

Prosthetic Rehabilitation of a Young Patient with Alveolar Ridge Deficiency: From a Minimally Invasive Resin-Bonded Bridge to an Ultra-Translucent Zirconia Fixed Partial Denture

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Abstract: Background: Restoration of missing mandibular incisors in young patients is often complicated by limited alveolar bone volume and incomplete skeletal maturation. **Case Report:** A 17-year-old female patient presented with loss of the two mandibular central incisors. A minimally invasive ceramic resin-bonded bridge was provided as an interim restoration to preserve tissue and esthetics during growth. At 20 years old, implant placement was indicated; however, cone-beam computed tomography revealed severe bone deficiency at the edentulous site. Consequently, a definitive ultra-translucent zirconia conventional bridge was fabricated. **Results:** After a three-year follow-up, the zirconia bridge demonstrated excellent esthetic integration, functional stability, and healthy periodontal conditions. **Conclusion:** A conservative, stepwise prosthetic approach provides a predictable and esthetic long-term solution in young patients with anterior mandibular tooth loss and bone deficiency, particularly when implant therapy is contraindicated.

Keywords: Mandibular Incisors, Resin-Bonded Bridge, Ultratranslucent Zirconia, Bone Deficiency, Conservative Approach, Fixed Prosthesis.

Case Report

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How to cite this paper:

Imen Kalghoum *et al* (2026). Prosthetic Rehabilitation of a Young Patient with Alveolar Ridge Deficiency: From a Minimally Invasive Resin-Bonded Bridge to an Ultra-Translucent Zirconia Fixed Partial Denture. *Middle East Res J. Dent.*, 6(2): 25-31.

Article History:

| Submit: 26.01.2026 |
| Accepted: 27.02.2026 |
| Published: 02.04.2026 |

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1. INTRODUCTION

Loss of mandibular incisors in young patients represents a complex restorative challenge due to a combination of functional, esthetic, and biological factors. The narrow anterior mandibular ridge frequently exhibits significant bone resorption after tooth loss, limiting implant placement options. Moreover, incomplete skeletal maturation in adolescents and young adults contraindicates implant therapy until growth completion, to avoid infra-occlusion and peri-implant tissue complications [1-3].

In this context, a conservative, minimally invasive interim approach is essential. Resin-bonded bridges (RBBs) are widely recognized as an effective solution, preserving enamel integrity, maintaining interdental papillae, and delivering esthetic results with minimal biological cost. A prospective clinical study in young patients with hypodontia showed that RBBs achieved high survival over 24 months [4]. Also, the

general long-term performance of RBBs is supported by systematic review data [5].

Once skeletal growth is completed, a definitive restoration may be considered based on the patient's bone condition and expectations. Recent advances in ceramic technology now make ultra-translucent zirconia a highly attractive option: fifth-generation multi-layered zirconia combines favorable mechanical strength with excellent optical properties, enabling esthetic fixed prostheses in the anterior region [6-8].

This case report presents the prosthetic management of a young female patient with a mandibular anterior defect and significant alveolar bone deficiency. The treatment consisted of a resin-bonded ceramic bridge during growth, followed by a definitive ultra-translucent zirconia bridge after skeletal maturation, when implant therapy was contraindicated.

2. CASE PRESENTATION

A 17-year-old female patient presented to the Department of Fixed Prosthodontics with a chief complaint of missing lower front teeth and esthetic concerns. Clinical history revealed the loss of both mandibular central incisors following trauma several years earlier.

Clinical examination showed a symmetrical smile line, preserved gingival architecture, and a narrow anterior mandibular ridge with a slight horizontal concavity. The adjacent teeth (lateral incisors and canines) were intact, vital, and well aligned. (Figure 1). She had a defective removable fixed partial denture (Figure 2). Her chief complaint was the replacement of the missing two mandibular incisors with a fixed prosthesis [9].



Figure 1: Frontal view showing the missing centrals



Figure 2: Frontal view with removable partial denture

Implant placement appeared to be an appropriate treatment option; however, the patient was only 17 years old, which is below the recommended age for minor implant surgery. Given that the lingual surfaces of the mandibular incisors were out of occlusion, and considering the adequate length, vitality, and alignment of the potential abutment teeth, a minimally invasive all-ceramic resin-bonded bridge was selected. This conservative approach served as a

provisional solution until periodontal and skeletal maturation could be reached, typically around the age of 20 years (Figure 3). Tooth preparation was limited to the lingual surfaces of the adjacent teeth to preserve enamel for adhesive bonding. The bridge was fabricated using a high-strength lithium disilicate framework, etched and silanated before adhesive cementation with light-cured resin.

