RESEARCH PAPER

Integration of Precision Attachments and Digital Manufacturing in Obturator Prosthesis Design: A Clinical Case Report

Dr. Gayathri S.[1*], Dr. Jeevanandam L.[2], Dr. Aparna N.[3], Dr. Karthi Arivarasan N.[4], Dr. Aboli Rajesh Sangewar[5], Dr. Ragasanthoshini G.[6]

[1]Post Graduate, Department of Prosthodontics, Crown & Bridge, Mahatma Gandhi Post-graduate Institute of Dental Sciences, Puducherry
Email: gayathrirsri99@gmail.com

[2]Professor, Department of Prosthodontics, Crown & Bridge, Mahatma Gandhi Post-graduate Institute of Dental Sciences, Puducherry
Email: indofrenchdental@gmail.com

[3]Associate Professor, Department of Prosthodontics, Crown & Bridge, Mahatma Gandhi Post-graduate Institute of Dental Sciences, Puducherry
Email: draparnanmds@gmail.com

[4]Assistant Professor, Department of Prosthodontics, Crown & Bridge, Mahatma Gandhi Post-graduate Institute of Dental Sciences, Puducherry
Email: drkarthiprostho@gmail.com

[5]Post Graduate, Department of Prosthodontics, Crown & Bridge, Mahatma Gandhi Post-graduate Institute of Dental Sciences, Puducherry
Email: aspirantaboli@gmail.com

[6]Post Graduate, Department of Prosthodontics, Crown & Bridge, Mahatma Gandhi Post-graduate Institute of Dental Sciences, Puducherry
Email: raganeelu@gmail.com

***Corresponding Author:** Dr. Gayathri S., Post Graduate, Department of Prosthodontics, Crown & Bridge, Mahatma Gandhi Post-graduate Institute of Dental Sciences, Puducherry
Email: gayathrirsri99@gmail.com

Received: 25th June 2026; **Revised:** 28th July 2026; **Accepted:** 10th October 2026; **Available Online:** 15th October 2026

ABSTRACT

Acquired maxillary defects following tumour resection leave an open communication between the oral and nasal cavities and disturb speech, mastication, deglutition and facial form. An obturator remains the most widely used method of rehabilitation, although retention and stability are difficult to obtain when the remaining supporting structures are confined to one side of the arch. This report describes the definitive prosthetic management of a 40-year-old woman who had undergone a right partial maxillectomy for mucoepidermoid carcinoma of the maxillary sinus and presented with an ill-fitting interim obturator, difficulty in chewing, altered speech and nasal regurgitation.

The well-healed defect reached the middle meatus and involved the posterior alveolar ridge and part of the palatal vault, and was classified as an Aramany Class I defect. Treatment combined a metal-ceramic fixed partial denture on the remaining left abutments with a definitive obturator retained by Rhein 83 OT Equator extracoronal attachments. The master cast was digitized, and the fixed partial denture, the attachment housings and the obturator framework were designed in Exocad and produced in cobalt–chromium by direct metal laser sintering. The framework required minimal chairside adjustment. At six months the patient reported comfortable function, intelligible speech and resolution of nasal regurgitation.

Keywords: Maxillary defect; Obturator prosthesis; Precision attachment; Rhein 83 OT Equator; Direct metal laser sintering; Computer-aided design and computer-aided manufacturing; Maxillofacial prosthodontics; Aramany Class I defect.

How to cite this article: *Gayathri S.1* Dr. Jeevanandam L.2 Dr. Aparna N.3 Dr. Karthi Arivarasan N.4 Dr. Aboli Rajesh Sangewar5 Dr. Ragasanthoshini G.6. Integration of Precision Attachments and Digital Manufacturing in Obturator Prosthesis Design: A Clinical Case Report. Int J Drug Deliv Technol. 2026;16(87s):1164-1173. DOI: 10.25258/ijddt.16.87s.119.*

Source of support: ***Nil.***

Conflict of interest: *None*

Introduction

Malignancies of the maxilla and the paranasal sinuses are uncommon, but their surgical management carries a heavy functional cost. Resection of the maxilla removes the anatomical barrier between the oral cavity, the nasal cavity and the maxillary sinus, and the resulting communication interferes with mastication, deglutition, articulation and facial support.1,2 Patients often describe escape of fluid through the nose, a nasal quality to the voice and an inability to generate intraoral pressure, and the psychological effect of the visible facial change is frequently as troubling to them as the functional loss.3

Two broad options exist for restoring the resected maxilla. Microvascular free-flap reconstruction closes the defect biologically and is well suited to large composite losses, but it demands a long operating time, donor-site morbidity and a period of healing before any prosthesis can be considered.4 Prosthetic obturation, by contrast, restores the separation of the two cavities immediately, keeps the surgical site accessible for tumour surveillance, and can be modified as the tissues remodel. For these reasons an obturator remains the treatment of choice for the majority of maxillectomy patients, particularly when the defect is unilateral and the remaining dentition is sound.5,6 Recent systematic reviews confirm that the definitive obturator continues to deliver worthwhile functional and quality-of-life gains in this population, while noting that the published evidence is dominated by small, heterogeneous case series, that clasp-retained frameworks still account for roughly 60 per cent of reported designs, and that digital fabrication methods appear in only a small minority of cases.7,8

