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PRIKAZ SLUČAJA
*CASE REPORT*

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# Korištenje 3D ispisa u izradi trajne proteze s opturatorom: prikaz slučaja

# *Fabrication of a 3D Printing Definitive Obturator Prosthesis: a Clinical Report*

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**Sažetak**

**Uvod:** Dostignuća digitalne tehnologije u slikovnim prikazima i proizvodnim procesima omogućila su kliničarima nove terapijske mogućnosti. Tako se stereolitografijom (SLA) jednostavno, predvidivo i precizno rekonstruiraju prirođeni i stečeni tkivni defekti. **Prikaz slučaja:** Na pregled je došao šezdesetpetogodišnji pacijent s karcinomom pločastih stanica lijevoga maksilarnog sinusa. Upućen je na obostranu maksilektomiju, a planom terapije bila je predviđena izrada potpune gornje proteze s opturatorom. Za 3D ispis plastičnog modela defekta korišteni su CT snimka i 3D softver za planiranje. Najprije je bio izrađen voštani predložak opturatora koji je služio za izradu silikonskoga. Konačni otisak uzet je s intraoralno pozicioniranim predloškom opturatora. Radni model je udvostručen i novi je odljev uložen u kivetu. Nakon što je kiveta otvorena, vosak je uklonjen i stvoren je prostor s unutarnje strane opturatora. Transparentna zagrijana polimerizirajuća akrilatna smola na unutarnjem dijelu opturatora poslužila je da bi se poboljšala retencija između akrilatne baze proteze i silikonskog materijala za mekano podlaganje. Pacijent je šest mjeseci dolazio na redovite kontrole. Proteza se prema potrebi podlaže u ordinaciji. **Zaključak:** Pacijenti nakon maksilofacijalnih kirurških zahvata mogu imati poslijeoperacijske komplikacije, poput trizmusa i boli. U ovom slučaju bio je osiguran precizan protetički rad zahvaljujući kombinaciji digitalne tehnologije i konvencionalnih tehnika.

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## Uvod

Opturator je maksilofacijalna proteza za zatvaranje prirođenih i stečenih tkivnih defekata, primarno na tvrdom nepcu i/ili na susjednim alveolarnim/mekim tkivnim strukturama (1). U maksilofacijalnoj protetici defekt koji se treba rehabilitirati uglavnom otežava uzimanje preciznog otiska ili je pacijent pod psihološkim pritiskom ili ima bolove. Problemi pri uzimanju otiska nastaju zbog razlike u svojstvima mekoga i tvrdoga tkiva, pomičnosti, podminiranih mjesta i distorzije otisnog materijala (2). Ako se upustimo u uspoređivanje s proteklim desetljećima, danas je veća potreba za rehabilitacijom takvih pacijenata. Naime, u SAD-u je tijekom posljednjih 40 godina za 15 posto porastao broj pacijenata s oralnim karcinomom (3). To upozorava da je potrebno precizno i individualizirano planiranje terapije u skladu sa zahtjevima koji se postavljaju.

CAD/CAM tehnologijom sve se češće koristimo u dentalnoj medicini od 1980. godine i to kao alternativom tijekom oblikovanja i proizvodnje nadomjestaka. Iako je na tržištu mnoštvo sustava, njihova je najvažnija komponenta

## Introduction

The obturator is a maxillofacial prosthesis used to close a congenital or acquired tissue opening, primarily of the hard palate and/or contiguous alveolar/soft tissue structures(1). In Maxillofacial Prosthetics, the anatomical structures that have to be rehabilitated most of the time impede the clinician to make a detailed impression or even the patient himself/herself is under psychological pressure or pain.

Impression taking procedure has to consider a diversity of soft and hard tissues, mobility, undercuts and the distortion of impression material related to weight and consistency(2). At the present time, compared to the previous decades, a need for the rehabilitation of such patients has increased. There has been an increase of oral cancer patients of 15% in the U.S.A. during the last 40 years, (3). These numbers reveal the need for a more accurate, demanding and personalized treatment planning.

