

# Fotografija u stomatologiji

## Photography in Dentistry

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*Fotografija predstavlja dragocenu pomoć u svim oblastima medicine i stomatologije. Primena fotografije u stomatologiji je danas sastavni deo brojnih dijagnostičkih i terapijskih procedura i često značajan dokument o toku i ishodu sprovedene terapije. Za intraoralne i ekstraoralne fotografije koriste se različite vrste aparata. Aparati koji koriste film (Single Lens Reflex) SLR, digitalni SLR (DSLR) i kompaktni digitalni aparati su oprema koju tržište nudi praktičarima za najrazličitije zahteve. Međutim, najveći broj analiza naglašava prednosti i apostrofi-  
ra značaj digitalnih aparata, posebno u snimanju makro fotografija u stomatologiji. Uvođenje digitalnih aparata u stomatološku praksu predstavlja važan korak u budućnost.*

*Cilj ovog rada je bio da ukaže na značaj fotografije u stomatologiji, odnosno da ukaže na osnovnu tehnologiju savremenih aparata za fotografiju i analizira prednosti i nedostatke danas dostupnih aparata.*

**Ključne reči: fotografija, stomatologija, digitalni aparat****SUMMARY**

*Photography offers precious support in all areas of medicine and dentistry. Usage of photography in dentistry is an integral part of numerous diagnostic and therapeutic procedures and an important document of progression and outcome of subscribed therapy. Various types of cameras are available for intraoral and extraoral photography. Market offers different kinds of photographic equipment to dental practitioners such as cameras with films (Single Lens Reflex) SLR, digital SLR (DSLR) and compact digital cameras. However, majority of analyses emphasize advantages and relevancy of digital cameras, especially in taking macro photographs in dentistry. Introduction of digital cameras in dental practice is an important step toward the future.*

*The aim of this study was to point out the importance of photography in dentistry, demonstrate basic technology of contemporary cameras and to analyze advantages and disadvantages of available cameras.*

**Keywords: photography, dentistry, digital cameras**

Termin fotografija izvedena je iz grčke reči “photos”- svetlost, i “graphein”- crtati. Ovu reč je prvi put upotrebio Sir John F.W. Herschel 1839 godine, ilustrujući način snimanja slika pod dejstvom svetlosti ili sličnog zračenja na odgovarajućem osetljivom materijalu.<sup>1</sup>

Fotografija predstavlja dragocenu pomoć u svim oblastima medicine i stomatologije. Smatra se da je fotografija u stomatološkoj praksi prisutna pre kao podgrupa u okviru medicinske odnosno kliničke fotografije nego kao posebna oblast. No, ova činjenica ne umanjuje njen značaj i sveprisutnost u različitim segmentima stomatoloških specijalnosti.<sup>2</sup>

Šta nudi fotografija u stomatologiji?

- utvrđivanje zdravlja usta i zuba pacijenata pre tretmana u cilju blagovremene i tačne dijagnoze, potrebnog plana terapije i evaluacije postignutih rezultata

The term “photography” is derived from the Greek words “photos” – light, and “graphein” – draw. The word was first used by Sir John F. W. Herschel in 1839, to illustrate the way of taking pictures with the use of light or a similar radiating agent on a suitable sensitive material.<sup>1</sup>

Photography is precious support in all areas of medicine and dentistry. In the dental practice, photography is viewed as a subdivision of medical, i.e. clinical photography, rather than a separate area. Nevertheless, this fact does not lessen its importance and universal applicability in various segments of dental specialties.<sup>2</sup>

How can photography be utilised in dentistry?

- examination of health status of patient’s mouth and teeth prior to treatment, in order to establish timely and accurate diagnosis, required therapy plan and the evaluation of results;

- edukativne programe, mogućnost validne prezentacije stručnih i naučnih radova
- reklamiranje dentalnih proizvoda i usluga

Fotografije u stomatologiji su ekstraoralne i intraoralne. Fotografisanje spoljašnjosti lica i njegovih delova najčešće ne predstavlja problem i ne zahteva specijalnu opremu ili pristup. Ekstraoralnom fotografijom mogu se baviti iskusni fotografi, ali isto tako i nedovoljno obučeni stomatolozi. Sa druge strane, intraoralne fotografije su komplikovanije i zahtevaju određenu opremu i iskustvo. Fotografije unutrašnjosti usne šupljine nije moguće kvalitetno napraviti "običnim" aparatima, već su potrebna specijalna sočiva i ogledala. U te svrhe mogu se koristiti aparati sa filmom ili digitalni fotoaparati. Uz to, treba znati, da verodostojna i reprezentativna foto dokumentacija podrazumeva postupak standardizacije fotografija, korišćenje istog aparata i istih optičkih parametara u svim fazama terapijskog postupka.<sup>2,3</sup>