Several classification systems guide prosthetic planning. Aramany described six classes of partially edentulous maxillectomy defect based on the relationship of the defect to the remaining teeth, and his Class I, in which resection is carried out along the midline and the abutments are confined to one side of the arch, is the pattern encountered most often.9 The prosthesis is supported on one side only, and every functional load applied on the defect side tends to rotate it about a sagittal fulcrum that runs close to the residual ridge. Finite element and experimental analyses published within the last five years have quantified this behaviour, showing that stress in a Class I obturator concentrates at the abutment closest to the defect and at the junction of the major connector with the bulb, and that both the retention obtained and the stress transmitted to the supporting structures depend more on the configuration of the retentive elements than on the bulk of the obturator itself.10,11

Retention has traditionally been obtained with cast circumferential or bar clasps engaging the surviving teeth. Clasps are effective, but they are visible when they cross the anterior teeth, they transmit torque to a small number of abutments, and they tend to loosen as the acrylic obturator bulb absorbs secretions and increases in weight.12,13 Precision and semi-precision attachments were introduced to address these shortcomings. An attachment consists of a patrix fixed to a crown or framework and a matrix housed in the removable component, and the two engage with a defined path of insertion. Because the retentive element lies within the contour of the restoration, the clasp arm is eliminated, the load is directed more nearly along the long axis of the abutment, and the retentive force can be adjusted by exchanging the nylon insert.14,15

Extracoronal stud attachments of the OT Equator type (Rhein 83, Bologna, Italy) are particularly useful in maxillofacial work. The patrix is only about 2.1 mm in vertical height, which allows it to be accommodated where interarch space is limited, and the manufacturer supplies nylon caps of different retentive values so that the retention can be titrated to the patient's tolerance and to the periodontal status of the abutments.15,16 A one-year multicentre randomised controlled trial of this attachment reported stable retention and low prosthetic maintenance, which supports the mechanical reliability of the system, although that evidence derives from implant-retained rather than tooth-retained applications.16 Reports of attachment-retained obturators have described improved patient acceptance and more favourable stress distribution than clasp-retained designs, although the evidence remains largely at the level of individual case reports and small series.17,18

The second development that has changed the fabrication of these prostheses is digital manufacturing. A digitized master cast can be surveyed virtually, the path of insertion can be altered and re-evaluated in seconds, and the framework can be designed with uniform connector thickness and controlled relief over the defect margins. Two systematic reviews published in 2024 mapped the use of these methods in maxillofacial prosthodontics and reached similar conclusions: digital steps are now applied at some point in most reported obturator workflows, but wholly digital protocols remain

uncommon, and most authors combine digital design with conventional impression making.19,20 Direct metal laser sintering, in which successive layers of cobalt-chromium powder are fused by a focused laser beam, produces the framework without a wax pattern, an investment or a casting ring, and frameworks made in this way are free of the shrinkage porosity and nodule formation that complicate conventional casting.21,22 A systematic review of digitally produced removable partial denture frameworks found that direct metal additive manufacturing combined with a conventional impression was both the most frequently used protocol and the one associated with the best qualitative and quantitative fit outcomes.23 Clinical work published since has been consistent with this. A cross-over clinical trial found that laser-sintered frameworks required significantly fewer laboratory repetitions than cast controls and showed better adaptation of the reciprocal arms,24 an in vitro and clinical assessment reported adaptation at least equivalent to conventional casting,25 and a systematic review and meta-analysis of patient-reported outcomes found no disadvantage for digitally fabricated frameworks compared with conventional ones.26

Evidence specific to digitally fabricated maxillofacial prostheses has also begun to accumulate. A randomised crossover trial in patients with hemimaxillectomy recorded significantly better scores on the Obturator Functioning Scale for fully digital, three-dimensionally printed obturators than for conventionally processed prostheses in the functional and esthetic domains,27 a randomised self-controlled study reported clinically acceptable adaptation and a shorter chairside impression time for a three-dimensionally printed definitive obturator,28 and a prospective series of digitally planned immediate obturators recorded satisfactory restoration of masticatory function in three-quarters of patients one month after surgery.29

The present report describes the rehabilitation of an Aramany Class I maxillary defect with a definitive obturator retained by OT Equator extracoronal attachments, in which both the fixed and the removable metallic components were designed in a single digital environment and manufactured by direct metal laser sintering. Attachment-retained obturators and additively manufactured frameworks have each been reported separately, and a small number of reports have combined semi-precision attachments with a digitally designed or laser-sintered framework in post-mucormycosis defects.30,31 The specific combination described here, in which extracoronal precision attachments, a single integrated computer-aided design of the splinted fixed partial denture together with the obturator framework, and direct metal laser sintering of both metallic components are applied to an Aramany Class I oncological defect, does not appear to have been documented previously. The purpose of this report is to describe the clinical sequence, the design decisions taken at each stage and the functional outcome obtained.