The CAD-CAM technology has been developed as an alternative tool for designing and manufacturing in dentistry since 1980. Although there are numerous systems available intraoralna kamera koja snima anatomiju usne šupljine i pretvara je u digitalne podatke (4). Nakon toga poseban softver uređuje digitalizirane podatke i prenosi ih u glodalicu. Na kraju, u CAM tehnologiji koriste se kombinirani podatci kako bi se izradio dizajnirani objekt. Postoje dvije metode izrade – jedna je suptrakcijska kada se materijal izrezuje iz bloka, a druga je adicijska i njome se objekt stvara u slojevima. Stereolitografija je ekstenzija CAD/CAM tehnologije kojom se izrađuju 3D prototipovi. Izvorno potječe od tehnike brzog prototipiranja, a danas u kombinaciji s laserskom tehnologijom omogućuje u dentalnoj medicini individualno stvaranje 3D modela prilagođenih pacijentovim anatomskim strukturama i potrebama. Stereolitografski modeli možda će u rješavanju kraniofacijalnih anomalija progresivno nadomještati tradicionalne glodane modele (5). SLA kao metoda proizvodnje primjenjuje se u mnogim područjima, no mora se odrediti kada je indicirana. Njezine su prednosti to što se za izradu modela upotrebljavaju fotosenzitivni polimeri, što omogućuje kratku proizvodnju i stvaranje složenih anatomskih struktura uz male materijalne troškove. No, pri uporabi SLA koristi se uzak spektar materijala, a ti polimeri mogu uzrokovati iritacije jer se modeli ne mogu sterilizirati (6).

Digitalizirana proizvodna tehnologija postala je dostupnija nakon što je poboljšana tehnika slikovnih prikaza. CT-om i CBCT-om često se koristimo u dentalnoj medicini za trodimenzionalni prikaz i dobivanje točnih digitalnih podatka koji se mogu odmah koristiti (7).

Fourie i suradnici koristili su se CBCT-om kako bi provjerili vjernost prikaza mekih tkiva. Njihovi nalazi pokazali su da postoje manjkavosti u prikazu površinskih detalja, ali su zaključili da je CT pouzdana i precizna metoda (8).

Uporaba podataka dobivenih CT-om za stvaranje 3D modela za izradu mobilnih proteza ili opturatora bez intraoralnog skeniranja ili uzimanja otiska kirurškog područja, nije uobičajena tehnika. U ovom kliničkom slučaja opisana je kombinacija konvencionalnog i digitaliziranog postupka za izradu opturatora.

## Prikaz slučaja

Šezdesetpetogodišnji pacijent s preboljenim tumorom lijevoga maksilarnog sinusa došao je u ordinaciju radi protetičke terapije. Šest mjeseci prije toga bio je na obostranoj maksilektomiji s kirurškom resekcijom koja je sezala od stražnjeg ruba ramusa i kuta mandibule do frontalne površine lijeve strane viscerokranija. Nakon detaljnoga intraoralnog pregleda ustanovljeno je da je nepčani defekt bio velik (dimenzije 10,4 x 10,5 cm) (slika 1.). Uz to pronađeni su preostali korijeni desnoga središnjeg sjekutića i očnjaka. Mandibula je bila ozubljena s nekoliko elongiranih zuba zahvaćenih karijesom, što je zahtijevalo multidisciplinarni terapijski pristup.

Histološkim pregledom ustanovljena su obilježja karcinoma pločastih stanica umjerene diferencijacije (stadij $T_4N_1M_0$).

Pacijentu se posljedično razvio snažan trizmus te je imao bolove dok je govorio ili jeo. Ta dva postoperacijska simp-

on the market, the main sequence is primarily produced by a scanner that converts human anatomy into digital data following a specific software program that can edit the digitized data and give information to a fabrication machine(4).

Finally, the CAM technology uses the combined data and fabricates the final restoration. There are two methods for fabrication: one is cut back from a certain material block (subtractive technique) and the other is layering the restoration (additive technique). Stereolithography (SLA) is the extension of CAD CAM technology in order to produce 3D prototype models. Originally it emerged from Rapid Prototyping (RP) technology combined with laser technology and nowadays it gives dentistry the possibility to create customized 3D models for each patient adjusted to his needs and anatomical structures. The use of stereolithographic models may progressively replace traditional milled models in the management of craniofacial anomalies (5). SLA, as a manufacturing method, has many applications, however, it must be carefully selected. The advantages of SLA is that light sensitive polymers are used to fabricate models, which allows a brief fabrication time and gives the ability to create complex anatomical structures with low cost materials. However, SLA has a small range of materials in use and the polymers may cause skin sensitization because the models cannot be sterilized (6).

