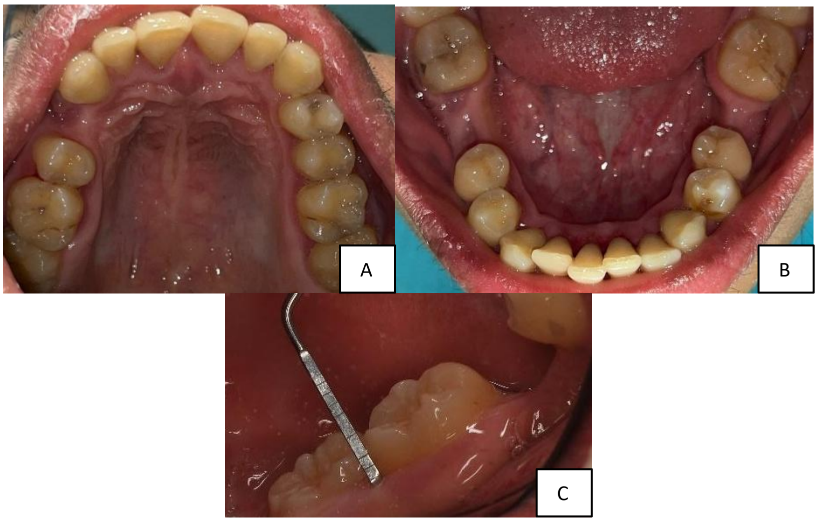

Figure 1. Intraoral examination. A. Missing tooth 14. B. Missing teeth 36 and 46. C. Clinical crown height of tooth 47 is 5 mm.

During the first visit, intraoral photographs were taken to document the clinical condition, and diagnostic casts were obtained using stock trays and alginate impression material. Pre-prosthetic management included improving oral hygiene and stabilising the periodontal condition to ensure an optimal enamel surface for bonding and to minimise functional interferences before fabrication of the RBFDP. A panoramic radiograph was obtained, and clinical evaluation of tooth vitality and mobility was performed.

The next step was to determine the appropriate prosthesis design. Design principles were considered based on several factors, including enamel coverage, interproximal contact coverage, occlusal clearance, rest design, height of contour, and proximal extension. The selected treatment was fabrication of an adhesive bridge to replace tooth 46, with a sanitary pontic design to facilitate self-cleansing. Metal onlay retainers were planned for teeth 45 and 47, with occlusal rests on the distal and mesial aspects of tooth 47 and the distal aspect of tooth 45.

Figure 2. Panoramic radiographic examination.

During the second visit, tooth preparation was initiated by establishing a single vertical path of insertion. Using a tapered diamond bur, preparation was performed to a depth of 0.3–0.5 mm, beginning on the proximal surfaces, which were modified to be either parallel or to form a 6° convergence angle, and then continuing to the lingual surfaces. The preparation margin was maintained approximately 1 mm above the gingival margin.

The resistance form was then established on the proximal surfaces. The preparation was extended to the mesiobuccal and distobuccal aspects of the abutment teeth to enhance resistance. Proximal resistance was achieved by creating either a proximal groove or a box form. To obtain a proximal wrap-around, the preparation was extended to approximately 180° or more, allowing the metal framework to achieve mechanical retention with the abutment teeth.

Subsequently, an occlusal rest was prepared using a round diamond bur. The rest seat measured 1.5–2 mm buccolingually, 1.5–2 mm mesiodistally, and approximately 1 mm in depth. The contour of the occlusal rest followed the natural tooth morphology, extending from the marginal ridge to the fossa of the abutment tooth. This occlusal rest design provided mechanical stability for the metal framework during function. The cervical margin of the preparation on the abutment teeth was finished as a supragingival chamfer.

Figure 3. Tooth preparation. A. Preparation of tooth 45 with a putty index. B. Lingual view of teeth 47 and 46. C. Preparation of tooth 47 with a putty index.

After completion of tooth preparation, an impression was made using a double-impression technique with polyvinyl siloxane material. Following bite registration, the working cast was sent to the laboratory for fabrication of the metal coping. At the subsequent visit, a metal coping try-in was performed to assess adaptation to the prepared abutments and to ensure adequate space for porcelain. The coping was fabricated from a nickel–chromium (Ni–Cr) alloy.

A sanitary pontic design was selected to facilitate self-cleansing, with onlay metal wings on teeth 45 and 47 and occlusal rests on the mesial and distal aspects of the abutment teeth. The adaptation of the coping, occlusion, and pontic–ridge relationship was carefully evaluated. Before cementation, the metal–ceramic bridge was tried in the mouth to evaluate aesthetics, retainer margin adaptation, occlusal rest seats, pontic–gingiva adaptation, contact points with adjacent teeth, and occlusal and articulating contacts.