Case Report

A 40-year-old woman was referred to the department of prosthodontics for definitive prosthetic rehabilitation. She had undergone a right partial maxillectomy eighteen months earlier for a mucoepidermoid carcinoma of the right maxillary sinus. The surgical margins had been reported as clear on histopathology, no adjuvant radiotherapy had been administered, and she had remained under regular oncological review without evidence of recurrence.

An interim acrylic obturator had been provided during the immediate postoperative period. As the defect matured and the surrounding tissues remodelled, the prosthesis had become progressively loose. At the time of presentation she complained of difficulty in chewing on the right side, a change in the quality of her speech that her family found difficult to follow on the telephone, and escape of liquids into the nose while drinking. She also reported that the prosthesis dislodged when she yawned or laughed, and that she had begun to avoid eating in company.

Extraoral examination showed mild facial asymmetry with a depression over the right zygomatic region and a healed, hyperpigmented scar lying inferior to the zygomatic prominence. [Fig-1]The right nasolabial fold was less pronounced than the left, and there was a slight loss of upper lip support on the affected side. Mouth opening was adequate at 42 mm, and the temporomandibular joints were asymptomatic. No cervical lymphadenopathy was detected.





Frontal view Right lateral view

Figure 1- extraoral images

Intraoral examination revealed a well-healed, irregular to oval maxillary defect on the right side. The defect extended superiorly to the level of the middle meatus and involved the posterior alveolar ridge together with a portion of the palatal vault, producing an oro-nasal communication[Fig-2].The lining was completely epithelialized, with no granulation tissue, ulceration or discharge, and the scar band along the buccal margin of the defect was supple. The right lateral wall of the defect presented a shallow undercut that was considered useful for the peripheral seal of the obturator bulb.

The maxillary teeth present were 21, 22, 23, 24, 25, 26 and 27 in the FDI notation. All of them responded within normal limits to vitality testing. Probing depths did not exceed 3 mm, mobility was within physiological limits, and oral hygiene was satisfactory after an initial phase of scaling and root planing. Panoramic and intraoral periapical radiographs confirmed adequate crown-to-root ratios for the intended abutments and showed no periapical pathology. The interarch space measured on the diagnostic casts on the defect side was 11 mm, which was sufficient for the planned attachment system.

The defect was classified as an Aramany Class I maxillary defect. Three treatment options were discussed with the patient. The first was a conventional clasp-retained cast partial obturator, the second was an implant-retained obturator, and the third was a fixed and removable design in which a splinted metal-ceramic fixed partial denture would carry extracoronal attachments for a definitive obturator. Implant placement was not pursued because the residual bone on the defect side was inadequate and the patient was unwilling to undergo further surgery. She expressed a strong preference for a restoration in which no metal component would be visible during speech or smiling. The third option was therefore selected, using Rhein 83 OT Equator attachments and a framework fabricated through a combined computer-aided design and direct metal laser sintering workflow. Written informed consent was obtained after the sequence, the cost and the maintenance requirements had been explained.

Figure 2 – Intraoral images showing frontal view and occlusal view showing Aramany class 1 defect

Diagnostic phase

Primary impressions were recorded with irreversible hydrocolloid (Prime Dental Products, India). The defect was blocked out with moist gauze before the maxillary impression to prevent the material from locking into the undercut, and the gauze was secured with dental floss as a precaution. [Fig-3]

Figure 3-Diagnostic impression made with alginate







Diagnostic casts were poured in type III dental stone. The casts were surveyed and a diagnostic wax-up was completed to assess the available restorative space, the occlusal plane and the amount of lip support that the prosthesis would need to provide. On the basis of this analysis a fixed-removable design was confirmed, and a custom tray was fabricated in autopolymerizing acrylic resin with a 2 mm wax spacer and tissue stops.

Abutment preparation and definitive impression

Teeth 21, 22, 23 and 26 were prepared to receive a metal-ceramic fixed partial denture with a chamfer finish line placed at the level of the free gingival margin[Fig-4]. Splinting these abutments was considered essential, since the attachments would transfer both vertical and lateral components of the occlusal load to a unilateral abutment group. Provisional restorations were cemented with non-eugenol temporary cement and adjusted for occlusion and contour.