All these manufacturing technologies became more accessible imaging technology had been improved. CT and CBCT are widely used in dentistry and provide volumetric data that can be used immediately and in a very accurate way (7). Fourie et al. used CBCT to detect whether soft tissue imaging is reliable. Their findings revealed that there is a deficiency in surface detail, however, they concluded that CT is a reliable and accurate method (8).

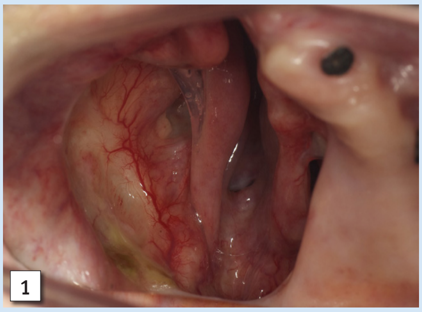
Using the data from the CT scan in order to create a 3D model for RPDPs or obturators without an intraoral scanning or impression making of the surged area is not a commonly used technique. This clinical report provides a combined concept of conventional and digital technology for obturator fabrication.

## Clinical case

A 65-year- old male patient with a history of a tumor of the left maxillary sinus was referred for a prosthetic treatment. A bilateral maxillectomy was performed 6 months prior to the surgical resection which extended from the posterior border of the ramus and angle of the mandible the anatomical level of the posterior frontal surface, in the left visceral skull. A thorough intra-oral examination showed that the palatal defect was large (dimensions 10.4 x 10.5 cm) (Figure 1). Moreover, the two remaining roots of the right central incisor and canine were found. The mandibular arch was dentate and it had many overerupted carious teeth requiring a multidisciplinary treatment approach.

The histological examination demonstrated the features of a non-keratinized squamous cell carcinoma of moderate differentiation (Stage $T_4N_1M_0$).

