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Case report

Planning for success: Full mouth rehabilitation with different fixed restorations

Muhamad Faizran Loo Szen Bin Fadly Loo
Centre of Studies for Restorative Dentistry, Faculty of Dentistry, Universiti Teknologi MARA (UiTM), Sungai Buloh, Selangor, Malaysia

ABSTRACT

Background: *A minimally invasive approach in a full mouth rehabilitation is preferred, especially in a younger patient, as it is reversible, in line with the European Consensus Statement.* ***Purpose:*** *This case report aims to highlight the importance of detailed planning of a full mouth rehabilitation involving different fixed restorations, including direct composite restoration, indirect posterior onlays, and the replacement of an unrestorable tooth with a dental implant.* ***Case:*** *A 52-year-old gentleman presented with severe generalized non-carious tooth surface loss (NCTSL), planned for full mouth rehabilitation in a reorganized approach. His treatment was complicated by subgingival restorative margins and an unrestorable tooth, requiring replacement.* ***Case management:*** *Periodontal disease was stabilized, and the full mouth rehabilitation was initiated with direct composite restoration of the anterior teeth using the injection molding technique (IMT), followed by the implant placement protocol and extraction of unrestorable tooth 24. The final implant abutment and restoration were digitally designed and delivered with high accuracy.* ***Conclusion:*** *Full mouth rehabilitation requires detailed planning and can be complicated by the replacement of missing teeth with dental implants. However, digital technology and good communication with the dental technologist can help to deliver the prosthodontically driven implant restoration with good accuracy.*

Keywords: *implant; injection molding; onlays; tooth wear*
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Correspondence: Muhamad Faizran Loo Szen Bin Fadly Loo, Faculty of Dentistry, Universiti Teknologi MARA (UiTM), Sungai Buloh Campus, Jalan Hospital, 47000, Sungai Buloh, Selangor, Malaysia. Email: faizran@uitm.edu.my

INTRODUCTION

A single etiology of tooth surface loss (TSL) can be difficult to identify, as many patients present with combined etiologies. Dentin hypersensitivity and dentoalveolar compensation are two of the consequences of TSL. However, chipping and fracture of the incisal edges as well as tooth shortening result in the majority of patients complaining of the deterioration of their aesthetic smile.[1]

The process of dentoalveolar compensation maintains the vertical dimension of occlusion (VDO) as the alveolar process adapts to the TSL. Subsequently, this may lead to a lack of restorative space, deeming rehabilitation of the severely worn dentition challenging.[2]

Hence, full mouth rehabilitation applying the reorganized approach using the retruded axis position (RAP) or retruded contact position (RCP) is well documented to increase the VDO and gain the necessary restorative space.[3] In the past, treatment plans that include elective endodontic treatment, surgical crown lengthening, and full coverage restorations have been suggested. These treatments are costly, time-consuming, and most importantly, invasive.

With the improvement in adhesive techniques and composite resin materials,[4] there is a trend in utilizing the minimally invasive approach of adhesive dentistry for the management of severely worn dentition. This is especially vital in younger patients, who would benefit from a reversible and comprehensive lifelong approach.[5] According to Mesko et al.,[6] composite is an additive restoration and can be used predictably to increase the VDO, providing sufficient space for the planned rehabilitation and occlusal scheme. The same review showed that composite can be considered as a medium-term restoration with easily repaired complications such as chipping and discoloration.

Treatment planning is not always straightforward in restorative dentistry. It is complex for a case with severe tooth wear, lack of restorative space, missing teeth, and failing dentition. With the support of the available evidence,

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this case report aims to describe the minimally invasive approach to managing severely worn dentition. This involves detailed planning of a full mouth rehabilitation with different fixed restorations, including direct composite restoration, indirect posterior onlays, and the replacement of an unrestorable tooth with a dental implant.

CASE

Mr. SB, a 52-year-old gentleman, was referred by his general dental practitioner to Edinburgh Dental Institute for the treatment of generalized TSL. He was concerned about his deteriorating dentition and wanted to prevent further wear of his teeth. The progression of the tooth wear started two years ago, and he was aware of nighttime teeth grinding, for which he had a nightguard. The patient's medical history revealed Type 2 diabetes, gastroesophageal reflux disease (GERD), and asthma, which were well controlled by medication. He gave a significant social history of having a stressful occupation, alcohol consumption exceeding the NHS's alcohol guideline recommendation, and drinking an increased amount of orange juice and grapefruit juice daily.

