

Treatment Planning and Dental Rehabilitation of an Orthodontically Compromised and Neglected Dentition: A Clinical Case Report

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Abstract

When planning a rehabilitation in an unstable patient with a malocclusion, the clinician is often confronted with challenges in selecting treatment modalities that deliver long term success in function and aesthetics, whilst being resilient to pathogenic breakdown. Accurate diagnosis and prognosis is paramount in these cases, and when combined with an evidence based approach, robust treatment plans may be implemented.

This case aims to present a protocol to rehabilitate the damaged dentition in a manner that retains biological tissue, whilst restoring natural form and appearance. For cases where the 'gold standard' of restoration and orthodontics cannot be achieved, alternate treatment routes exist whereby oral health may be regained without excluding the option of comprehensive treatment in the future.



Figure 1: Pre-treatment and Post-treatment progression

Case Assessment

The patient (AS), a 25 year old attended his first dental appointment in 10 years, with a concern to improve his appearance for his upcoming wedding. AS had not experienced any pain, was medically fit, a non-smoker, and worked locally as a farmer. The initial extra-oral examination revealed a prognathic mandible, incompetent lips associated with a low Frankfurt Mandibular Plane Angle, with a high smile line. No lymphadenopathy or temporomandibular joint dysfunction was detected. The intra-oral soft tissue examination showed draining sinus tracts adjacent to the 12 and 22, with no other mucosae related abnormalities.

Dental charting and special tests are summarised in Figure 2.

Orthodontic Assessment		Teeth Present	
Skeletal Class	III severe	7 6 5 4 3 2 1	1 2 3 4 5 6 7
FMPA	Low	8 7 6 5 4 3 2 1	1 2 3 4 5 6 7 8
Lower Face Height	Increased	BPE:	
Naso-labial angle	90	2	3
Lips	Incompetent	2	2
Facial Assymetry	Nil	Sensibility:	All teeth tested, black denotes negative EPT+thermal responses
Midlines	Coincident	Radiographs:	Full mouth peri-apicals
TMJD	No abnormalities	Report:	Multiple proximal radiolucencies across all maxillary teeth, except 13 12, 24, 26 well defined, non-corticated radiolucencies at apicies Caries extending subgingival in 12 Retained roots 22, 24, 26 Conical form and not in close proximity to maxillary sinus No bone loss noted
Incisor Relationship	III	Diagnoses:	1. Decoronated 22, 24, 26 with associated peri-apical abscesses 2. Inflammatory root resorption 12, 46 due to failed root treatments 3. Caries primary and secondary (emboldened):
Maximum Intercuspation	Unstable MIP	7 6 5 4 3 2 1	1 2 3 4 5 6 7
Molar Relationship	Left: NA Right: Full unit class III	8 7 6 5 4 3 2 1	1 2 3 4 5 6 7 8
Overjet	Reverse		
Overbite	Negative		
Openbite	Nil		
Crossbites	Full arch in cross bite No displacement		
Upper Crowding	Mild		
Lower Crowding	Poorly aligned Severely compensated		
Figure 2: Summary of diagnostic examination			
			4. Non-vital 11, 21, 23 5. Plaque-induced gingivitis 6. Class III skeletal malocclusion

It is the view of the author that the mandibular posterior segments had been protected by dentoalveolar compensatory effects, causing lingual inclinations allowing the tongue to act as a physical barrier to cariogenic agents, as well creating an area of high buffering capacity through saliva. Furthermore, the lack of a stable maximum intercuspation position had resulted in minimal tooth surface loss related to attrition, and no parafunctional signs were noted.

