CASE REPORT
PRIKAZ BOLESNIKA

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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

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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

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

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

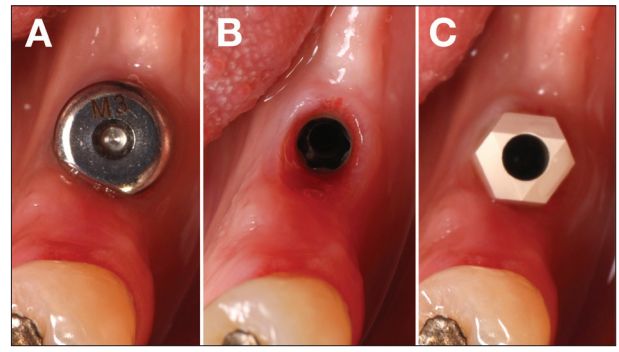

Figure 6. Final digital impression
Slika 6. Konačni digitalni otisak

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

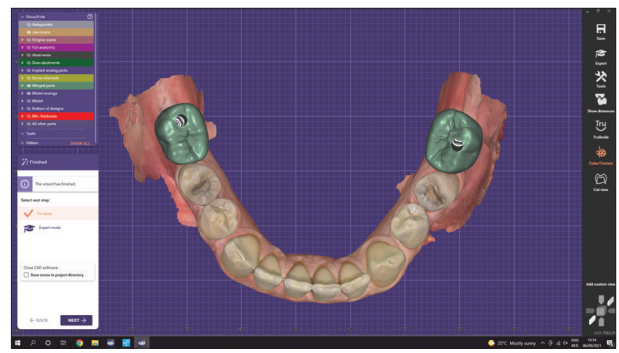

Figure 7. Final design of future restorations in EXOCAD software
Slika 7. Definitivni dizajn i izgled budućih kruna u softveru Exocad

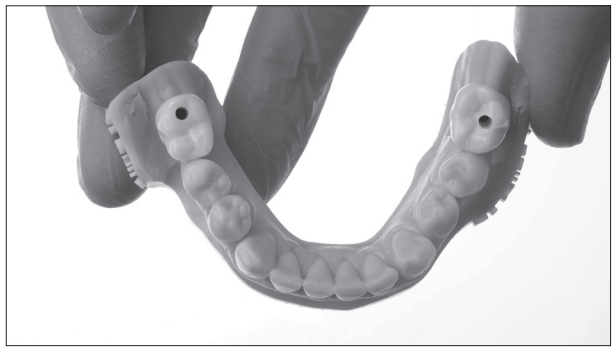

Figure 8. Plastic crowns according to the design – the same shape and size as final restorations
Slika 8. Plastične krune izrađene prema dizajnu – iste veličine i oblika kao i definitivne buduće krunice

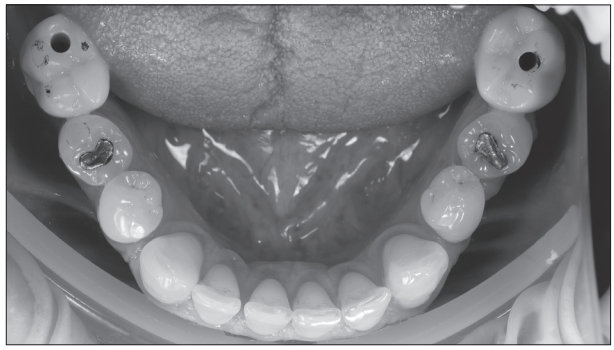

Figure 9. Try-in of plastic crowns- correction of occlusal contacts
Slika 9. Proba plastičnih kruna i korigovanje okluzalnih kontakata

Figure 10. Screw-retained zirconia single crowns on the printed model, as received from dental laboratory
Slika 10. Šrafom retinirane krune od cirkonije na modelu, dobijene iz dentalne laboratorije

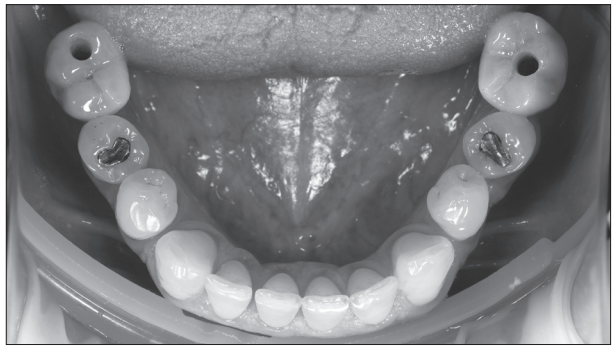

Figure 11. Screw-retained zirconia single crowns positioned on implants
Slika 11. Šrafom retinirane krune od cirkonije postavljene na implantate

