Implant-supported single zirconia crowns for posterior teeth using completely digital work-flow – a case report

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SUMMARY
Introduction Planning fixed prosthodontic reconstruction can be challenging task in everyday practice. When the last tooth in dental arch is missing, a single implant-supported crown is recommended. With the evolution of digital technology, it became possible that these restorations can be made using completely digital approach. The aim of this case report was to present complete clinical procedure of making implant supported single zirconia crowns for posterior teeth using completely digital approach.

Case report A 53-year-old patient presented to the dental office with missing both first molars in the lower dental arch. The decision was made to make two implant-supported single screw-retained crowns, using digital approach. Intraoral scanning of the soft tissues and the implants’ position was done using intraoral scanner Medit i500. The laboratory steps followed: computer-assisted design (CAD) and computer-assisted manufacturing (CAM) of zirconia crowns.

Conclusion Implant-supported single crowns for posterior teeth are an excellent solution for patients when the last tooth in dental arch is missing. Digital approach - from initial intraoral scanning (IOS), to designing the restoration in software and further processing of monolithic CAD/CAM generated crowns out of zirconia gives predictable, highly esthetic and functional results for implant-supported single crowns.

Keywords: digital approach; IOS; screw-retained crowns; implant-supported crowns; implants

INTRODUCTION
Planning fixed prosthodontic reconstruction can be challenging task in everyday practice, considering all biological and technical risks during the procedure. Prosthodontic restorations can be tooth or implant-supported. In the posterior region, the decision about gap reconstruction is made based on the condition of adjacent teeth. If they are intact or with minimal restoration, then bridge would be poor choice as it would damage abutment teeth. In that case, implant-supported single crown is the first choice, presenting the most tissue-preserving option [1]. Also, when the last tooth in the dental arch is missing, a single implant-supported crown is a recommended.

When making an implant-supported single crown, there are two options: screw-retained and cemented restorations. The choice is usually made according to clinician preferences since there is no evidence that any method is better [2].

The evolution of intraoral scanning technology (IOS) completely changed dental practice. The digital workflow begins with intraoral scanning of the soft tissues and implants’ position. Afterward, the laboratory steps follow: computer-assisted design (CAD) and computer-assisted manufacturing (CAM). According to design, final monolithic restoration is manufactured from zirconia, lithium disilicate, or hybrid ceramic materials [3, 4].

The aim of this case report is to present complete clinical procedure of making an implant supported single zirconia crown for posterior teeth using completely digital approach.

CASE REPORT
A 53-year-old patient presented to the dental office with missing both first molars in the lower dental arch. First molars were his last teeth in the lower dental arch. The decision was made to restore them with implant-supported single crowns, because other fixed prosthodontic restorations were not possible. Implants Blue Sky (Bredent Medical GmbH&Co.KG, Germany) were placed in the region of the teeth 36 and 46. After the healing period of 6 months, gingival formers were placed and peri-implant mucosa was allowed to heal for 14 days. At the very beginning of the procedure, shade determination was done to avoid dehydration and change of teeth color later on (Figure 1). Intraoral photographs were taken with camera (Canon R, Canon 100mm 2.8 L, Yongnuo YN-24EX TTL Macro Flash) and sent to the laboratory to achieve better color effects and matching with adjacent teeth.

The scanning was done using Medit i500 intraoral scanner (Medit corp., Seoul, Korea). Firstly, the whole lower dental arch was scanned, with gingival formers on
implants (Figure 2). Then, using a tool in MEDIT software part of the digital impression with gingival formers was deleted (Figure 3). To represent the position and orientation of dental implants in intraoral scanning procedure scan body SKYUSCAI (Bredent Medical Gmbh&Co.KG, Germany) was used (Figure 4). One scan body was used for both sides, scanning one implant at a time, using HD (high definition) option of the scanner (Figure 5).

The scan was saved as STL file that was sent to the dental laboratory (Figure 6). Digital models were printed in dental laboratory using printer DWS xfab2500pd and resin DWS Precisa RD097 and restorations were designed using one scan body and, scanning one implant at a time.

Figure 1. Colour determination of adjacent tooth using Vita Classic shade guide
Slika 1. Određivanje boje susednog zuba korišćenjem ključa boja Vita Classic

Figure 2. Dental implant with gingival former after healing of surrounding tissues
Slika 2. Implanant sa gingiva formerom posle perioda zarastanja okolne gingive

Figure 3. Initial scan of the lower dental arch with gingival formers, and after deleting parts of the scan where implant position was determined using one scan body, and scanning one implant at a time
Slika 3. Inicijalni sken sa gingiva formerima i posle brisanja delova skena koji će biti naknadno skenirani nakon postavljanja otisnog elementa jedan po jedan

Figure 4. Scan body positioned on implant 46
Slika 4. Otisni element postavljen na implantant u regiji 46