Figure 1. Frontal (upper) and occlusal (lower) view of the intraoral photographs.

Figure 2. Intraoral periapical radiographs of maxillary posterior teeth (upper) and the orthopantomogram (lower).

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On clinical examination, he had an average lip at smile (100% of maxillary crowns and interdental papilla were visible at smile).[7] He had fair oral hygiene, with plaque (30%) and bleeding (20%) scores recorded. Figure 1 shows pronounced signs of tooth wear with more than 1/3 loss of palatal tooth structure on the maxillary posterior teeth, proud standing amalgam restorations, and dentinal craters (cupping lesions) on the posterior teeth. Perimolysis of the maxillary teeth on the palatal surfaces and corresponding wear facets in lateral excursions were also noted. A BEWE cumulative score of 12 was given. His dentition was heavily restored with indirect and direct restorations. Root canal treatment was previously initiated for tooth 24, which was tender to percussion.

Occlusal analysis showed bilateral shallow canine guidance, and the RCP to intercuspal position (ICP) slide consisted of 1 mm horizontal and 1.5 mm vertical components. This was then verified on the average value arcon articulator (Denar Automark).

Positive pulp sensibility tests were obtained on all teeth except tooth 24 and tooth 26, which was negative for a cold and electrical pulp test. An orthopantomogram showed previously root canal-treated tooth 26 with suboptimal root canal filling and 1/3 of horizontal bone loss for the maxilla and mandible (Figure 2).

An intraoral periapical of the maxillary left posterior teeth showed that tooth 24 had been heavily restored coronally, with direct restoration extending into the pulp chamber with a widening of the periodontal ligament. The root canal filling was suboptimal for tooth 26, as it was short of radiographic apex and was not well condensed. There was also periapical radiolucency at the distal aspect of the mesial root, and there was evidence of excess cement on the mesial of the metal crown 26.

A list of diagnoses was provided, which included generalized periodontitis stage II grade B, currently unstable (risk factors: stress, diabetes); previously initiated root canal treatment with symptomatic apical periodontitis 24; previously root canal-treated 26 with asymptomatic apical periodontitis; and generalized severe NCTSL primarily causing erosion with signs of attrition.[5]

Hence, the aim was to stabilize his periodontal disease, resolve apical periodontitis, and control and intercept the progress of TSL. Ultimately, the goal was to provide a stable occlusal scheme with an improved dental aesthetic.

CASE MANAGEMENT

The treatment options were presented to the patient, along with advantages and disadvantages. It was highlighted that the stabilization phase should be the first step of treatment, as it was important to assess the condition of abutment teeth and to resolve any active disease before proceeding to the prosthetic phase. It was also explained that the reorganized approach was necessary for the rehabilitation; it would have an impact on the occlusion, affecting speech and function; and would require some time to adapt to.[8]

He opted for direct restorations where possible to be conservative and non-invasive, avoiding the increased biologic cost of indirect restorations. He understood the higher risk of the potential need for servicing and maintenance of the direct restorations.

With higher masticatory force, the posterior teeth with defective amalgam restorations and previously root canal-treated tooth 26 were planned for indirect partial cuspal coverage. However, the complications of posterior lithium disilicate restorations, including chipping, fracture, and margin discoloration, were discussed with the patient.[9]

Diagnostic wax-up for smile analysis and full case assessment were done in RAP at an increased VDO. The new VDO was set by a 3 mm increase in the incisal guidance pin of the articulator from the RCP. The actual increase was determined to be 4 mm in the anterior teeth, allowing adequate space for the bulk of materials.

A mock-up was completed to assess facial and dental aesthetics, speech, and occlusion, which allowed us to communicate the suggested plan to the patient. He was given time to acclimate and found it to be satisfactory and meeting his expectations.

After dismantling the metal crown 26, the abutment tooth was found to be restorable; however, tooth 24 presented with a lack of circumferential ferrule and loss of palatal retaining wall, resulting in a compromised structural integrity.[10] After thorough discussion about the prognosis treatment options and the advantages and disadvantages of each option (direct composite restoration, surgical crown lengthening with post-retained crown, extraction and implant) for tooth 24, the patient opted for extraction and replacement with an implant-supported crown.

After the atraumatic extraction of tooth 24, clinical examination revealed adequate palatal and apical bone for primary stability. However, as there was loss of buccal bone post-extraction, immediate implant placement was not indicated. According to the 6th ITI consensus,[11] type 2 implant placement protocol refers to the placement of an implant after substantial soft tissue healing but before any clinically significant bone fill.