Subsequently, the patient presented with severe trismus and pain in the facial and mucosal area which interfered with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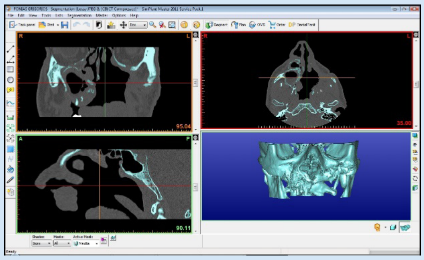
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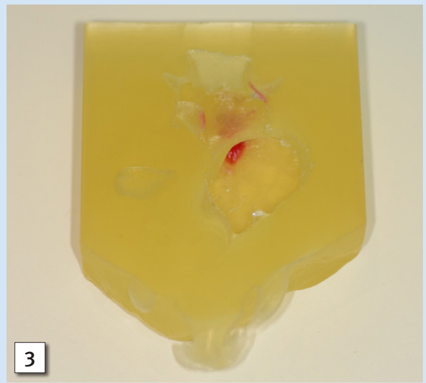
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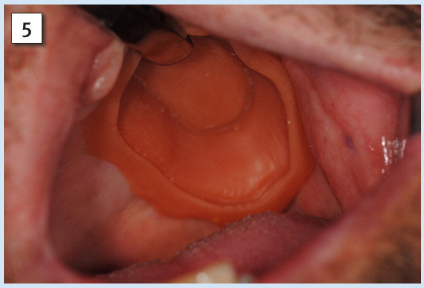
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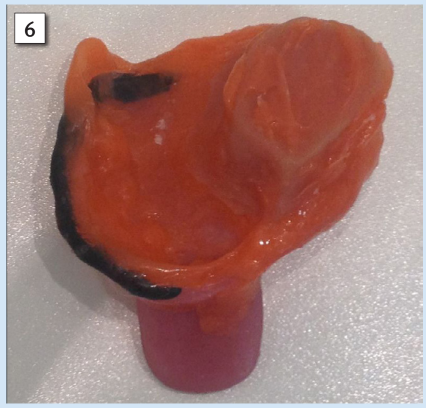
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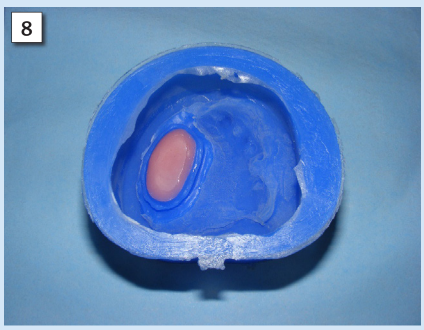
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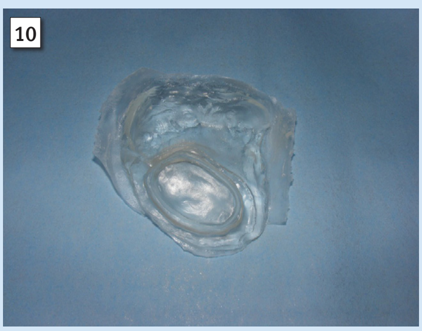
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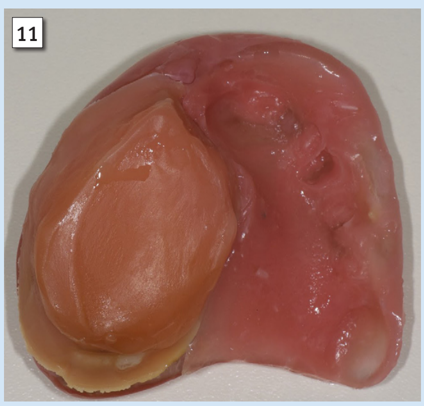
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**Slika 1.** Početno stanje nepčanog defekta
**Figure 1** Pre-operative condition of palatal defect
**Slika 2.** Prikaz maksilarnog defekta u softveru *Simplant*
**Figure 2** Simplant software view of maxillary defect
**Slika 3.** Anatomski model defekta u 3D ispisu
**Figure 3** A 3D printing anatomical model of defect
**Slika 4.** Uloženi voštani objekt
**Figure 4** An invested wax pattern of a hollow bulb
**Slika 5.** Intraoralno pozicioniranje predloška
**Figure 5** An intraoral application of the hollow bulb.
**Slika 6.** Konačni otisak s inkorporiranim silikonskim predloškom
**Figure 6** The final impression with the silicone hollow bulb *in situ*.
**Slika 7.** Izrada radnog modela – na rubovima predloška vidi se retencijski utor
**Figure 7** Fabrication of a working cast. The retention groove of the hollow bulb can be detected on its borders.

**Slika 8.** Udvostručenje radnog modela i silikonskog opturatora
**Figure 8** Duplication of the master cast and the silicone obturator.
**Slika 9.** Novi radni model s voštanim brtvilom
**Figure 9** A new working model created with the wax sealant imprinted.
**Slika 10.** Izrada transparentne akrilatne baze
**Figure 10** Fabrication of the transparent heat cured acrylic denture base.
**Slika 11.** Direktno podlaganje konačnog opturatora materijalom za mekano podlaganje
**Figure 11** Direct relining of the definite 3D printing obturator prosthesis with RTV soft lining materials.
**Slika 12.** Situacija pet godina poslije izrade gornje proteze s opturatorom ispisane u 3D-u
**Figure 12** A 5 year- follow up of the maxillary 3D printing obturator prosthesis.

toma zakomplicirala su daljnju protetičku terapiju. Nakon intraoralnog pregleda, prikupljanja nalaza i rasprave o terapijskim mogućnostima prihvaćen je plan terapije koji je uključivao izradu potpune gornje proteze s opturatorom. Na preostalim korijenima središnjeg sjekutića i očnjaka provedena je endodontska terapija i izrađeni su kompozitni ispuni da bi se izbjeglo vađenje i rizik od osteonekroze. Postkirurški maksilarni defekt doveo je do hipernazalnog govora i curenja tekućine kroz nos, a otežavao je žvakanje i gutanje (9).

Zbog vizualizacije i komunikacije obavljeno je trodimenzionalno mjerenje razmjerno velikoga nepčanog defekta i to korištenjem kompjutorizirane tomografije (CT) i softvera za 3D planiranje (SimPlant v14, Materialise Dental N.V., Leuven, Belgija) (slika 2.). Softver MIMICS korišten je za 3D procesuiranje DICOM slika i pripremu podataka u STL formatu za izradu modela. Procesuirano je 116 CT slika u DICOM formatu te je kreiran niz podataka u STL formatu.