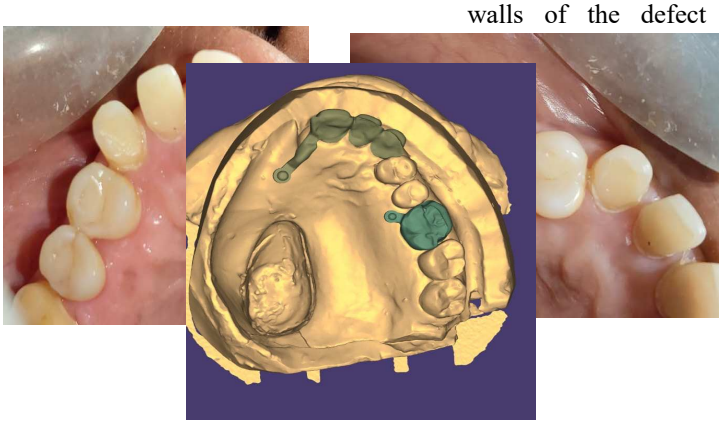


Figure 4- Tooth preparation done irt 21 ,22, 23 & 26

Before the definitive impression, the gingival sulci were displaced using knitted cords of sizes 000 and 00 impregnated with aluminium chloride solution, so that the finish lines were clearly exposed[Fig-5].The margins of the defect and the adjacent buccal sulcus were then functionally moulded with low-fusing green stick compound (DPI, Mumbai, India), the patient being asked to perform border movements, to swallow and to phonate during moulding.

Figure 5- gingival retraction

The definitive impression was made in a single stage with monophase polyvinyl siloxane material,[Fig-6] and it was inspected for the recording of the finish lines, the defect walls and the peripheral extensions before being poured in type IV die stone. A duplicate cast was retained as a reference.

Figure 6- Border molding of the defect area and the sulcus with green stick compound & Final impression made with monophase material

Digital design

The master cast was digitized with a laboratory optical scanner, and the resulting file was imported into Exocad design software.[Fig-7] Virtual surveying identified a path of insertion that was common to the prepared abutments and to the defect side of the arch, and the survey line was adjusted until the undercuts on the distal abutments and the walls of the defect could be engaged without interference.

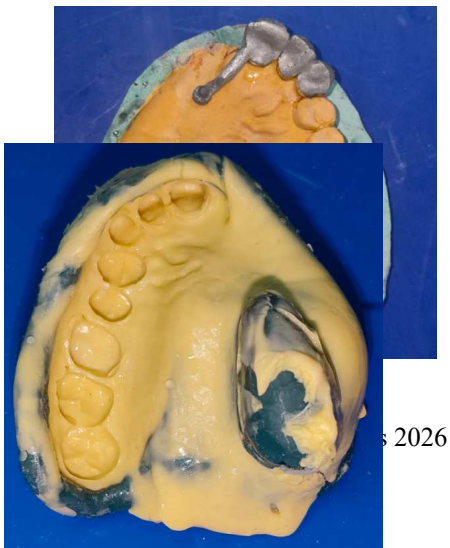


Figure 7- Metal crown and bridge with precision attachments

The metal-ceramic fixed partial denture was designed first. The copings were given a uniform thickness of 0.5 mm with a 30 micrometre cement space beginning 1 mm short of the finish line. Two OT Equator patrices were then positioned in the virtual library, in relation to 21 and 26, and their long axes were aligned with the planned path of insertion[Fig-8]. Their position was checked against the wax-up so that the housings would not interfere with the

artificial teeth.



Figure 8- DMLS -crown & bridge

The obturator framework was subsequently modelled at a uniform thickness of 0.8 mm, carrying the attachment housings anteriorly and posteriorly, a mesh retention area for the acrylic resin and a peripheral flange extending into the defect. Relief of 0.3 mm was applied over the defect margins and over the median palatal raphe. Finite adjustment of the connector outline was carried out on screen until the framework covered the palate adequately without encroaching on the rugae area used for tongue contact during articulation.

Fabrication

The design files were transferred to a direct metal laser sintering unit, and both the fixed partial denture substructure and the obturator framework were built in cobalt-chromium alloy powder in 20 micrometre layers.[Fig-9]

Figure 9- DMLS -obturator framework

The components were separated from the build platform, stress relieved according to the manufacturer's cycle, air abraded with 50 micrometre aluminium oxide and then finished and polished. Ceramic was subsequently layered on the fixed partial denture substructure and the shade was matched to the adjacent natural teeth

Clinical trial and insertion

The metal-ceramic prosthesis was tried in and assessed for marginal adaptation, passive fit, proximal contacts, occlusion and shade. Fit was verified with a silicone disclosing medium and confirmed radiographically.[Fig-10] After the patient approved the appearance, the prosthesis was cemented, and excess cement around the attachment patrices was removed carefully while the cement was still in the rubbery stage.



Figure 10- metal ceramic prosthesis try in

The obturator framework was then tried in.[Fig-11] The fit of the framework against the tissues, extension of the flange into the defect and engagement of the attachment housings were evaluated, and minor adjustments were made at the distal flange with a fine stone.

Figure 11- obturator framework try-in

A record base and wax occlusion rim were constructed over the framework, and the maxillomandibular relationship was recorded at an occlusal vertical dimension established from the patient's phonetic and rest position assessments. The artificial teeth were then arranged in acrylic on the framework in a bilaterally balanced scheme so that contacts on the defect side would help to resist rotation of the prosthesis.