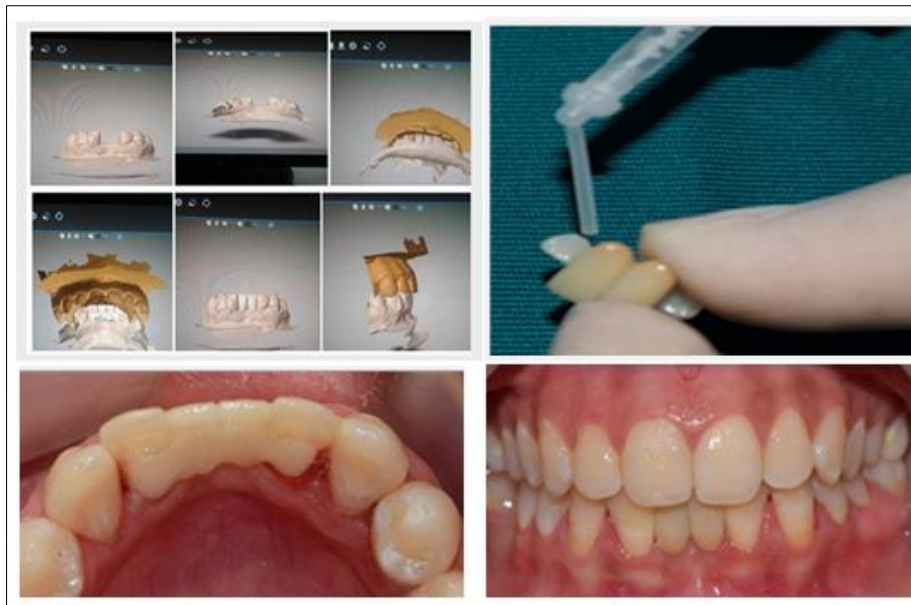


Figure 3: Conception and bonding of the provisional all-ceramic resin-bonded bridge

The restoration achieved immediate esthetic satisfaction and functional comfort. The patient was followed periodically for maintenance and monitoring of alveolar growth. However, the resin-bonded bridge fractured twice at the connector area, highlighting the mechanical limitations of this provisional solution.

At 20 years old, after confirmation of skeletal maturity, a new radiographic and clinical evaluation was performed. Cone-beam computed tomography (CBCT) revealed insufficient alveolar ridge width (less than 4 mm) and height, with thin cortical plates (Figure 5).