Stabilisation

Prior to any restorative consideration, patient motivation and commitment to changing ingrained habits was paramount to re-establishing health from dental neglect. The prevention protocol began with full mouth debridement through hand and ultra-sonic instruments (Chapple 2015). Progression to mechanical interdental hygiene was

encouraged to prevent caries as well as improve gingival health (Poklepovik 2013). Chemical reduction of the destructive carious process can be achieved by high fluoride toothpastes (Davies 2008), fluoride varnishes (Marinho 2002), and in the short term with casein phosphopeptide-amorphous calcium phosphate pastes (Yengopal 2009). These methods in conjunction with practical oral hygiene motivation aimed to halt progression of caries and reduce gingival inflammation. Temporary glass ionomer restorations were provided in cavitated teeth with an objective to create a convex surface from a concave lesion, such that effective plaque clearance could be achievable. In addition, it improves aesthetics for the patient, which is an instant motivating factor for changing habits. At a review consultation, a diet record from the patient was analysed for evidence of cariogenic substances. It is recognised that fructose containing foods cause acidic challenge, however, are less cariogenic than refined added sugar. Therefore, the timing and frequency of refined sugar and acidic beverages were discussed and modifications suggested. The distribution of caries in AS is indicative of historical caries in childhood years, and dietary habits had since changed. Plaque clearance was monitored visually through a series of clinical photographs. Despite this being a subjective assessment, it was an invaluable patient education tool and clinical record. The Turesky and O’Leary indices represent more objective and sensitive means to record oral hygiene.

Tooth 12 was deemed to be unrestorable due to the extent of caries radiographically and that an orthograde root treatment was already present. Other hopeless teeth 22, 26 were extracted non-surgically and 24 removed surgically. A two sided flap design was used and all apices accounted for. Chlorhexidine 0.2% irrigation was introduced into the site and polyglycolic acid based sutures used to close the site. The extraction of 46 was declined by the patient until symptomatic.

After all sinus tracts had diminished, the long term prognosis for 11, 21 and 23 was determined through complete caries removal under rubber dam isolation. During execution, all three displayed necrotic pulp chambers and prior to root canal therapy, factors influencing the restorability of a tooth included the remaining unaffected supra-gingival tooth structure, the operator’s ability to isolate the tooth, and the enamel margin that is available for bonding procedures. Root canal therapy was completed with a view to mechanically and chemically (Heling 2001) disinfect the root systems and achieve a dry apex that could accept gutta percha obturation. An asymptomatic tooth that may be dried adequately may undergo root canal therapy with no significant difference in outcome with a single or two visit approach (Sathorn 2005). The long term survival of such treatment can be predicted at 74% at 10 year recall, or higher (Lumley 2008, Salehrabi 2004).