At the wax try-in the esthetics, lip support, phonetics, occlusal plane and midline were evaluated, and the patient was asked to count from sixty to seventy and to repeat sibilant words to confirm that the palatal contour did not interfere with speech.[Fig-12]



Figure 12- try in procedure

After her approval, the prosthesis was flasked and processed in heat-polymerized acrylic resin. The obturator portion was hollowed during processing to reduce weight, and the access opening was closed with a thin autopolymerizing resin lid that was sealed and finished flush with the surrounding surface. The prosthesis was deflasked, remounted for occlusal correction, finished and polished. At insertion the nylon inserts of medium retentive value were seated in the housings, the prosthesis was placed, and the peripheral seal against the defect walls was verified by asking the patient to sip water and to blow gently through the nose with the lips closed. Occlusal contacts were refined with articulating paper until simultaneous bilateral contact was achieved in centric relation, and excursive interferences were eliminated. Pressure-indicating paste was used to identify and relieve two localized areas of tissue blanching along the buccal flange.[Fig-13]



Figure 13- Definitive obturator insertion

Instructions and maintenance

The patient was taught to insert and remove the prosthesis along the established path of insertion rather than by rotating it, and she was asked to demonstrate the procedure until she was confident. Instructions were given on cleaning the attachment housings with a soft interdental brush, on cleaning the abutment crowns and the fixed partial denture margins, and on leaving the prosthesis out overnight in water. She was advised to return immediately if the prosthesis became loose, if the tissues became sore, or if she noticed any change in the appearance of the defect lining. Recall appointments were arranged at one week, one month, three months and six months.

Follow-up and Outcome

At the one-week review the patient reported that she was able to drink without nasal escape for the first time since her surgery. Two small areas of mucosal soreness along the anterior flange were relieved. By the one-month visit she was eating a normal mixed diet and reported that she could chew on the defect side, which she had not attempted with the interim prosthesis. Her speech was assessed informally by asking her to read a standard passage aloud, and both the operator and her accompanying relative judged the hypernasality to have resolved. She reported that telephone conversations were no longer a difficulty.

At three and six months the prosthesis remained stable and retentive, the attachment nylon inserts did not require replacement, and no wear of the patrices was visible under magnification. The abutment teeth showed no increase in probing depth or mobility, and radiographs taken at six months showed no change in the crestal bone levels. The defect lining remained healthy, and the seal at the periphery of the obturator bulb was intact. The patient described herself as satisfied with the appearance of the restoration and stated that the absence of visible metal had been the feature she valued most.

Discussion

The rehabilitation of an acquired maxillary defect is one of the more demanding problems in prosthodontics, because the prosthesis must seal a communication, restore occlusion and support the face while resting on a foundation that has been reduced on one side. In this patient the choice of an obturator rather than a surgical reconstruction was made on grounds that are widely accepted. The defect was moderate in size, the residual dentition was healthy, and continued visual access to the resection site was desirable for tumour surveillance during the follow-up period.4,5 An obturator also allowed the patient to be treated without further hospital admission, which she had made clear she wished to avoid.

Biomechanical considerations in the Aramany Class I defect

In a Class I defect the abutments lie on one side of the arch and the defect occupies the other, so the fulcrum line runs anteroposteriorly close to the residual ridge. Any load applied over the obturator bulb therefore produces a rotational displacement rather than a purely vertical one, and the retentive elements on the dentate side are placed under tensile stress at every masticatory cycle.9,12 Recent numerical and experimental work on this specific defect class is directly relevant to the design used here. Mousa and co-workers evaluated several retentive configurations for Aramany Class I obturators and reported that the arrangement of the retentive elements, rather than the bulk of the prosthesis, governed both the retention generated and the magnitude of stress transmitted to the abutments and the residual bone, with widely separated retainers on splinted abutments producing the most favourable pattern.11,32 Sudhan and colleagues, analysing single- and two-piece closed bulb obturators in the same defect class, similarly found that stress concentrated at the abutment nearest the defect.10 Aramany's original recommendation of a linear or tripodal arrangement of retention for this class was followed here by placing one attachment as far anteriorly as the canine allowed and the second at the distal-most abutment, so that the retentive units were separated by the greatest available distance.9 Splinting the abutments with a fixed partial denture distributed the resulting load across four roots rather than concentrating it on one, and this is generally considered a prerequisite when extracoronal attachments are used on a unilateral abutment group.14

Precision attachments compared with clasp retention

Clasp-retained cast partial obturators remain a reliable and economical option, and they are often the correct choice when abutment prognosis is uncertain or when the patient's manual dexterity is limited. Their principal drawbacks are esthetic and biomechanical. A clasp arm crossing an anterior abutment is visible during speech, and the retentive terminal engages an undercut at a distance from the long axis of the tooth, so that displacement of the prosthesis generates a tipping moment. Attachments avoid both problems. The retentive component is contained within the contour of the crown, and the resultant of the retentive force acts much closer to the long axis of the abutment. In the present case this was the deciding factor for the patient, whose main stated requirement was that no metal should be visible.