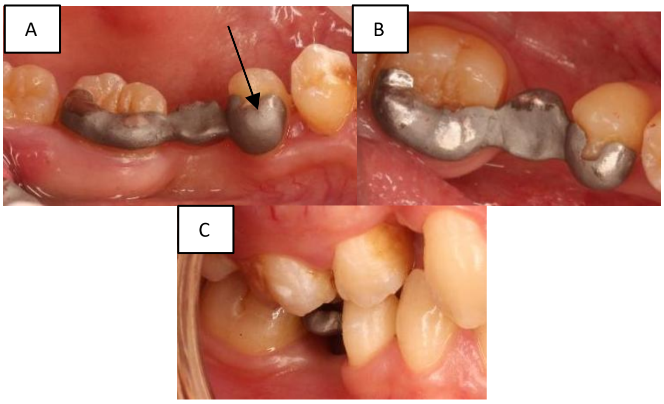

Figure 4. Adaptation of the coping on teeth 45 and 47. A. Lingual view. B. Arrow indicating the onlay wing on tooth 47. C. Occlusal view.

The enamel surfaces of the abutment teeth were cleaned using pumice with prophylactic paste, polished, thoroughly dried, and isolated. Phosphoric acid etching was performed on the enamel surfaces for 30 seconds, followed by rinsing with water for 10–30 seconds and air-drying. A bonding agent was applied to both the inner surface of the retainer onlay wing and the abutment teeth, and then light-cured. Resin cement was applied to the inner surface of the retainer wing and the prepared abutment surfaces. The adhesive bridge was positioned along the path of insertion and seated with finger pressure. Excess cement was removed, and additional light-curing was performed at the restoration margins and over the abutment teeth. Final occlusion and stability were rechecked to ensure optimal function.

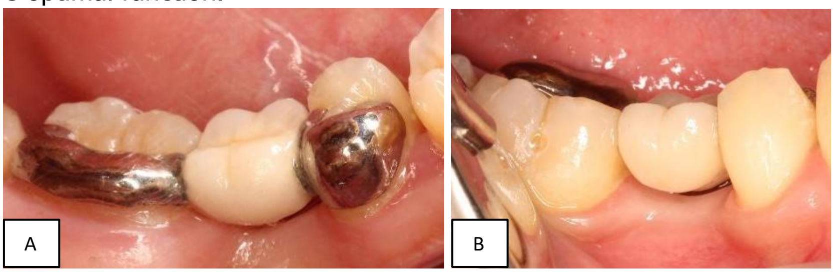

Figure 5. Cementation of the bridge on teeth 45 and 47. A. Lingual view. B. Buccal view.

A follow-up examination was conducted one week after insertion. The tissue surrounding the pontic and abutment teeth, as well as the occlusion, was evaluated. Subjectively, the patient reported no complaints and expressed satisfaction with the prosthesis. Objectively, there were no signs of gingival inflammation or food impaction, and the restoration demonstrated satisfactory retention, stability, and occlusion. The patient was advised to maintain optimal oral hygiene and attend regular periodic check-ups.

DISCUSSION

This case demonstrates that a modified resin-bonded FDP with onlay metal wings may be an effective option for managing a short clinical crown and a lingually inclined abutment. Conventional FDPs or implants may require greater tooth reduction or surgical intervention, whereas resin-bonded FDPs preserve tooth structure while maintaining function and aesthetics. In this case, the onlay metal wings were intended to improve retention and resistance where abutment morphology was unfavourable. The treatment decision was therefore based on minimal intervention combined with enhanced mechanical and adhesive retention.[33] From the patient's perspective, the outcome was satisfactory, with no discomfort or functional problems reported after insertion.[34]

Nevertheless, the short follow-up period means that long-term outcomes such as debonding, wear, or fracture could not be evaluated. As a single case report, the findings cannot be generalised, and further studies with longer follow-up periods are required.

Successful tooth preparation and restoration require simultaneous consideration of biological factors that affect oral tissue health, mechanical factors that influence restoration integrity and durability, and aesthetic factors that affect the patient's appearance.[1] Excessive removal of tooth structure to provide porcelain thickness may lead to pulpal injury and structural weakening, making careful balancing of these factors essential in clinical decision-making. [17]

Modern preparation designs incorporate features such as wrap-around coverage, proximal grooves, and occlusal rests, which enhance resistance to functional stresses without compromising conservative principles.[18,19] Establishing an appropriate path of insertion lowers the survey line and allows conservative enamel-based preparation, thereby improving bond durability.[19] In the fabrication of resin-bonded FDPs, attention to detail is required in three key phases: abutment tooth preparation, restoration design, and bonding.[20]