Za izradu preciznog anatomskog modela koji točno prikazuje defekt, a oblikovan je virtualno na temelju unesenih podataka, korišten je 3D pisač Solido SD300 (Solidmodel, Acton, SAD). To je poseban stroj koji reže tanke slojeve PVC plastike te se oni lijepe sloj po sloj dok se ne dobije potpuni anatomski model (slika 3.). Postupak traje od 10 do 12 sati.

## Laboratorijski postupak

Na početku je izrađen voštani predložak opturatora kojim je defekt zatvoren na anatomskom modelu. Voštani objekt uložen je u sadru (Silky Rock, Whip-mix Corp. Whipmix, Louisville, SAD), a zatim je vosak otopljen kako bi ostala šupljina koja služi kao kalup (slika 4.). Dobiveni prostor ispunjen je zagrijanim polimerizirajućim silikonom za mekano podlaganje (Molloplast-B, Detax GmGh and Co., Ettlingen, Njemačka) te je deset minuta bio izložen pritisku od 100 kPa i zatim zagrijan do 100 $^{0}$C stupnjeva u vodenoj kupelji, nakon čega je slijedila dvosatna polimerizacija u kipućoj vodi u skladu s uputama proizvođača. Na površinu sadre u kiveti naneseno je sredstvo za izolaciju.

Preliminarni otisak u ustima uzet je konfekcijskom žlicom sa silikonskim predloškom opturatora. Prema tako dobivenom modelu izrađena je individualna žlica. Rubovi su definirani termoplastičnim materijalom (Impression compound, type 1 Kerr Corp. CA, SAD), a zatim je silikonom srednje konzistencije uzet funkcijski otisak (Episil, Dreve, Unna, Njemačka) (slike 5. i 6.). Sljedeći potez uključivao je izradu radnog modela od sadre tipa IV (Whip-mix Corp. Whipmix, Louisville, SAD) (slika 7.). Radni model udvostručen je s pomoću laboratorijskog silikona (Prestige. Duplex, Vanini Dental Industry, Grassina, Italija), pri čemu je vosak brtvio područje opturatora (slika 8.). Nakon polimerizacije silikonskog kalupa, novi radni model uložen je u kivetu. Na modelu je

speaking, nutrition and functioning. Those two post operation symptoms complicated further the prosthetic restoration plan. Following intra oral examination, data collection and discussion of treatment options, the treatment plan was agreed consisting of definite obturator prosthesis for the upper arch. The remaining roots of central incisor and canine had a RCT and composite restorations in order to avoid extraction and the risk of osteonecrosis. Post-surgical maxillary defects predispose the patient to hypernasal speech, fluid leakage through the nose and compromise the masticatory ability and deglutition (9).

Visualization and communication of pathology involved a 3 dimensional (3D) measurement of a remarkably large palatal defect using a computerized tomography (CT) data and a 3D planning software (SimPlant v14, Materialise Dental N.V., Leuven, Belgium) (Figure 2). The MIMICS software (SimPlant v14, Materialise Dental N.V., Leuven, Belgium) was utilized for a 3D processing of the DICOM images and the preparation of the STL file for manufacturing the model. 116 CT images in a DICOM format were processed and a relevant STL file was developed.

A 3D-printing Solido SD300 (Solidmodel, Acton, USA) was the rapid manufacturing technology used for building the precise anatomical model within the limits of the defect. It was developed from virtual planning data input. This specific 3D printing machine is cutting thin the layers of PVC plastic (Solidmodel, Acton, USA) which are glued together layer by layer until the complete anatomical model is fabricated (Figure 3). The duration of the process was about 10-12 hours.

## Laboratory process

At the beginning, a wax pattern of the hollow bulb was fabricated using the plastic anatomical model. The wax pattern was invested in stone (Silky Rock, Whip-mix Corp. Whipmix, Louisville, USA) and then boiled out from the mold (Figure 4). The space created, was packed with a heat cured silicone soft liner (Molloplast-B, Detax GmGh and Co., Ettlingen, Germany) for approximately 10 min under bench pressure (100 kPa), into the dummy blank and then heated up to 100$^{0}$ C in a water bath, followed by curing in boiling water at 100$^{0}$ C for 2 h according to the manufacturer's recommendations. A separating agent was applied to the stone surfaces of dental flasks for insulation.