The OT Equator system was selected in preference to bar or intracoronal designs for three reasons. Its low vertical profile suited the available interarch space; its nylon inserts are supplied in several retentive values, so retention can be reduced if the abutments show early signs of strain or increased if the patient reports looseness; and the inserts are replaceable at the chairside without disturbing the framework. A one-year multicentre randomised trial of this attachment system in overdentures reported stable retention and few prosthetic complications, which is reassuring with respect to the wear behaviour of the nylon insert, although that study examined implant rather than tooth support and its findings cannot be transferred directly to the present application.16

Comparison with recent attachment-retained obturator reports

It is useful to set this case beside the recent reports that used comparable designs, since these define what is and is not new here. Shetty and colleagues rehabilitated a maxillectomy defect with a conventionally cast framework carrying precision attachments and described satisfactory retention and patient acceptance; the framework was produced by the lost-wax technique and the attachment position was determined on a surveying table.17 Dhaliwal and co-workers reported an Aramany Class I defect treated with a cast partial denture carrying a closed hollow-bulb obturator and semi-precision attachments, and reached functional conclusions closely comparable with those obtained here, namely improved chewing, speech and swallowing with resolution of nasal regurgitation, again with entirely conventional fabrication.18 Two further reports have introduced digital technology into an attachment-retained design. Rathee and colleagues used direct metal laser sintering to produce cast partial denture frameworks carrying semi-precision attachments in three patients with post-mucormycosis maxillary defects and reported improved oral function with a shortened laboratory sequence,30 and Chahal and co-workers digitally designed a precision attachment with a cast partial framework in a single patient with a post-mucormycosis partial maxillectomy.31

Set against these reports, the present case is distinguished by three features taken together rather than by any claim of general superiority. First, the defect was an oncological Aramany Class I defect in a dentate patient rather than an infective defect. Second, the splinted metal-ceramic fixed partial denture, the attachment housings and the obturator framework were designed together within one digital environment, so that patrix parallelism, housing clearance and the position of the artificial teeth were resolved before any component was produced, rather than the attachment being added to an independently designed framework. Third, both the fixed and the removable metallic components were additively manufactured, whereas the earlier reports applied additive manufacturing or digital design to the removable component alone. The contribution of this report is therefore the integration of extracoronal precision attachments, a single integrated digital design and direct metal laser sintering of both components within one treatment sequence for this defect class. It is not evidence that this approach outperforms a conventionally cast clasp-retained or attachment-retained obturator, a question that only a comparative trial could answer.

Contribution of the digital workflow

Designing the framework in software altered the planning stage in a way that is difficult to reproduce on a surveying table. The path of insertion could be tested repeatedly against both the prepared abutments and the walls of the defect, and the parallelism of the two attachment patrices could be verified numerically rather than by eye. Connector thickness and relief were specified as values rather than estimated in wax, and the design file was stored, which means that a replacement framework can be produced from the same data should the original be damaged.19,23 The virtual wax-up also allowed the position of the attachment housings to be checked against the intended position of the artificial teeth before any metal was produced, and this avoided the situation, familiar in conventional practice, in which a housing is found to occupy the space required for a denture tooth only at the try-in stage.

Direct metal laser sintering contributed accuracy at the production stage. Because the framework is built layer by layer from cobalt-chromium powder, the errors introduced by wax distortion, investment expansion and alloy shrinkage during conventional casting are avoided, and defects such as porosity and surface nodules are correspondingly rare.21,22 Clinical evaluations support this. A cross-over

clinical trial of laser-sintered removable partial denture frameworks found significantly fewer laboratory repetitions and better adaptation of the reciprocal arms than in cast controls,24 and an in vitro and clinical comparison reported adaptation at least equivalent to conventional casting.25 A systematic review and meta-analysis of patient-reported outcomes found no difference between digitally and conventionally fabricated frameworks, which suggests that the benefit of the digital route is realised principally within the laboratory rather than being perceived directly by the patient.26 The clinical impression in this case was consistent with those reports, since the framework seated fully at the first trial and required adjustment only at one distal flange.

Obturator-specific evidence points in the same direction. In a randomised crossover trial in patients with hemimaxillectomy, fully digital three-dimensionally printed obturators scored significantly better than conventional prostheses for functional and esthetic limitation, while chewing limitation and social disability did not differ,27 and a randomised self-controlled study reported clinically acceptable adaptation with a shorter chairside impression time for a three-dimensionally printed definitive obturator.28 Wholly cast-free digital techniques for definitive hollow obturators have also been described.33 It should be noted, however, that both 2024 systematic reviews of digital maxillofacial prosthodontics concluded that fully digital protocols remain the exception, and that a recent systematic review of definitive palatal obturators identified digital impression methods in only about 6 per cent of reported cases.7,19,20 The workflow used here, which retained a conventional functional impression of the defect and applied digital methods to design and manufacture, corresponds to the hybrid protocol that this literature identifies as both the most commonly used and, on current fit data, the best performing.23

Functional and quality-of-life outcomes

The improvements described by this patient follow the pattern reported in the literature on obturator rehabilitation. Restoration of the palatal seal removes nasal air escape and typically produces an immediate reduction in hypernasality, while the return of a stable occlusal table allows masticatory function to recover over subsequent weeks.34,35 Systematic review evidence indicates that definitive obturation produces consistent gains in oral health-related quality of life in maxillary oncological defects, with speech, eating in public and appearance the domains that improve most,8 and these were the three domains this patient spontaneously mentioned. A recent prospective study of speech intelligibility after obturator rehabilitation recorded most of the improvement within the first few months of prosthesis use,34 a time course that matches what was observed here.