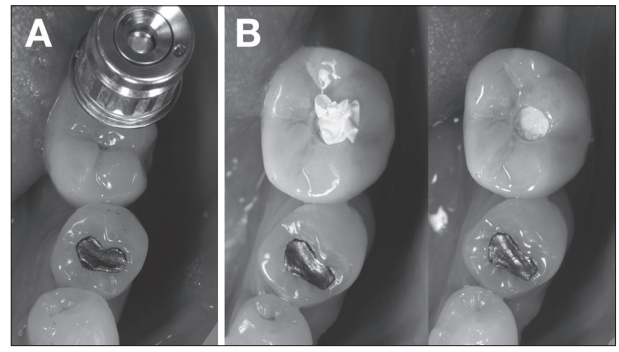

Figure 12. a) Rotating force applied until wanted torque is reached (25 Ncm), b) Teflon tape plug positioned in screw access holes
Slika 12. a) Ušrafljivanje krunice do postizanja željenog torka (25 Ncm), b) Teflon traka postavljena u pristupni otvor

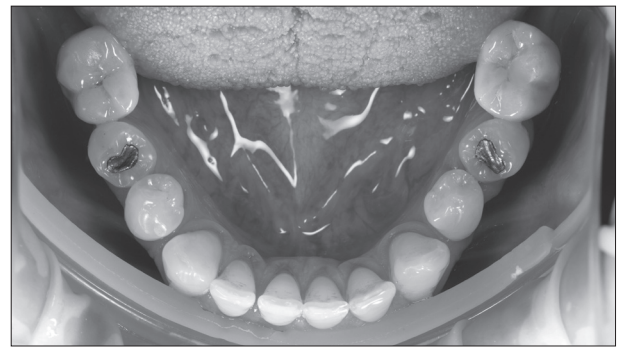

Figure 13. Screw access holes closed with resin composite restorative material
Slika 13. Zatvaranje pristupnog otvora kompozitnim materijalom

in EXOCAD software (GMBh, Darmstadt, Germany). 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%)

[5, 6]. Another study showed that biological and technical complications are frequent (33.6%) [7].

Biological complications of tooth-supported reconstructions include dental caries, loss of pulp vitality, and periodontal disease progression. In implant reconstructions, technical complications are more common, and they include mechanical damage of implants, implant components and/or suprastructures [1]. According to meta-analysis, the incidence of screw or abutment loosening is 12.7% and 0.35% for screw or abutment fracture after 5 years, and for supra-structure-related complications, the incidence of ceramic or veneer fractures is 4.5% [5].

The crowns made in this report were screw-retained. Screw-retained crowns have many advantages, and the most important one is retrievability. Since the cumulative incidence of screw or abutment loosening was 12.7% in a 5-year period according to Jung et al. [5], it is important that they can be easily removed and retightened if needed, which is not the case with cemented ceramic crowns. Screw retained crowns also eliminate the risk of excess cement that can compromise soft tissues surrounding the implant [8].

The use of digital impressions is becoming more and more popular due to its numerous advantages- they are more comfortable for the patients, less time-consuming, and easier to store and share than conventional models. However, the conventional impressions are still considered the gold standard in fixed prosthodontics. The accuracy of digital models and comparison with conventional models is a topic of numerous investigations [9–12]. According to recent studies, intraoral scanning accuracy is high for single crowns, and the deviations in virtual implant positions are clinically acceptable [10, 13, 14]. In our case, the results showed great precision of digital impression, and just minor changes regarding occlusion were made on plastic crowns.

Generally, patients report less inconvenience and they prefer digital impression procedure than the conventional procedure [15]. Moreover, one of the advantages of digital impression is that if there is an error in the scan, it is not necessary to retake complete impression; only the critical spot can be scanned again, which significantly saves time. Also, the communication with the dental laboratory is faster and safer, since digital impression is sent digitally and it is not possible to damage it during transport.

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, highly esthetic and functional results for implant-supported single crowns.

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Digitalni pristup izrade cirkonijumskih krunica na implantima u bočnoj regiji – prikaz slučaja

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KRATAK SADRŽAJ

Uvod Planiranje fiksne protetske nadoknade je vrlo zahtevan i izazovan zadatak u svakodnevnoj stomatološkoj praksi. Kada nedostaje poslednji zub u zubnom nizu, preporučuje se izrada krune na zubnom implantatu. Razvoj digitalnih tehnologija omogućio je da se ova vrsta nadoknade izrađuje kompletno digitalnim pristupom.

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, sa nedostatkom oba donja prva molara, koji su u ovom slučaju poslednji zubi u zubnom nizu, želeo je da ovaj nedostatak nadoknadi fiksnim protetskim nadoknadama. Odlučeno je da se izrade dve šrafom retinirane krune na implantatima, kompletno digitalnim pristupom. Intraoralno skeniranje mekih tkiva i pozicije implantata urađeno je uz pomoć intraoralnog skenera Medit i500. Zatim su usledile laboratorijske procedure: komjuterski asistirano dizajniranje i kompjuterski asistirana izrada cirkonijumskih krunica.

Zaključak Krune na implantatima su odlično rešenje za pacijente kod kojih nedostaje poslednji zub u zubnom nizu. Digitalni pristup – od inicijalnog intraoralnog skeniranja, dizajniranja nadoknada u softveru i konačne izrade monolitnih kruna od cirkonije, daje predvidive, visokoestetske i funkcionalne rezultate pri izradi pojedinačnih kruna na implantatima.