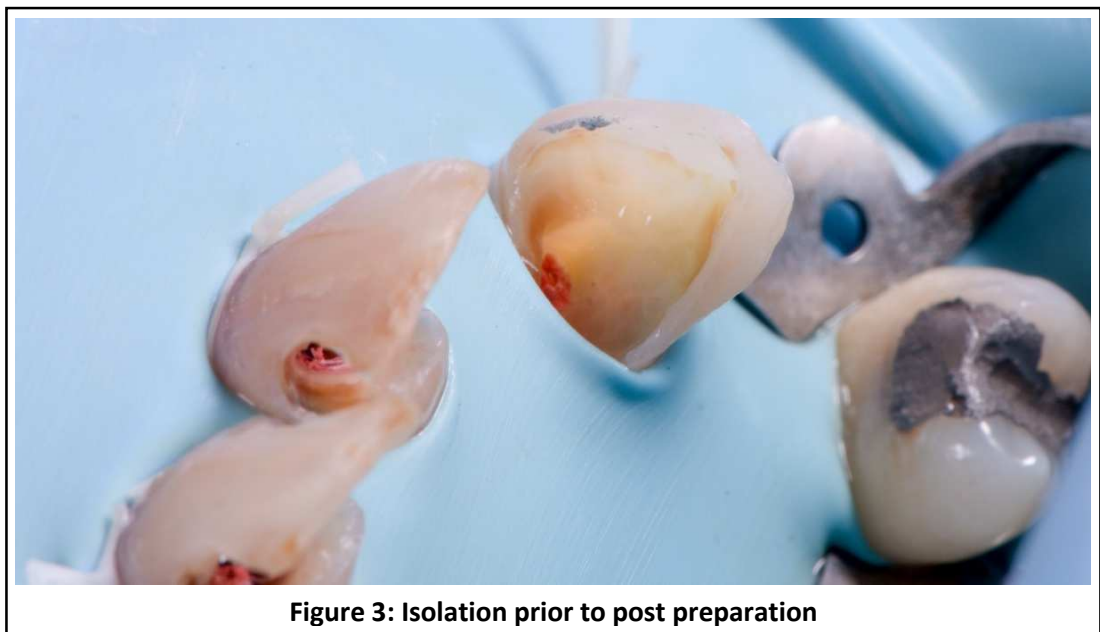


Figure 3: Isolation prior to post preparation

The definitive restoration of 11, 21, 23 must take into account the efficacy and clinical evidence for different treatment modalities, the prognosis of the teeth in the event of secondary pathology and patient factors, including the standard of oral hygiene. Following successful root canal therapy, there were three restorative options available:

- Decoronation and use as overdenture abutments
- Post-retained full coverage crowns
- Post-retained direct composite resin restorations

Decoronation represented the greatest loss to the patient, as anterior central incisors are a recognisable feature in an individual's smile, and the bone loss involved in removal of an upper canine would cause a loss in lip support as well introducing a prosthodontic challenge to replace satisfactorily. Alveolar bone may be retained effectively via decoronation and primary closure, with an objective to proceed to fixed implant supported prostheses in the future (Cohenca 2007). Although implant placement represents a predictable and long-term treatment, economic status was prohibitive, and this would compromise orthodontic correction as a future treatment route. The patient and operator agreed on the treatment modality that retained the most remaining tooth structure yet still allowed for progression to full coverage indirect options at a later date.

The use of a ferrule is well documented to influence the fracture resistance of an endodontically treated tooth (Assif 1993, Sorensen 1990, Isador 1999). It may be defined as the band that encircles the external dimension of the remaining tooth. By using a conservative approach, the residual tooth structure may be spared for use as a substrate for future crown preparation. It is recognised that direct composite resin in large restorations display an increased complication rate, primarily due to a lower modulus of elasticity than that of full coverage cast crowns. Post-retained composite restorations were selected as a minimally invasive medium term option with the foresight that full coverage crowns will be an inevitability (Lindhe 1984, Schwartz 2004).

Post placement in all three anterior teeth was indicated to mechanically retain the composite core material as well as provide a post-core for the long term crown preparation. Posts are available as direct prefabricated (metal, fibre-resin, zirconium oxide) or indirect (cast metal or pressed reinforced ceramic). Cast and direct metal posts display a modulus of elasticity in excess of 200GPa, fibre posts as 20GPa and dentine as 18GPa. An endodontically treated tooth is reported to being more susceptible to fracture due to changes in the collagen matrix causing the tooth to dry over time (Devoto 2009). The union of a high modulus post into a relatively low modulus dentine cavity causes stress concentration in the weaker material, increasing the likelihood of tooth fracture. Prefabricated fibre posts were selected due to their resemblance in properties to dentine, and the support in the literature for their efficacy (Mentink 1993, Libman 1995, Malferrari 2003).

At three months, the re-evaluation of the periodontal and oral hygiene status showed probing depths of no more than 3mm, with minimal bleeding on probing. The UL4 extraction site healed to a recession defect on the UL3, with all other extraction sites healing normally. The patient was displaying excellent motivation and improving his oral hygiene incrementally. This allowed the progression to the pre-prosthetic treatment phase.

Pre-prosthetic phase

The restorative phase was executed via quadrant caries removal with high and slow speed rotary instruments in conjunction with hand excavators. Posterior teeth were restored with dental amalgam through the siqveland matrix system and wooden wedges. Many practitioners in the USA, Sweden, Finland and Norway have become 'amalgam free' in recent years in favour of composite resin and indirect treatment protocols. The rationale of amalgam mercury toxicity are not supported in clinical literature and at present in the United Kingdom, amalgam still stands as a predictable long term restoration (Opdam 2010). Furthermore, amalgam has technical benefits in that it is not as moisture sensitive as composite resin and is a packable material that can restore deeper sub-gingival situations. It is the view of the author that for restorations in the aesthetic zone, tooth coloured materials should be used where possible, and in posterior segments with greater than two surfaces, amalgam is the optimal direct material choice. Accordingly, posterior restorations were placed with a mind set to restore the teeth to natural form, anatomy and function whilst creating cleansable margins for the patient.