Overhang restoration 27(M) was removed, non-surgical periodontal therapy was completed, and his oral hygiene was reinforced. After three months post initial non-surgical periodontal therapy, a localized 6-point pocket chart was done for sextants 1, 3, and 6. There was no pocket more than 4 mm, and improved plaque and bleeding scores were noted. Retreatment of 26 was initiated, and provisional restoration conforming to the existing occlusal scheme (ICP) was provided. Figure 3 shows direct composite restorations for 13–23, 33–43 in RAP, and at the planned increased VDO using Ganiel composite A2 with the IMT. Posterior composite occlusal stops were placed to maintain the restorative space and prevent unwanted tooth movement of the posterior teeth (Figure 3). The occlusal stops also provide posterior contacts for even distribution of load.

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Figure 3. Direct composite restorations of the anterior teeth with occlusal stops on mandibular posterior teeth.

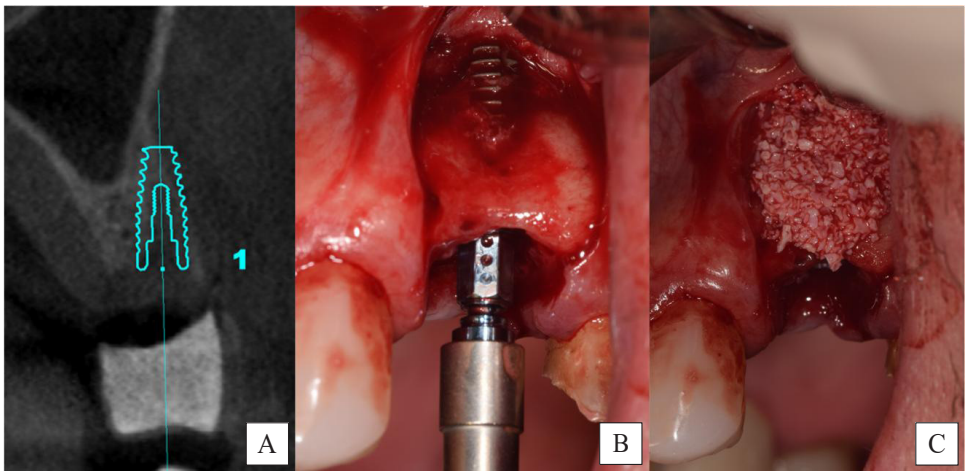

Figure 4. A–C: The sagittal view of the CBCT scan; B–C: The prosthodontically driven implant placement with anticipated GBR.

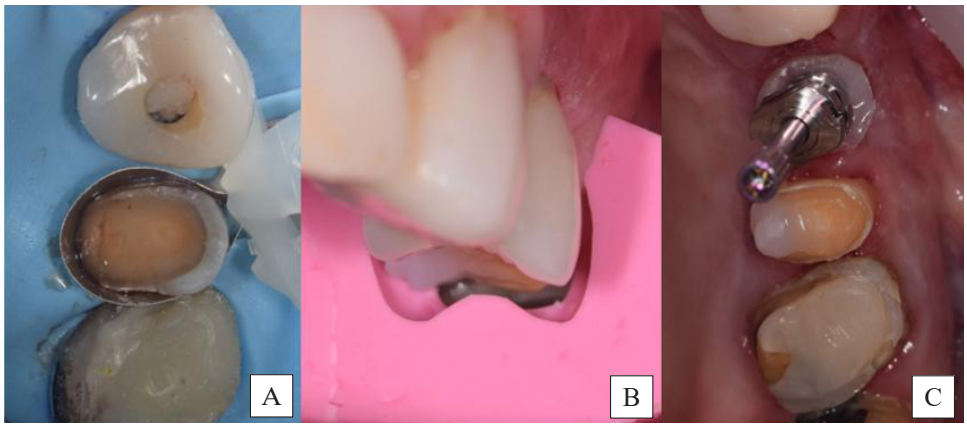

Figure 5. A: Adaptation of matrix band to palatal subgingival margin for DME; B: Preparation done with reduction guide; C: Customized impression coping 24.