Limitations

This report describes a single patient followed for six months, so no conclusion can be drawn about the long-term behaviour of the attachments, the durability of the nylon inserts or the periodontal response of the splinted abutments over a period of years. Outcomes were recorded clinically and were not supported by standardized instruments for masticatory efficiency, nasalance or patient-reported quality of life, so the comparisons drawn above with published reports are narrative rather than quantitative. No conventionally fabricated control prosthesis was made for this patient, and the fit of the sintered framework was therefore assessed clinically rather than against a comparator. The cost of the digital workflow and of the attachment system is higher than that of a conventional clasp-retained obturator, which is a relevant consideration in many practice settings. Comparative studies with larger samples and longer observation periods are needed before attachment-retained, additively manufactured obturators can be recommended as a routine alternative.

Conclusion

Prosthetic rehabilitation of this Aramany Class I maxillary defect with a digitally designed obturator retained by Rhein 83 OT Equator precision attachments provided satisfactory clinical rehabilitation in this case. The attachments provided retention without any visible metal component and directed functional load closer to the long axes of the splinted abutments, while computer-aided design and direct metal laser sintering allowed the path of insertion and the framework dimensions to be controlled precisely and reduced the number of laboratory stages. Within the limits of a single patient followed for six months, the specific combination of extracoronal precision attachments, integrated digital design and additive manufacture of both the fixed and the removable metallic components proved workable and was well accepted in a partially dentate maxillectomy patient in whom retention, function and appearance all had to be addressed. Longer follow-up and comparative studies are required before any general advantage over conventional clasp-retained or cast attachment-retained obturators can be claimed.

References

1. Desjardins RP. Obturator prosthesis design for acquired maxillary defects. J Prosthet Dent. 1978;39(4):424-35.
2. Parr GR, Tharp GE, Rahn AO. Prosthodontic principles in the framework design of maxillary