Figure 4: Posterior quadrants pre-treatment and post-treatment progression

Anteriorly, damaged teeth may be restored aesthetically and functionally using the 'natural layering concept' whereby chromatic dentine, chromatic enamel and achromatic incisal shades are applied in measured masses to reproduce accurate value, chroma and opalescence (Dietschi 2006). In order to re-create an optically natural anterior tooth, a multi-shade approach in composite resin is a predictable direct method. Firstly, in order to visualise the final outcome, a diagnostic wax-up was prescribed. This was used to fabricate a silicone palatal matrix which is critical to restoring the teeth in an efficient and accurate manner.

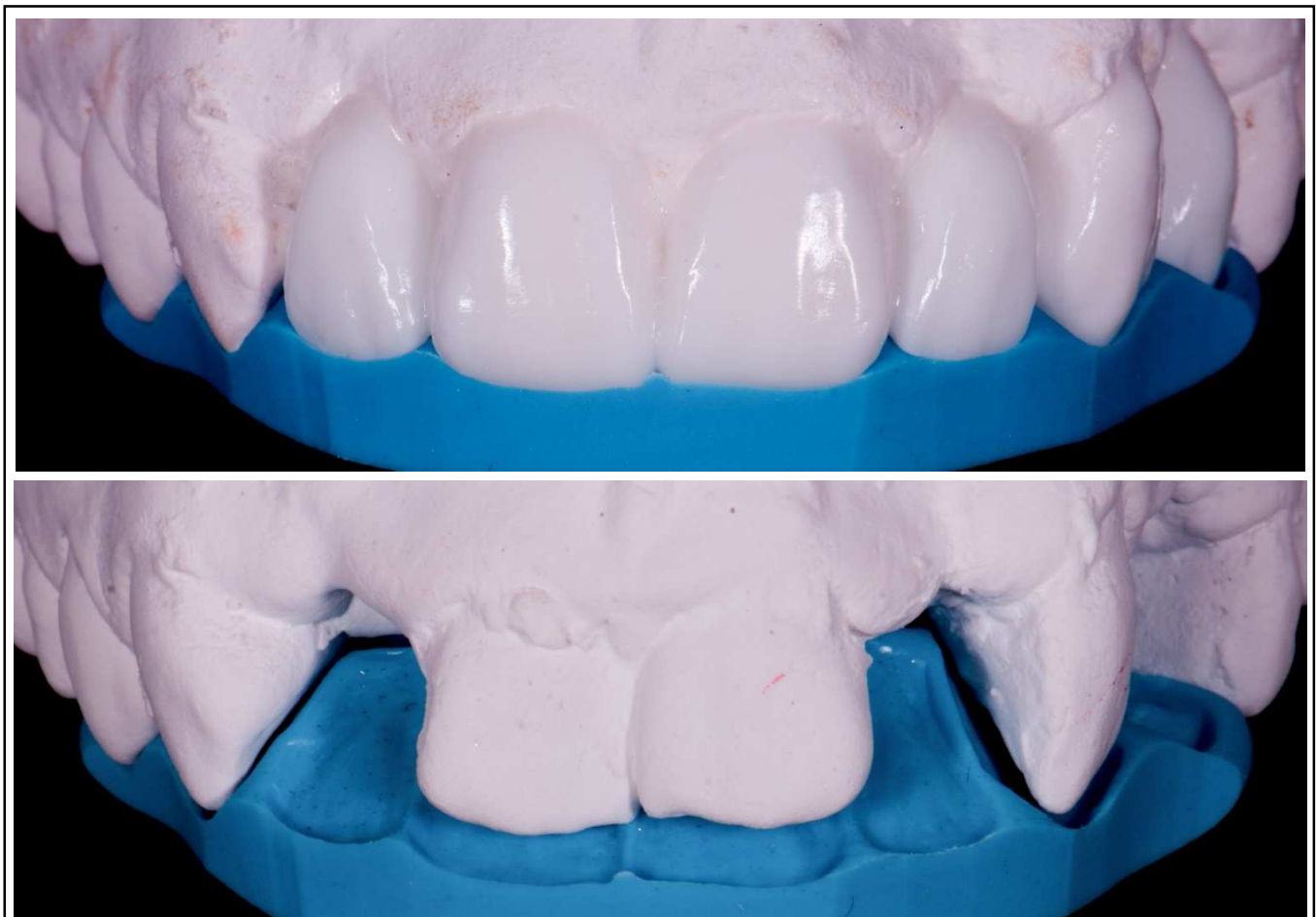


Figure 5: Diagnostic wax-up with palatal silicone index



Accurate shade determination for use of tooth coloured materials can be challenging, especially if the teeth to be restored are discoloured. The Vita classical shade guide comprises polished acrylic tabs corresponding to hue (A-D), and chroma (1-4). Discrepancies often exist between manufacturer composite shades and the Vita shade guide, including differences between batches of an identical composite system. Cross polarisation photography has been implemented in dentistry since 1996 to eliminate specular reflections from an image, to objectify shade assessment (Vanini 1996). Figure 7 illustrates the method in combination with composite resin buttons. Figure 8 applies the preparatory steps to the clinical situation.