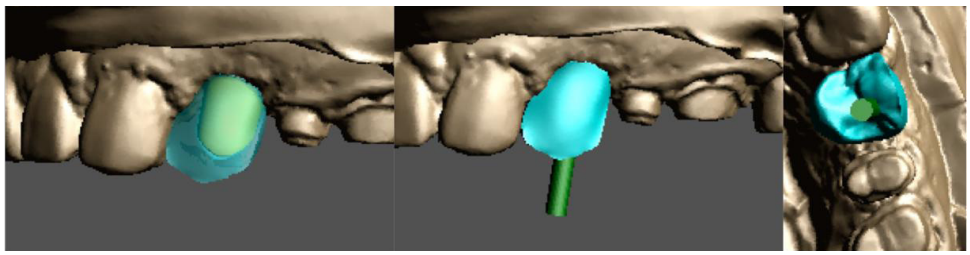

Figure 6. Design of the abutment considering the occlusal thickness of the zirconia crown for strength, the buccal cutback with no unsupported layered porcelain.

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A cone beam computed tomography (CBCT) scan was taken seven weeks post-extraction with the radiographic stent in situ, and the DICOM file was uploaded on guided implant planning software. The sagittal view of the scan anticipated good primary stability from apical and palatal bone and predicted a buccal dehiscence during implant placement, which would require a simultaneous guided bone regeneration (GBR), as seen in Figure 4A. A Straumann RC BLT 10 mm implant was placed eight weeks post-extraction with simultaneous GBR using xenograft materials BioOss and Bioguide (Figure 4B). The flap was reapproximated, the implant was surgically exposed using a tissue punch eight weeks post-implant placement, and an open tray pick-up impression was made with polyether for the provisional screw-retained implant-supported crown.

Root canal treatment for tooth 26 was completed. Immediate dentin sealing (IDS) was done, and the tooth was restored coronally with composite restoration. Posterior amalgam restorations were removed, IDS was done, and deep margin elevation (DME) was completed on tooth 25 (P) and tooth 27(M) (Figure 5A).

To have better control of the occlusion, teeth preparation for posterior lithium disilicate onlays (Figure 5B), an impression, and a fit of the indirect restorations were first completed for the right posterior teeth, followed by the left posterior teeth. The onlays were cemented using dual cure resin cement under rubber dam isolation. VDO was conformed, and the occlusion was adjusted to achieve RCP=ICP. This was verified by having even occlusal contact on the anterior teeth and the right posterior restorations.

An open tray pick-up impression with indexed and customized impression coping of tooth 24 was made using heavy and light polyvinyl siloxane (PVS) impressions (Figure 5C). A screw-retained veneered zirconia implant crown on a customized titanium abutment with an indexed connection was selected to restore implant 24. In designing this screwmentable restoration, emphasis was given to the design of the customized titanium abutment to have the ideal retention and resistance form, as it provided support and retention for the zirconia crown. The design of the abutment considered the thickness of the crown for strength (Figure 6). At the same time, for an improved aesthetic result, a veneered zirconia crown was opted for. However, only buccal cutback was designed for the veneering, and it did not extend to the occlusal surface. This avoided unsupported veneering material and, hence, prevented the risk of chipping.

The screw-retained implant-supported crown was delivered, and a Michigan splint was provided for maintenance of the restorations. The Michigan splint was designed to provide bilateral contacts on all posterior teeth in RAP, and the anterior ramp provides disocclusion of the posterior teeth during lateral excursions and protrusion (Figure 7). Last, Figure 8 shows the before and after treatment smile photographs of the patient, as well as intraoral photographs post-treatment.

Figure 7. Posterior disocclusion with anterior ramp and even occlusal contact in RCP=ICP.

Figure 8. Various views of completed full mouth rehabilitation.

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DISCUSSION

The aims of the treatment were accomplished, and the patient's expectations were met. Hence, the execution of the treatment plan can be considered successful. It is important to understand the patient's complaints and concerns in providing appropriate treatment options to then conceptualize and finalize the treatment plan. In full mouth rehabilitation, a well-controlled, staged approach can yield a successful outcome. The formulation of a comprehensive treatment plan relies on an accurate history and clinical examination of the patient. Due to the history of GERD and a high consumption of drinks with low pH, such as orange and grapefruit juice, both intrinsic and extrinsic factors of erosion were identified to be the main contributing factors for his tooth wear. Furthermore, corresponding wear facets during lateral excursions suggested a parafunctional teeth-grinding habit, which led to the diagnosis of attrition. It is vital to have a good appreciation of these etiological factors as the identification of these factors leads to successful prevention and management.