obturator prostheses. J Prosthet Dent. 1989;62(2):205-12.
3. Kornblith AB, Zlotolow IM, Gebhardt J, Berg L, Gorlick J, Krainer M, et al. Quality of life of maxillectomy patients using an obturator prosthesis. Head Neck. 1996;18(4):323-34.
4. Brown JS, Shaw RJ. Reconstruction of the maxilla and midface: introducing a new classification. Lancet Oncol. 2010;11(10):1001-8.
5. Beumer J, Curtis TA, Firtell DN. Maxillofacial rehabilitation: prosthodontic and surgical considerations. St. Louis: Mosby; 1996.
6. Chen C, Ren W, Gao L, Cheng Z, Zhang L, Li S, et al. Function of obturator prosthesis after maxillectomy and prosthetic obturator rehabilitation. Braz J Otorhinolaryngol. 2016;82(2):177-83.
7. Ceraulo S, Barbarisi A, Hu ZH, Perazzolo S, Caccianiga G, Lauritano D, et al. Definitive palatal obturator applications: a systematic literature review. Prosthesis. 2025;7(5):112.
8. Manoj N, Chidambaranathan AS, Balasubramanium M, Rajapandi GR. Role of obturator in restoring quality of life and function in maxillary oncological defect cases: a systematic review. Oral Oncol Rep. 2024;11:100636.
9. Aramany MA. Basic principles of obturator design for partially edentulous patients. Part I: classification. J Prosthet Dent. 1978;40(5):554-7.
10. Sudhan RH, Chander GN, Anitha KV. Finite element stress analysis of Aramany class I maxillectomy defect with single- and two-piece closed bulb obturators. Gerodontology. 2021;38(2):209-15.
11. Mousa MA, Husein A, El-Anwar MI, Ariffin A, Abdullah JY. Evaluation of the biomechanics of Aramany class I obturators of different designs using numerical and experimental methods. Part I: retention and associated stress. J Prosthet Dent. 2024;132(5):1088.e1-1088.e8.
12. Keyf F. Obturator prostheses for hemimaxillectomy patients. J Oral Rehabil. 2001;28(9):821-9.
13. Singhal MK, Ahmad F, Nair C, Bankoti P. A cast partial obturator with hollow occlusal shim and semi-precision attachment. Indian J Dent Res. 2018;29(1):123-7.
14. Burns DR, Ward JE. A review of attachments for removable partial denture design: Part 1. Classification and selection. Int J Prosthodont. 1990;3(1):98-102.
15. Hedzelek W, Rzatowski S, Czarnecka B. Evaluation of the retentive characteristics of semi-precision extracoronal attachments. J Oral Rehabil. 2011;38(6):462-8.
16. Tallarico M, Fiorillo L, Montanari M, Scrascia R, Cristache CM, Ferrari E, et al. One-year multicenter randomised controlled trial comparing OT Equator and Locator attachments to retain an early loaded implant overdenture on two implants. Int J Biomater. 2023;2023:2745262.
17. Shetty PP, Chowdhary R, Shetty PP. A maxillofacial prosthetic obturator using precision attachments. Indian J Dent Res. 2020;31(5):799-802.
18. Dhaliwal H, Tembhurne J, Gangurde A, Jaiswal N, Jadhav M. Prosthetic rehabilitation of hemi-maxillectomy patient with definitive obturator using precision attachment: a case report. Int J Oral Health Dent. 2024;10(3):240-5.
19. Paul A, Dhawan P, Jain N. Digital applications in the fabrication of obturators in maxillectomy defects: a systematic review. Cureus. 2024;16(9):e70479.
20. Srivastava G, Padhiary SK, Mohanty N, Patil PG, Panda S, Cobo-Vazquez C, et al. Digital workflow feasibility for the fabrication of intraoral maxillofacial prosthetics after surgical resection: a systematic literature review. Acta Odontol Scand. 2024;83:392-403.
21. Revilla-Leon M, Ozcan M. Additive manufacturing technologies used for processing polymers: current status and potential application in prosthetic dentistry. J Prosthodont. 2019;28(2):146-58.
22. Kim HR, Jang SH, Kim YK, Son JS, Min BK, Kim KH, et al. Microstructures and mechanical properties of Co-Cr dental alloys fabricated by three CAD/CAM-based processing techniques. Materials (Basel). 2016;9(7):596.
23. Conceicao P, Portugal J, Neves CB. Evaluation of removable partial denture metal frameworks produced by digital methods: a systematic review. Appl Sci. 2023;13(19):10824.
24. Conceicao PR, Franco M, Alves N, Portugal J, Neves CB. Fit accuracy assessment of removable partial denture frameworks produced by direct metal laser sintering: a clinical trial. Clin Oral Investig. 2025;29(5):253.
25. Elhadery SS, Alhajj MN, Yunus N, Ibrahim N, Zanul Abidin Z, Ahmad SF, et al. Adaptation of cobalt chromium frameworks fabricated by conventional versus selective laser melting techniques: an in vitro and clinical assessment. J Prosthet Dent. 2025;134(5):1836-42.
26. Muehlemann E, Liguori MG, Pachiou A, Jung RE, Strauss FJ. Patient-reported outcomes of digitally vs. conventionally fabricated

frameworks in removable partial dentures: a systematic review and meta-analysis. J Dent. 2025;161:105920.
27. AboShady MM, Amer MM. Patient satisfaction with conventional versus fully digital obturators fabricated with 3D printing: a randomized crossover trial. BMC Oral Health. 2025;25:826.
28. Zhang H, Gan J, Zhu C, Jiao T. A digital workflow for fabrication of a 3D-printed definitive obturator prosthesis and a preliminary evaluation of its clinical adaptation: a randomized self-controlled study. J Prosthodont. 2026;35(2):143-52.
29. Ta AT, Le DT, Dam MT, Phuong TT, Nguyen DM, Pham HT, et al. Design process and early functional outcomes of digitally planned immediate obturator prostheses after partial maxillectomy. Prosthesis. 2025;7(4):80.
30. Rathee M, Divakar S, Jain P, Singh S, Chahal S. Prosthetic rehabilitation of mucormycosis patients using DMLS fabricated cast partial denture with semi-precision attachments: a case series. Spec Care Dentist. 2024;44(2):478-85.
31. Chahal S, Dahiya D, Nagar P, Mittal S. Digitally fabricated precision attachment with cast partial framework retained obturator in a partial maxillectomy patient following mucormycosis: a case report. Natl J Maxillofac Surg. 2024;15(2):332-6.
32. Mousa MA, Husein A, El-Anwar MI, Yusoff N, Abdullah JY. Evaluation of the biomechanics of Aramany class I obturators of different designs using numerical and experimental methods. Part II: stress distribution. J Prosthet Dent. 2025;133(1):321.e1-321.e8.
33. Ma D, Wang X, Zhang T, Bai S. A digital and cast-free workflow for fabricating a definitive hollow obturator prosthesis for a maxillectomy defect: a dental technique. J Prosthet Dent. 2025;134(4):1322-6.
34. Negi P, Kallala D, Gulia SK, Challa RSP, Motup R, Gaur A, et al. Speech intelligibility outcomes in maxillectomy patients rehabilitated with obturator prostheses: a prospective study. Bioinformation. 2026;22(3):1425-8.
35. Rieger J, Wolfaardt J, Seikaly H, Jha N. Speech outcomes in patients rehabilitated with maxillary obturator prostheses after maxillectomy: a prospective study. Int J Prosthodont. 2002;15(2):139-46.