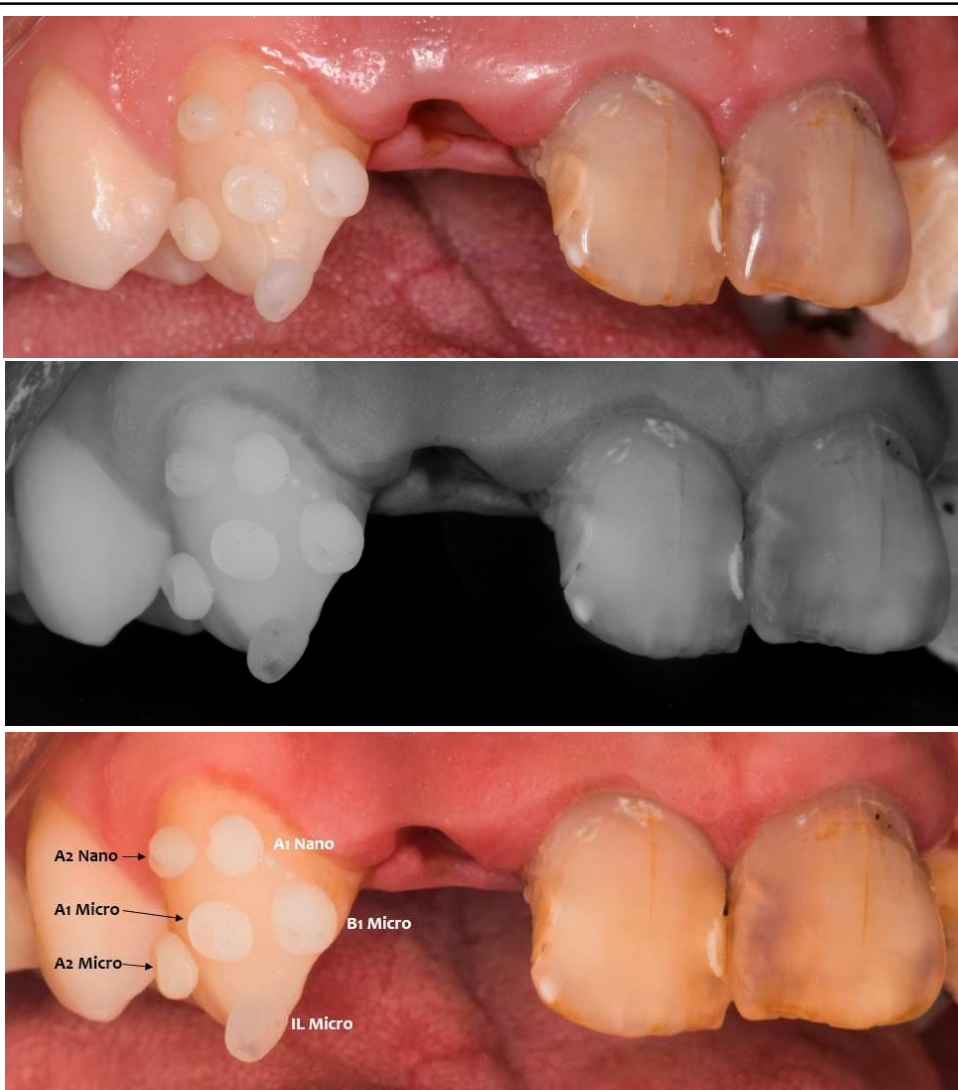


Figure 7

Image 1: Ring flash, no cross polarisation. Subjective shade assessment.

Image 2: Ring flash with cross polarisation in monochrome. Objective value assessment. A2 Nanofill selected.

Image 3: Ring flash with cross polarisation in hyper contrast. Objective chroma assessment. A2 Microfill selected with incisal light Microfill.

Figure 8



Image 1: Isolation under rubber dam. Gingivae retracted with floss ligatures.

Image 2: Palatal and proximal shells constructed with silicone index using an achromatic nanofill composite resin. An opaque dentine followed by a chromatic enamel was cured in controlled increments to optimise the final shade and mitigate C-factor stress (Felippe 2003, Dietschi D 2006, Watts D 2008). An achromatic incisal shade was placed at the incisal third to mimic the appearance in a natural amelodentinal interface.



Image 3: Final light curing was applied under glycerine to ensure complete polymerisation of the oxygen inhibited layer. Following this, rubber dam removal and gross finishing was completed with rotary discs and silicone points (Mopper B 2011, Vanini L 2007). Both the patient and the operator were satisfied with the final result.



Once dentally fit, AS was offered a specialist orthodontic referral. Correction may include upper and lower fixed appliances to decompensate the mandibular and maxillary arches, followed by orthognathic surgery, further fixed appliance therapy and prosthetic rehabilitation. It was not the patient's wish to undergo extensive rehabilitation as time was a limiting factor, as well as economic means. The patient was made aware of the benefits of orthodontic correction if it were to be considered at a later date, and the compromises that present for his current treatment.

Prosthetic phase