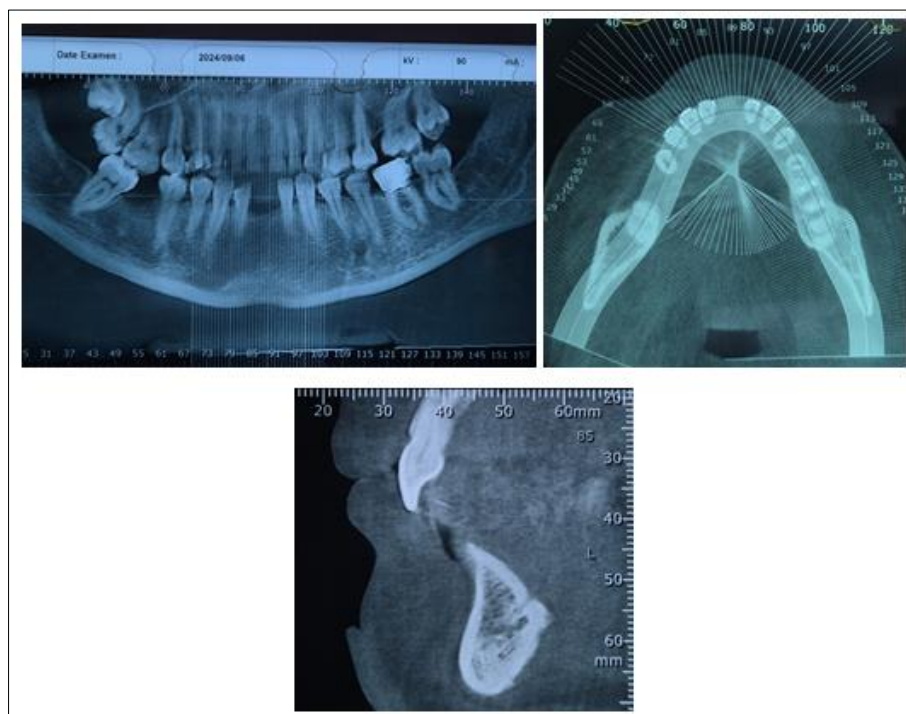


Figure 5: Coronal and oblique CBCT slices of the region of the inferior centrals

The bone deficiency made implant placement unsuitable without major augmentation.

An in situ diagnostic assessment was performed, and the elevation of a full-thickness flap

confirmed the presence of type IV bone quality associated with a knife-edge ridge morphology. Consequently, once the flap was repositioned, the clinical findings indicated that a conventional fixed dental bridge was the most appropriate treatment option

as the patient declined surgical procedures, a conventional three-unit fixed bridge was proposed.

The definitive prosthesis was fabricated in ultra-translucent fifth-generation zirconia (3Y-TZP/5Y-PSZ hybrid), (Figure 6).



Figure 6: Zirconia definitive prosthesis

The tooth preparation provided a prosthetic space of 1.5 to 2 mm, with an adequate taper of the proximal walls and meticulous rounding of all line angles, ensuring the complete absence of any undercuts.

A ¼-round chamfer finish line with a rounded internal angle was achieved, and all angles were refined using a yellow ring finishing bur providing both strength and superior esthetics (Figure 7).



Figure 7: Frontal view of the 42 and 32 preparation

The bridge was cemented using resin-modified glass ionomer cement. A periodic follow-up schedule was recommended, with evaluations at 1 month, 3 months, and then at 1 year (Figure 8).

The zirconia bridge exhibited excellent integration with surrounding dentition, natural translucency, and harmonious gingival contours. The occlusion was well balanced, and the patient reported high satisfaction regarding comfort and appearance.

At the three-years follow-up, clinical and radiographic evaluation revealed:

- Stable marginal adaptation with no secondary caries,
- Healthy periodontal tissues,
- No chipping or surface wear,
- Preserved occlusal function and phonetics.

These results confirmed the long-term stability and esthetic reliability of the zirconia bridge as a definitive solution in cases where implant therapy is not feasible (Figure 8).



Figure 8: Frontal view of the definitive zirconia bridge

4. DISCUSSION

The anterior mandibular region presents specific challenges for implant-based rehabilitation due to the limited alveolar width and proximity of the lingual cortical plate. In young patients, post-extraction resorption and delayed bone maturation further complicate the treatment [9-11].

Several studies emphasize the importance of delaying implant placement until complete skeletal development to avoid infraocclusion and aesthetic discrepancies. In this context, resin-bonded bridges represent a valuable interim solution due to their minimal invasive concept, reversibility, and esthetical satisfaction. Ceramic materials for a resin-bonded bridge are often used such as Lithium disilicate which has demonstrated promising short and medium-term results with a survival of 90.9% at 15 months and 100% at 6 years. Besides, only 5 to 7% of ceramic chipping were reported.

A short-term multicenter retrospective study by Sato *et al.*, (2024) reported comparable survival rates between composite RBFDPs with 92.3% and zirconia RBFDPs with 91.7%, having only one debonding observed in the zirconia group.

The viability of Resin-bonded fixed dental prosthesis RBFDPs, does not only rely on the material but also on the designs. A systematic review and meta-analysis by Alqutaibi *et al.*, demonstrated that cantilever ceramic RBFDPs exhibit significantly fewer complications than double-retainer designs, although overall failure rates were comparable. This research aligns with *in vitro* results by Kasem *et al.*, which showed that both retainer design and ceramic material are notably related to fracture resistance after aging.

Long-term cohort studies also report acceptable survival outcomes for RBFDPs, with a 5-year cumulative survival rate of approximately 86.7%. Nevertheless, success rates, defined as prostheses free of complication, remain lower around 71.7%. Therefore, technical events such as debonding remain prevalent. Higher pontic

numbers and non-vital abutment teeth have been identified as significant risk factors for failure [2]. Consistently, systematic reviews indicate that debonding is the most frequent technical complication, while cantilever designs with a single wing demonstrate superior long-term performance [9].