Ključne reči: digitalni pristup; intraoralno skeniranje; krunice na implantatima; šrafom retinirane krunice; implantati

UVOD

Planiranje fiksnih protetskih nadoknada je izuzetno izazovan zadatak u svakodnevnoj praksi, ukoliko se uzmu u obzir svi biološki i tehnički rizici koji mogu nastati u toku izvođenja same procedure.

Fiksne protetske nadoknade se mogu izrađivati na zubima ili zubnim implantatima. U bočnoj regiji, odluka o vrsti nadoknada u regiji bezubih prostora donosi se na osnovu stanja susednih zuba. Ukoliko su zubi intaktni ili sa minimalnim restauracijama, nije poželjna njihova preparacija. U tom slučaju metod izbora je postavljanje implantata i izrada krunice na implantatu, maksimalno čuvajući zubna tkiva [1]. Takođe, ukoliko nedostaju poslednji zubi u zubnom nizu, preporučuje se izrada zubnih nadoknada na implantatima.

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

I pored brojnih prednosti šrafom retiniranih kruna, navodi u literaturi ne pokazuju precizne dokaze o tome koji je metod bolji, tako da kliničar donosi odluku na osnovu slučaja i ličnih preferenci [2].

Napredak digitalnih tehnologija i evolucija intraoralnih skenera (IOS) značajno su promenili savremenu stomatološku praksu.

Digitalni pristup počinje intraoralnim skeniranjem okolnih zuba i mekih tkiva, kao i pozicije samih implantata korišćenjem intraoralnih otisnih elemenata (scan body).

Nakon toga, otisak se digitalnim putem šalje laboratoriji, gde se pristupa digitalnom dizajniranju restauracija (CAD), a zatim rezanju kruna od odabranog materijala (CAM). Nakon definisanja potrebnih korekcija, ukoliko su prisutne, u laboratoriji se pristupa izradi definitivnih kruna od izabranog materijala: zirkonije, litijum-disilikata ili hibridnih keramičkih materijala [3, 4].

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 u donjoj vilici, koji su ujedno i poslednji zubi u donjem zubnom nizu. Odlučeno je da se nedostajući molari rehabilituju sa krunama na implantatima. Postavljeni su implantati Bredent blueSKY (Bredent Medical Gmbh&Co.KG, Germany) u regiji 36 i 46. Nakon perioda oseointegracije od šest meseci, postavljeni su gingiva formeri na period od 14 dana.

Na samom početku intervencije određena je boja budućih restauracija, kako bi se izbegao mogući problem usled dehidratacije zubnih tkiva i promena njihove boje (Slika 1). Takođe, napravljene su intraoralne fotografije pacijenta kamerom (Canon EOS RCanon 100 mm 2,8 L, Yongnuo YN-24EX TTL Macro Flash for Canon) i poslate laboratoriji, kako bi se postigli bolji estetski efekti i slaganje boje sa okolnim zubima. Prilikom uzimanja digitalnog otiska intraoralnim skenerom, u prvoj fazi je skenirana cela donja vilica sa gingiva formerima (Slika 2). Zatim je u softveru MEDIT samog skenera korišćen alat za brisanje dela otiska u regiji implantata, u ovom slučaju sa gingiva formerom (Slika 3). Za tačnu poziciju i orijentaciju implantata u intraoralnom skeniranju korišćen je SKY uni. fitscan abutment SKYUSCAI (Bredent Medical Gmbh&Co.KG, Germany) (Slika 4). Korišćen je jedan otisni element za oba implantata, prvo na poziciji 36, a zatim zuba 46, uz pomoć opcije HD (high definiton) koju nudi intraoralni skener MEDIT i500 (Medit corp., Seoul, Korea) (Slika 5).

Dobijeni digitalni otisak, sačuvan kao .STL fajl, poslat je dentalnoj laboratoriji (Slika 6). Digitalni modeli su štampani u

dentalnoj laboratoriji koristeći printer DWS xfab2500pd sa materijalom DWS Precisa RD097, a restauracije dizajnirane u softveru EXOCAD (GmbH, Darmstadt, Germany) (Slika 7). Prema definitvnom dizajnu budućih nadoknada izrađene 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 ovoj fazi je lakše napraviti korekcije, ukoliko su one potrebne, nego na definitivnim keramičkim krunama. Nakon minimalnog korigovanja okluzalnih kontakata na plastičnim krunama, korekcije su poslate na uvid laboratoriji, a zatim su finalne keramičke nadoknade izrezane od cirkonije i poslate 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 periodoncijuma. U implantnoj rehabilitaciji tehničke komplikacije su češće i one uključuju mehanička oštećenja samog implantata, neke od komponenti ili suprastruktura [1].

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

Krunice pravljene u ovom prikazu slučaja su retinirane šrafom. Šrafom retinirane krune imaju dosta prednosti, od koji 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 ostatka cementa subgingivalno, koji može da kompromituje okolna meka tkiva 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 poređenje 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 kontakata 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 otisak 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 predvidive, visokoestetske i funkcionalne rezultate u procesu izrade kruna na implantatima u bočnoj regiji.