Preliminary impressions were obtained using a stock tray with a silicone hollow bulb intraorally. The master cast was used to create a special tray. Border molded impression was obtained through the border molding process by utilizing impression compound (Impression compound, type 1 Kerr Corp. CA, USA) and medium body vinyl polysiloxane (Episil, Dreve, Unna, Germany (Figure 5 and 6). The next step included the fabrication of a working cast using Type IV (Whip-mix Corp. Whipmix, Louisville, USA) dental die stone (Figure 7). Subsequently, the duplication of the master cast using laboratory silicone (Prestige. Duplex, Vanini Dental Industry, Grassina, Italy) was made with wax pouring inside the silicone obturator and the sealing of the area prikazan rub opturatora i voštanog brtvila tako da je ostao prazan prostor između proteze i opturatora (slika 9.).

Nakon završetka postupka kiveta je otvorena i vosak je otopljen i izvađen iz kalupa kako bi se stvorio prostor s unutarnje strane opturatora. Prozirna zagrijana polimerizirajuća akrilatna smola (Vertex, Vertex Denta, Zeist, Nizozemska) unesena je između akrilatne baze proteze i silikonskog opturatora kako bi se povećala retencija između dvaju materijala (slika 10.). Kiveta je pritisnuta i akrilatna smola ostavljena da se polimerizira u vodenoj kupelji (Interlab Products, Hull, UK) sedam sati na temperaturi od 70 $^0$C i nakon toga jedan sat na 100 $^0$C, u skladu s uputama proizvođača. korištena je Za određivanje međučeljusnih odnosa korištena je nepčana ploča s okluzalnim bedemima. Odabrani su i postavljeni prednji i stražnji zubi. Završna polimerizacija unutar kivete trajala je 90 minuta u vodenoj kupelji na temperaturi od 74 $^0$C i još 60 minuta na 100 $^0$C (slika 11.). Nakon stavljanja proteze u usta pacijenta, područja pojačanog pritiska tijekom funkcijski kretnji označena su indikatorskim silikonom (Fit Checker II, GC America Inc, SAD) i oslobođena, posebno u podminiranim područjima koja su zahvaćala anatomske rubove defekta.

Dodatno je ubrušena okluzija nove proteze i antagonistički prirodnih zuba. Pacijent je dobio upute kako održavati oralnu higijenu, s naglaskom na učinkovito čišćenje prirodnih zuba, proteze s opturatorom i nepčanog defekta. Kontrolni pregledi određeni su u razmacima od dva dana, jednog tjedna, nakon mjesec dana, nakon šest mjeseci i jedanput na godinu nakon predaje proteze (2). Na kontrolnom pregledu poslije šest mjeseci obavljeno je direktno podlaganje proteze silikonskim materijalom (Tokuyama Sofreliner, Tokuyama Dental Corporation, Taitou-Ku Tokyo, Japan), čime je poboljšana njezina retencija i preciznost rubova. Pet godina nakon predaje proteze s opturatorom nisu bili zabilježeni nikakvi klinički simptomi (slika 12.)

in terms of a cap (Figure 8). After the silicone curing, a new working cast was invested and reflasked. The model had the borderline of the obturator and the sealant imprinted, hence the gap between the denture and the obturator was preserved (Figure 9).

After the whole procedure had been completed, the flasks were opened, the wax was boiled out from molds and mold space was created in the internal part of the obturator. Transparent heat cured acrylic resin ( Vertex, Vertex Denta, Zeist, The Netherlands) was sandwiched with, at the inner part of the bulb, improving the retention between the acrylic denture base and the silicone hollow bulb (Figure 10). The dental flask was placed under bench pressure and the acrylic resin was allowed to cure for 7h at 70$^0$ C followed by 1 h at 100$^0$ C, according to the manufacturer's instructions in a water bath (Interlab Products, Hull, UK). A base plate with occlusal rims was used to record the jaw relationship. Selection and arrangement of anterior and posterior teeth was made. The final curing cycle included the dental flask within a water bath at 74$^0$ C for 90 min and 100$^0$ C for 60 min (Figure 11). After the obturator prosthesis was successfully inserted in the patient's mouth, pressure areas during functional movements were located with pressure indicator silicone (Fit Checker II, GC America Inc, USA) and relieved especially in large undercuts that composed the anatomical borders of the defect.