A key challenge in this patient was the short clinical crown height of the mandibular molar combined with lingual inclination, which reduced the available bonding area and complicated the path of insertion. These anatomical constraints directly informed the decision to use a modified onlay-wing design, as conventional lingual-wing designs alone would not provide adequate resistance against occlusal displacement. The onlay extension increased the bonding surface, created an additional vertical stop, and improved rotational resistance, consistent with evidence showing enhanced retention and load distribution in short clinical crowns.[19,21]

The choice of a metal framework rather than zirconia or an all-ceramic option was based on case-specific biomechanical demands. Metal retainers allow thinner yet stronger wings, provide favourable mechanical behaviour under high posterior occlusal load, and enable predictable bonding through oxide-layer interaction with universal adhesives.[22,23] Surface treatments performed in the laboratory and clinically, including airborne-particle abrasion, may further enhance micromechanical and chemical bonding and reduce the risk of debonding in posterior load-bearing areas.[24] In posterior RBFDPs, framework success depends on three main structural components: the occlusal rest, retentive surface, and proximal wrap with slots. These components act together to resist gingival displacement, occlusal lifting, and rotational torque.[22] This was particularly relevant because zirconia may require more aggressive preparation for mechanical retention, whereas implant therapy was not selected because the patient preferred a non-surgical and minimally invasive treatment.[25]

Clinical evidence from the past decade indicates that metal posterior adhesive bridges may achieve survival rates above 90% over 10 years when strict preparation guidelines are followed, including adequate wrap-around coverage, occlusal rests, and proximal slots. For example, Botelho et al. reported a 96% seven-year survival rate for posterior metal RBFDPs with minimal preparation designs that preserved enamel for bonding.[18] Recent clinical research also supports the reliability of this approach, reporting that posterior RBFDPs with onlay retainers in short crowns achieved a 10-year survival rate exceeding 93%, with most failures involving repairable debonding rather than catastrophic fracture.[26] Similarly, occlusal onlay wings have been reported to improve retentive strength compared with traditional lingual-wing-only designs, particularly under cyclic loading conditions that simulate posterior mastication.[27]

Periodontal considerations were also integral to treatment planning. Pontic design is a key factor in the success of resin-bonded fixed partial dentures.[28] A sanitary pontic design with supragingival margins was selected to facilitate plaque control and minimise soft-tissue inflammation, which is particularly important in posterior regions where access is limited. This design choice is supported by studies showing stable periodontal health when margins remain supragingival, and the pontic form promotes hygiene.[29,30]

A potential complication in this case is debonding, particularly because of the heavy occlusal forces in mandibular molars. The modified onlay-wing configuration may help mitigate this risk by increasing mechanical interlocking and optimising load transfer across enamel. Occlusal adjustment was performed to reduce eccentric stress, and the patient was informed about the possibility of debonding, which remains the most common and repairable complication in posterior RBFDPs.[31,32]

Overall, the biomechanical and periodontal challenges of this case justified the use of a customised metal onlay-wing RBFDP as a conservative alternative to full-coverage crowns or implant therapy. The main limitation of this case report is the short follow-up duration, which restricts the evaluation of long-term retention, resistance, and overall clinical performance of the modified onlay-wing RBFDP. In addition, as a single-case observation, the findings cannot be generalised to all posterior cases involving short, lingually inclined mandibular molars. The absence of comparative data and biomechanical analysis further limits the ability to determine whether the modified onlay-wing configuration offers consistent advantages over conventional retainer designs.

CONCLUSION

Metal posterior adhesive bridges with onlay wings offer a strong and minimally invasive solution for replacing teeth adjacent to short clinical crowns. Their biomechanical benefits may provide predictable short-term stability while preserving tooth structure. In this case, the modified onlay-wing design demonstrated favourable short-term clinical performance. However, a longer follow-up is required to confirm long-term durability and clinical value. This case implies that a modified onlay-wing design may broaden the clinical applicability of posterior adhesive bridges for mandibular molars with short, lingually inclined abutments, providing a minimally invasive option for challenging anatomical conditions while underscoring the need for further clinical validation.

Acknowledgements: The authors would like to express their gratitude to the Department of Prosthodontics, Faculty of Dentistry, Universitas Padjadjaran, for the clinical and technical support provided during the treatment and documentation of this case.
Author Contributions: Conceptualisation, A.A. and S.B.; methodology, A.A.; validation, S.B.; formal analysis, A.A.; investigation, S.B. and Y.D.R.; resources, A.A.; original draft preparation, A.A. and Y.D.R.; review and editing, A.A. and Y.D.R.; supervision, S.B.; project administration, A.A. All authors have read and approved the final version of the manuscript.
Institutional Review Board Statement: Not applicable.
Informed Consent Statement: Informed consent was obtained from the subject involved in the study.
Data Availability Statement: The data are available upon reasonable request.
Conflicts of Interest: The authors declare no conflict of interest.

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