Tooth replacement in an occlusally challenged environment was a cautionary factor in providing irreversible treatments. As previously discussed, implant placement was excluded at the assessment stage in recognition of patient preference, economic status, and due to an unstable occlusal relationship with no stable maximum intercuspation position. Fixed bridgework was also excluded on the basis that conventional preparation parameters would undermine the initial objective to restore with the least biological cost. Resin retained bridge designs were unsuitable due to a lack of sound palatal enamel surfaces.

Removable partial dentures have developed many iterations since their inception. AS appeared as a Kennedy class III modification III, and due to the presence of the class III skeletal and incisor pattern, the prosthesis was designed primarily as an aesthetic denture. Owing to this factor, and that the patient had no prior experience wearing a prosthesis, a high impact acrylic resin base material was to be used to replace 12, 22, 24 and 26. The primary cast was surveyed for wanted and unwanted undercuts as well as determining an ideal path of insertion. The skeletal pattern presented with an increased soft tissue undercut anteriorly, which inhibited flange placement. A 'gum-fit' design was selected as a result. In collaboration with the technician, Every principles were integrated where appropriate to restore all point contacts and relieve gingivae around the two central incisors. This may facilitate oral hygiene around heavily restored teeth as well as retaining palatal sensation. Retention was primarily through frictional fit, adhesion, cohesion and a wrought stainless steel 'I' clasp engaging 25. Bracing and stability were imparted by the major connector in close contact with the vault of the hard palate (Jepson 1995, Owall 2003, Wostmann 2005). It is noted that mucosae-borne dentures are known to cause recession due to the excess forces on marginal gingivae. The operator accepted this compromise as a tooth-mucosae borne cast cobalt chromium denture is to be considered following favourable medium term success of the present treatment plan.