Additionally, occlusal adjustments of the new prosthesis and the opposite natural dentition were made carefully. The patient was advised about oral hygiene procedures focusing on the effective cleaning of natural teeth, the obturator prosthesis and the acquired palatal defect. Postinsertion appointments were scheduled at intervals of 2 days, 1 week, 1 month, 6 months and once a year after placement of the prosthesis(2). After 6 months in patient's recall, a direct relining using a chairside silicone soft liner (Tokuyama Sofreliner, Tokuyama Dental Corporation, Taitou-Ku Tokyo, Japan) improved the fitting of the complete denture and the accuracy of its borders.

Five years after the initial placement of the 3D printing obturator prosthesis, no clinical symptoms were observed (Figure 12).

## Rasprava

Karcinom pločastih stanica u području glave i vrata otkrije se svake godine kod gotovo 400 tisuća pacijenata. Stadij bolesti ne smatra se važnim za planiranje terapije i terapijske strategije (10). Pacijenti operirani zbog karcinoma usne šupljine imaju poslijeoperacijske komplikacije, poput trizmusa i boli. Trizmus je tipična pojava i nakon zračenja, s incidencijom od 33,9 posto. Ako nije liječen, može prijeći u kronični oblik nakon čega slijedi postupna fibroza mišića. Kronična postoperativna bol pojavljuje se u 4,2 do 6,5 posto slučajeva. Ta dva simptoma utječu na kvalitetu života i otežavaju terapiju, no protetička rehabilitacija omogućuje prevladavanje postoperativnih poteškoća i vraćanje normalnih funkcija (govor, žvakanje, gutanje) (11– 13). Trizmus komplicira postupke u rehabilitacijskoj fazi i utječe na preciznost, posebno tijekom uzimanja otiska. Cheng i suradnici uzimali su pacijentima s

## Discussion

Squamous cell cancer of the head and neck (SCC) is diagnosed in nearly 400.000 patients per year. Staging of SCC has not been evaluated as a finding of importance related to the treatment planning and therapeutic strategies (10). Patients surged for oral cavity cancer develop postoperative complications such as trismus and pain which occur quite frequently. Trismus is well recognized in patients who have also received radiotherapy with the reported incidence of 33.9%. An unmanaged trismus converts into chronic trismus, followed by a gradual fibrosis of the muscles. Chronic postoperative pain is confirmed and its occurrence ranges from 4.2% to 6.5%. Those two symptoms affect the Quality of Life measurements and complicate the clinical management. However, prosthetic rehabilitation of oral cavity permits patients to overcome postoperative difficulties and bring back natumikrostomijom primarni otisak intraoralno i to izrađenom silikonskom žlicom. Nakon toga izradili su individualnu žlicu i uzeli otisak materijalom kitaste i srednje konzistencije. Poteškoća pri korištenju te tehnike jest to što može nastati dimenzijska distorzija zbog termalne ekspanzije sadre (14). Vojvodić i suradnici primjenjivali su dvovremensku otisnu tehniku. Primarni otisak služio je za izradu metalnog nosača koji je korišten kao individualna žlica za otiskivanje defekta. Ta je tehnika dobro dokumentirana, a prednost joj je preciznost otiska i manja nelagoda za pacijenta (15).

U ovom prikazu pacijent je, kao postoperativne simptome, imao jake bolove i izražen trizmus. U fazi uzimanja otiska pojavila se potreba za korištenjem trodimenzionalnih slikovnih prikaza i digitalne tehnologije kako bi se prevladao taj problem. Digitalna tehnologija, poput rapidnog prototipiranja i SLA, kao što su to pokazali Williams i suradnici, najprikladnije su metode ako je potrebno restaurirati složene anatomske strukture (13, 16 – 18). Posljednja generacija CT-a, u kombinaciji s programom za digitalnu analizu i 3D, brzim prototipiranjem može dati pouzdan rezultat. U slučaju da je potrebna maksilofacijalna proteza brže se izrađuje kalup te je s pomoću jednog kalupa moguće višestruko izlijevanje. CBCT se upotrebljava kao primarni model u kombinaciji sa SLA-om za konstrukciju dijelova ili cijele mobilne proteze, kako bi se smanjila bol tijekom postupka i anksioznost kirurških pacijenata. No kliničari trebaju uzeti u obzir troškove postupka, preciznost sustava i materijale kojima se koriste.