Figure 5. Gingiva around the implant 36: a) with gingival former, b) after removing gingival former and c) after scan body positioning
Slika 5. Izgled gingive oko implantata 36: a) sa gingiva formerom, b) nakon njegovog uklanjanja i c) nakon postavljanja digitalnog otisnog elementa (scan body) u regiji 36

Figure 6. Final digital impression
Slika 6. Konačni digitalni otisak

Figure 7. Final design of future restorations in EXOCAD software
Slika 7. Definitivni dizajn i izgled budućih kruna u softveru Exocad
According to the design (Figure 7), plastic crowns (DWS, Temporis DD-100 A2) (Figure 8) completely the same size and shape as final restorations, were made for try-in in the patient’s mouth (Figure 9). It was easier to make all shape changes in this phase instead of on a full-ceramic crown. Since only minor changes were made, they were sent back to the laboratory. The occlusal surfaces of the crowns were designed to avoid premature contacts during mastication and movements. According to the new situation, final full-ceramic restorations were made of zirconia and sent back for the final step (Figure 10). Before positioning crowns in patient’s mouth, the crowns were left in chlorhexidine antiseptic for 2 minutes. Final crowns were screwed on the top of the implants in patients’ mouths using a torque wrench calibrated at 25 Ncm (Bredent Medical Gmbh&Co.KG, Germany) (Figure 11). The screw access holes on the occlusal surfaces of the restorations were closed with teflon tape plug (Figure 12) and composite resin (GC gradia direct, GC Corporation, Tokyo, Japan) without using bond (Figure 13).

**DISCUSSION**

Implant-supported single crowns in the posterior region are the first choice when the adjacent teeth are intact or with minimal restorations. They show high survival rates after an observation period of 5 years (94.5% and 96.3%)
Implant-supported single crowns for posterior teeth are an excellent solution for patients when the last tooth in dental arch is missing. Digital approach -from initial intraoral scanning (IOS) to designing the restoration in the software and further processing of monolithic CAD/CAM-generated crowns out of zirconia gives predictable, high-
esthetic and functional results for implant-supported single crowns.

**CONCLUSION**

Implant-supported single crowns for posterior teeth are an excellent solution for patients when the last tooth in dental arch is missing. Digital approach -from initial intraoral scanning (IOS) to designing the restoration in the software and further processing of monolithic CAD/CAM-generated crowns out of zirconia gives predictable, high-
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Digitalni pristup izrade cirkonijumskih krunica na implantima u bočnoj regiji – prikaz slučaja

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UVOD
Planiranje fiksnih protetskih nadoknada je izuzetno izazovno zadatak u svakodnevnoj praksi, ukoliko se uzmemo za svi biološki i tehnički rizici koji mogu nastati u toku izvođenja samih procedure.

Fiksne protetske nadoknade se mogu izrađivati na zubima ili zubnim implantatima. U bočnoj regiji, odluka o vrsti nadoknade se pravilno pravila izrađuju na osnovu stanja susednih zuba, ukoliko su zubi intaktni ili sa minimalnim restauracijama. Ukoliko se zubi kreću, služi za njihovu stabilizaciju.

U bočnoj regiji, odluka o vrsti nadoknade se pravilno pravila izrađuju na osnovu stanja susednih zuba, ukoliko su zubi intaktni ili sa minimalnim restauracijama. Ukoliko se zubi kreću, služi za njihovu stabilizaciju.

Zubne krunice na implantatima, u zavisnosti od načina povozivanja mogu biti: šrafom retinirane krunice ili cementom retinirane krunice.

Uvedemo je toga, otišak se digitalnim putem šalje laboratoriji, a zatim je u softveru MEDIT samog skenera korišćen za digitalni pristup – od inicijalnog intraoralnog skeniranja, dizajniranja nadoknada i konačne izrade monolitnih krunica na implantatima. Digitalni pristup kompletno digitalnim pristupom omogućio je da se ovaj zadatak izrađuje bez bioloških i tehničkih rizika koji mogu biti predviđeni.

Cilj ovog prikaza slučaja bio je da se predstavi klinička procedura izrade šrafom retiniranih cirkonijumskih krunica na implantatima u bočnoj regiji kompletno digitalnim pristupom.

PRIKAZ SLUČAJA
Pacijent starosti 53 godine došao je u stomatološku ordinaciju i utvrđen mu je nedostatak oba prva molara, koji su u ovom slučaju poslednji zubi u zubnom nizu. Digitalni pristup – od inicijalnog intraoralnog skeniranja, dizajniranja nadoknada u softveru i konačne izrade monolitnih krunica na implantatima.