The limitations of implant solution in the mandibular symphyseal region further justify the consideration of conservative prosthetic alternatives. CBCT analysis have shown substantial bone loss following tooth loss in this region. One study of 103 edentulous mandibles reported crestal bone resorption ranging from 46% to 57%, with extreme cases exceeding 60% of the original bone height [1]. Additional CBCT-based investigations revealed a median horizontal alveolar thickness of only 4.13 mm and a cortical thickness of approximately 2.25 mm, underscoring the limited bone reserve available for implant placement [2]. These findings were confirmed by a recent cross-sectional study by Hassan *et al.*, (2023), which demonstrated significant reductions in both ridge height and width in the symphyseal area of edentulous mandibles, despite relatively preserved bone density [3].

Collectively, these anatomical limitations, growth-related considerations, and clinical outcomes support the use of Lithium Disilicate cantilever RBFDPs as a predictable, conservative, and biologically respectful solution for anterior mandibular tooth replacement, particularly in young patients or in cases where implant placement is contraindicated or must be delayed

In the present case, the RBB allowed functional and aesthetic restoration during adolescence while preserving the abutment teeth for future options. Upon reassessment, the severe bone deficiency contraindicated implant placement, and a conventional bridge became the best alternative. Ultratranslucent zirconia corresponds to 5 mol% Y_2O_3 partially stabilized zirconia (5Y-PSZ), also known as ultra-translucent cubic (UT) zirconia. The increased yttrium content to 5 mol% stabilizes about 50% of the zirconia in the cubic phase,

which enhances translucency to a level comparable to lithium disilicate glass-ceramics; however, this comes at the cost of reduced mechanical performance compared to lower-yttria (e.g., 3Y) zirconias.

Several recent studies have addressed the clinical and in vitro behavior of 5Y-PSZ:

Chen *et al.*, (2024) investigated the fracture resistance of 5Y-PSZ crowns of different thicknesses (0.8 mm, 1.0 mm, 1.2 mm) and with different surface treatments. They found that even 0.8 mm thick 5Y-PSZ crowns cemented with resin-modified glass ionomer cement had fracture loads comparable to 0.5 mm 3Y-TZP crowns, showing that ultra-thin 5Y-PSZ restorations can be mechanically viable. [21]. An in vitro aging study showed that 5Y-PSZ retains high aging resistance: after hydrothermal aging, the phase content (cubic vs tetragonal) and microstructure remained largely stable, and strength remained within the acceptable range for short-span anterior prostheses (~500–600 MPa) [22]. A recent in vivo prospective clinical pilot study evaluated 22 three-unit posterior fixed dental prostheses (FDPs) made from shade-graded 5Y-PSZ. After 3 years, the survival rate was 100%, with no mechanical complications and only a few manageable biological issues [23].

The effect of surface finishing (grinding and polishing) on 5Y-PSZ has also been studied: one report (2024) found that certain polishing/grinding protocols significantly influence biaxial flexural strength, which may have clinical implications during occlusal adjustments [24].

Regarding fracture risk under cyclic loading, a mastication simulation study showed that thinner 5Y-PSZ specimens (0.7 mm) had a high fracture rate under fatigue, while 1.2 mm thick 5Y-PSZ survived better, indicating that a minimum thickness may be required for long-term reliability; [25]. A 2-year retrospective clinical study of ultra-thin, no-prep 5Y-zirconia (Prettau® Skin) veneers reported a survival rate of 99.3%, with only one marginal chipping event, excellent esthetics, and no major biological complications. [26].

Ultra-translucent zirconia, introduced with improved yttria, provides enhanced translucency while maintaining adequate flexural strength, making it ideal for anterior restorations. This material offers a balance between mechanical performance and optical properties close to natural dentition.

The excellent three-year clinical outcome observed in this case supports current evidence that modern zirconia ceramics can be used successfully for

anterior fixed bridges when proper design, preparation, and cementation protocols are respected. A conservative approach should be applied for the success of all treatment.

5. CONCLUSION

The present case highlights the importance of a conservative, phased approach in the prosthetic management of young patients with anterior mandibular tooth loss and bone deficiency. A resin-bonded bridge provided an effective interim solution during growth, while an ultra-translucent zirconia bridge offered a stable, aesthetic, and functional long-term restoration once skeletal maturity was achieved.

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