## Zaključak

Postoje dokazi da su bol i trizmus česte postoperativne komplikacije. U ovom slučaju, da bi se prevladali ti problemi, korištena je digitalna tehnologija. Kombinacija konvencionalnih tehnika i SLA terapeutu je alternativa za izradu precizne proteze u što kraćem vremenu, smanjujući pritom nelagodu i anksioznost pacijenta.

## Zahvala

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## Sukob interesa

Nije naveden.

ral function (speech, nutrition, mastication) (11),(12)(13). Trismus complicates prosthodontics procedures during rehabilitation phase and disturbs materials accuracy, especially during the impression session. In order to overcome this problem, Cheng et al. made a primary impression for a microstomic patient creating intraorally a silicone tray. Subsequently, a custom tray was created and the impression was by using putty and medium viscosity silicone. The difficulty with this technique is that dimension distortion may occur due to gypsum thermal expansion (14). Vojvodic et al. used a two steps impression technique (alter cast impression technique). The primary impression was made to construct the metal framework which was used as a custom tray for the defect impression. The altered cast technique is well documented in the literature. The use of this impression technique has the following advantages: more accurate impression and less discomfort for the patient (15).

In this clinical case, the patient was in great pain and had severe trismus as postoperative symptoms. During the impression making stage, the clinicians decided to overcome this problem by resorting to imaging and digital technology. Digital technologies such as RP and SLA as shown by Williams et al are more accurate and more adequate methods when complex anatomical structures have to be restored (13), (16), (17),(18). The preciseness of the last generation of CTs combined with digital analyzing programs and 3D rapid prototyping can lead to a more reliable result. In maxillofacial prosthetic cases, where only the RP mold is fabricated, the process is shortened and multiple pouring is allowed from a single mold. Cone-beam computed tomography (CBCT) can be used to provide primary reconstruction as a primary cast combined with SLA and construct parts or complete removable prostheses reducing the chair side pain and anxiety of surgically treated patients. However, the clinicians should consider the procedure cost, the accuracy of the manufacturing system and materials used.

## Conclusion

There is evidence that pain and trismus are frequent postoperative complications. In this clinical case, digital technology was used to overcome the two symptoms. A combination of conventional techniques and SLA is an alternative for the clinician to make an accurate prosthetic restoration, thus reducing treatment time, patient discomfort and anxiety.

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## Conflict of interest

None declared.

**Abstract**

**Introduction:** Digital technologies related to imaging and manufacturing provide the clinician with a wide variety of treatment options. Stereolithography (SLA) offers a simple and predictable way for an accurate reconstruction of congenital or acquired defects. **Clinical case:** A 65-years old cancer patient with non- keratinized squamous cell carcinoma of left maxillary sinus came for a prosthetic clinical evaluation. A bilateral maxillectomy was performed and the treatment plan included definite obturator prosthesis for the upper arch. CT data and 3D planning software were used to create a 3D printing plastic model of the defect. A wax pattern of the hollow bulb was fabricated and cured with heat-cured silicone soft liner. A final impression was obtained with the hollow bulb placed intraorally. The master cast was duplicated and the new cast was invested and reflasked. The flasks were opened, wax was boiled out and some space was created in the internal part of the obturator. Transparent heat cured acrylic resin was sandwiched with, at the inner part of the bulb, improving the retention between the acrylic denture base and the silicone based soft lining material. The patient was then placed on a 6-month recall. The five-year follow up consists of a chair side relining, when needed, of the definite removable prostheses. **Conclusion:** Maxillofacial surgery patients may develop postoperative complications such as trismus and pain. In these cases, the combination of digital technology and conventional techniques provide an accurate prosthetic restoration.

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