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Dentalnoj laboratoriji koristeći printer DWS xfab2500pd sa materijalom DWS Precisa RD097, a restauracije dizajnirane u softveru EXOCAD (GmbH, Darmstadt, Germany) (Slika 7). Prema definitivnom dizajnu budućih nadoknada izrade su krunice od plastike (DWS, Temporis DD-100 A2) (Slika 8) identične veličine i oblika kao definitivne nadoknade, za još jednu probu u pacijentovim ustima (Slika 9). U ovom fazi je lakše napraviti korekcije, ukoliko su one potrebne, nego na definitivnim keramičkim krunama. Nakon minimalnog korigovanja okluzalnih kontaktata na plastičnim krunama, korekcije su poslale na uvid laboratoriji, a zatim su finalne keramičke nadoknade izrezane od cirkonije i posla te ordinaciji za finalni korak (Slika 10). Krunice su ostavljene u rastvoru hlorheksidina 2 minuta, a zatim ušrafljene na svoju poziciju korišćenjem moment ključa silom od 25 Ncm (Slika 11). Otvori za pristup šrafu su zatvoreni teflonskom trakom (Slika 12) i kompozitom GC gradia direct (GC corporation, Tokyo, Japan) bez korišćenja bonda (Slika 13).

DISKUSIJA

Pojedinačne krune na implantatima u bočnoj regiji predstavljaju terapiju izbora kada se bezubi prostor nalazi između intaktnih zuba ili zuba sa minimalnim restauracijama. Pokazuju visok stepen opstanka u posmatranom periodu od pet godina (94,5% i 96,3%) [5, 6]. Druga studija pokazuje da su moguće česte biološke i tehničke komplikacije (33,6%) [7].

Biološke komplikacije kod restauracija na zubima predstavljaju karijes, gubitak vitaliteta pulpe i pogoršanje stanja periodoncija. U implantnoj rehabilitaciji tehničke komplikacije su češće i one uključuju mehanička oštećenja samog implantata, neke od komponenti ili suprastrukture [1].

Prema istraživanjima, verovatnoća oslabljenja veze šrafa ili suprastrukture je 12,7%, a 0,35% da dođe do pucanja šrafa ili abatmenta nakon perioda od pet godina. Najčešće komplikacija vezana za suprastrukturnu je lovm keramike, čija je učestalost oko 4,5% [5].

Krunice pravljene u ovom prikazu slučaju su retinirane šrafom. Šrafom retinirane krune imaju dosta prednosti, od kojih je najbitnija dostupnost implantatu. S obzirom na to da učestalost slabljenja veze šrafa ili abatmenta iznosi 12,7% u periodu od pet godina prema Jungu i autorima [5], važno je da se, ukoliko je potrebno, sa lakoćom može pristupiti otvoru na kruni i vezu dodatno pojačati, što nije slučaj sa cementom retiniranim krunama. Šrafom retinirane krune takođe isključuju rizik od ostataka cementa subgingivalno, koji može da kompromituje okolnu meku tkivu i prouzrokuje peri-implantitis [8].

Upotreba digitalnih otisaka u stomatologiji značajno dobija na popularnosti usled brojnih prednosti. Intraoralno skeniranje je prijatnije za pacijenta, zahteva manje vremena za uzimanje otiska, i digitalni otisci su jednostavniji za čuvanje od konvencionalnih. Ipak, konvencionalni otisci se i dalje smatraju zlatnim standardom u fiksnoj protetici. Preciznost digitalnih modela i njihovo poredenje sa konvencionalnim modelima su predmet brojnih istraživanja [9–12]. Prema poslednjim istraživanjima, za pojedinačne krune intraoralno skeniranje je izuzetno precizno, a diskrepance u virtuelnim modelima su klinički prihvatljive [10, 13, 14].

U prikazanom slučaju, rezultati su pokazali veliku preciznost digitalnog otiska, uz minimalne korekcije okluzalnih kontaktata pri probi privremenih kruna izrađenih od plastike. Uopšteno, pacijentima je manje neprijatno i više vole digitalno otiskivanje nego kovencionalno [15]. Takođe, jedna od glavnih prednosti digitalnog otiskivanja je i činjenica da ukoliko dođe do bilo kakve greške, bilo u samom otiskivanju ili u preparaciji zuba, nije potrebno uzimati čitav otisk iz početka, nego je dovoljno obrisati i ponovo skenirati samo kritični deo, čime se dobija značajna ušteda vremena. Takođe, komunikacija sa zubnom laboratorijom je značajno brža i sigurnija, jer se skenirani otisci šalju u digitalnoj formi i nije ih moguće oštetiti prilikom slanja.

ZAKLJUČAK

Digitalni pristup, od početnog intraoralnog skeniranja (IOS) do dizajna restauracija korišćenjem softvera, i izrade monolitnih CAD/CAM cirkonijimskih zubnih kruna, daje preddvide, visokoestetske i funkcionalne rezultate u procesu izrade kruna na implantatima u bočnoj regiji.