In diagnosing this patient with periodontitis, a simple screening tool (BPE) was used for the initial assessment of the periodontal tissue. It was used to indicate the level of further examination needed and provide basic guidance on the treatment required. BPE was first developed by the British Society of Periodontology (BSP) in 1986, and they have also illustrated treatment guidelines for periodontal diseases. Hence, based on recent BSP guidelines,[12] radiographs were taken as it is recommended for all codes 3 and 4. Radiographs revealed mild bone loss (<15% of the root) in the three sextants with a BPE score of 3. However, the periodontal diagnosis made was based on the worse site of bone loss, which was at 22 distal. With the radiographic evidence of bone loss due to periodontitis, a full periodontal assessment, including a detailed 6-point pocket chart, should be done for an accurate periodontal diagnosis as part of the stabilization phase in a full mouth rehabilitation.

Thorough consideration of the advantages and disadvantages of using different restorative materials in the management of this case was based on the etiologies. No material had the ideal aesthetic and mechanical properties. Thus, the patient was made aware of the limitations of each restorative material in achieving his aesthetic and functional goals. Assessment of his anterior dentition revealed mild to moderate TSL with intact enamel for predictable adhesive dentistry. On the other hand, his maxillary posterior teeth presented with severe TSL, particularly the palatal surface. In this case, the cause of tooth wear was mainly identified to be the patient's GERD and some elements of attrition from parafunctional grinding. Hence, clinical choices were mostly driven by the medical anamnesis and financial affordability for the patient in terms of maintenance. Given the advancement of contemporary composite material and its minimally invasive approach advocated by the European consensus statement,[5] resin composite can provide satisfying functional and aesthetic results. Thus, it was considered an ideal material for this patient's therapy. The outcome of anterior composite survival in the five studies systematically reviewed[13] was reported to be "favorable" in the short to medium term, with over 90% survival at 2.5 years and over 50% at 5 years. The majority of the included studies used micro-filled and hybrid composite. Modern injectable resins, such as G-aenial Universal Injectable, have a high filler content, wear resistance, and gloss retention, meaning they were considered to be the best material in this case.

IMT aims to replicate the anatomy of a diagnostic wax-up, and the residual anatomical references (occlusal and interproximal) helped to guide composite shaping, allowing the clear stent to be repositioned precisely, without deformation. Hence, good anatomical references were necessary.

Another concern was that his posterior teeth lacked an enamel surface for a predictable adhesion. This was accentuated by the palatal wear extending subgingival into the cervical dentin. IDS results in improved micro tensile bond strength to freshly cut dentin compared to delayed dentin sealing.[14] In combination with IDS, DME was utilized to overcome the biological and operative problems, such as violating the supracrestal tissue attachment and the difficulties in bonding associated with deep margins. However, because the final strength of a tooth-restoration complex is highly dependent on adhesive procedures, optimum isolation with a rubber dam and a good adaptation of metal matrix to expose the cervical margin is imperative.[15] Matrix-in-a-matrix technique is useful in facilitating the isolation and fit of a deep subgingival matrix.[16]

A CBCT scan prior to extraction can be useful in indicating an atraumatic extraction to preserve the thin buccal bone for the possibility of immediate placement if there is sufficient bone volume for primary stability. In this case, type 2 implant placement was decided after the extraction considering there was loss of buccal bone, anticipating soft tissue healing would allow tension-free primary closure[17] for the GBR. Nevertheless, a CBCT scan taken with a radiographic stent allowed for a prosthodontically driven implant placement with simultaneous GBR, taking into consideration the vital anatomy, such as the left maxillary sinus, in this case.[18]

Screwmentable restoration used in this case relies on adhesive cement to bond to the titanium for retention. In resisting the dislodging forces, the presented customized titanium abutment substructure provides support and retention to the milled layered zirconia superstructure. CAD/CAM technology makes it possible to idealize the fundamentals of crown preparation geometry, such as abutment heights, convergence angle, and surface area of the abutment, for maximum adhesion of the superstructure.[19] The type of edentulous space, the process used to manufacture the surgical guide, and the guided surgery protocol can all affect how accurate computer-guided surgery is for patients who are partially edentulous.

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When the implants were positioned in Bounded Edentulous (BES) utilizing CAD/CAM-made surgical guides and a fully guided surgery protocol, more accuracy was discovered.[20]

In conclusion, digital implant planning software alongside CAD/CAM technology can improve the predictability of implant placement and manufacturing of the implant restorations respectively. As a result, the patient's satisfaction and the clinician's self-esteem can be boosted.

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