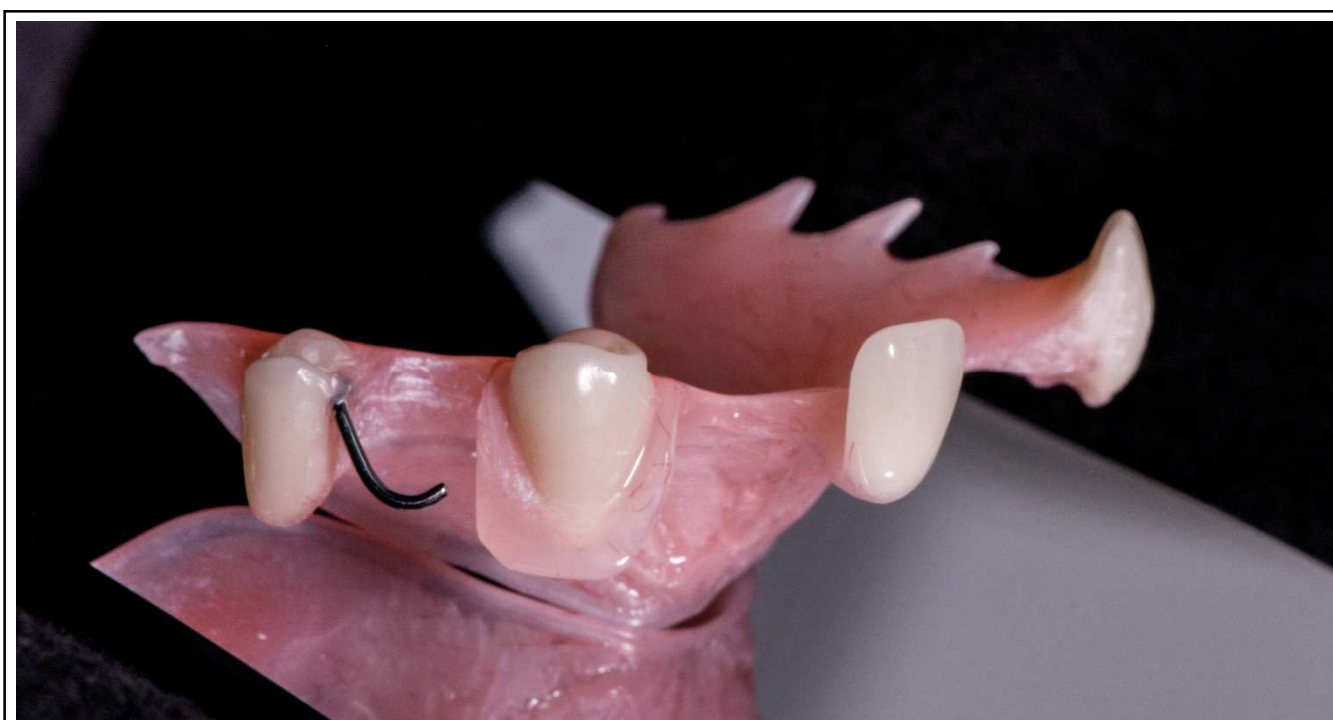


Figure 9: Finished prosthesis



Conclusions

This case report has explored the limits of direct restorative materials in a clinically compromised situation. Whilst the clinical results are imperfect, the objective of addressing the patient's initial concerns had been met. Long term monitoring and maintenance are required to prevent deterioration of any dental treatment. Multiple treatment plans may be proposed to restore the oral environment to our occlusal and pathological ideals, however, patient opinion will guide the clinician to which treatment routes are acceptable for the individual. This will always be subjective, and is a crucial factor in re-establishing a patient's smile.

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