Digitalne aparate treba razlikovati od digitalnih intraoralnih kamera. Intraoralne kamere su nastale adaptacijom medicinskih endoskopskih instrumenata. One su slične po obliku i veličini stomatološkim instrumentima što ih čini jednostavnim za rukovanje. Iako su vremenom postajale sve kvalitetnije, optičke karakteristike intraoralnih kamera i rezolucija su slabije čak i od istih osobina prosečnog digitalnog aparata. I pored toga, intraoralne kamere predstavljaju vrlo bitnu kariku u komunikaciji terapeuta i pacijenta u svakodnevnoj praksi. One omogućavaju prenošenje slike iz usta pacijenta direktno na monitor koji se posmatra, čime se olakšava informisanje i upoznavanje pacijenta sa mogućnostima u zbrinjavanju i predloženim planom terapije. Posebne prednosti su što intraoralne kamere dolaze u paketu sa integrisanim računarnom, odnosno računarskim softverom koji daje određene mogućnosti adaptacije, odnosno zamrzavanja slike u određenom trenutku a sve u cilju ilustracije predloženog tretmana i blagovremenog informisanja.<sup>3-7</sup>

## Oprema za fotografisanje

Za kvalitetno fotografisanje u stomatologiji potrebno je napraviti izbor između 35 mm SLR (Single Lens Reflex, "jednookih" refleksnih) aparata koji koriste film, digitalnih SLR aparata i kompaktnih digitalnih aparata. Neophodno je da aparat poseduje sočivo koje omogućava slikanje iz blizine, blic, a za kvalitetno fotografisanje u intraoralnoj sredini su takođe neophodni ogledala i retraktori. Određeni brend aparata nije od presudne važnosti, ali mora posedovati sve navedene funkcije da bi kvalitet bio odgovarajući.<sup>1,8</sup>

### SLR aparati

Osnovne komponente SLR aparata su telo aparata, sočivo i izvor svetlosti, odnosno blic. Refleksni aparati

- In educative programmes - enables valid presentations of expert and scientific works;
- In advertising dental products and services.

Photographs in dentistry are taken extraorally and intraorally. In most cases, the photographic recording of the face and its parts is not associated with any problems and does not require any special equipment or approaches. Extraoral photographs can be taken by experienced photographers and by insufficiently trained dentists alike. On the other hand, taking intraoral photographs is a more demanding task that calls for specific equipment and experience. Photographs of the oral cavity cannot be taken successfully by "ordinary" cameras, as they require the use of special lenses and mirrors. Cameras with films or digital cameras can be used for these purposes. In addition to that, it is important to know that a truthful and representative photo documentation implies the standardisation of photographs, the use of the same camera and the same optic parameters at all stages of the therapeutic procedure.<sup>2,3</sup>

Distinction should be made between digital cameras and digital intraoral cameras. Intraoral cameras were devised as a result of adaptation of medical endoscopic instruments. As to their shape and size, they are similar to dental instruments, which makes them easy to handle. Although their quality has been upgraded over the time, optical performances of intraoral cameras and resolutions are fairly poor, even when compared with the respective features of an average digital camera. However, regardless of these weaknesses, intraoral cameras constitute an essential link in communication between dentists and their patients in the everyday practice. They enable direct transmission of the picture from patient's mouth to the monitor where it can be viewed and the patient can be more easily informed and instructed of the treatment options and the proposed therapy plan. A particular advantage of intraoral cameras lies in the fact that they come in package with an integrated computer, that is with electronic software that offers certain options for adaption, i.e. freezing of the picture at a particular point, intended to provide an illustration of the proposed treatment, as well as timely information.<sup>3-7</sup>

## Photographic Equipment

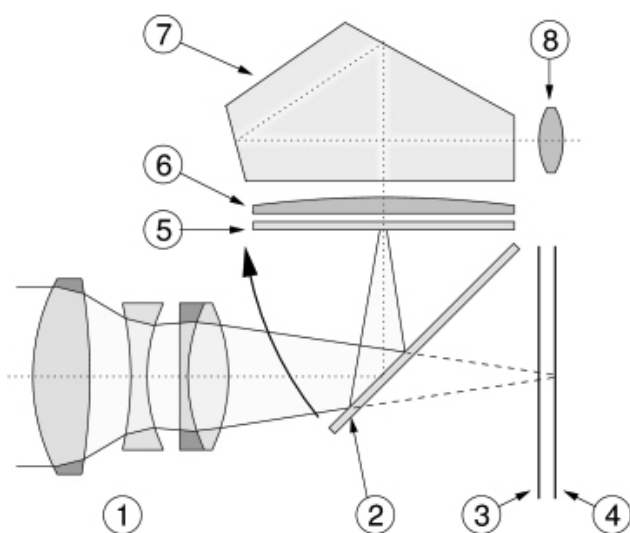
For good quality of dental photography, a choice should be made among 35 mm SLR (Single Lens Reflex, "single-eyed" reflex) cameras with films, digital SLR cameras and compact digital cameras. It is essential that the camera is equipped with a lens that enables recording from close distance and with flash, while mirrors and retractors are indispensable for good quality of intraoral photographs. A particular brand of camera should not be viewed as a decisively important factor, yet it should have all of the aforementioned functions in order to obtain an appropriate recording quality.<sup>1,8</sup>

### SLR Cameras

Basic components of SRL cameras include the body of the camera, the lens and the source of light. i.e. the

koriste ogledalo smešteno između objektivu i filma odnosno optičkog senzora i pentaprizmu u gornjem delu aparata. Slika koju fotograf vidi na okularu odnosno LCD (Liquid Crystal Display) ekranu je realna slika objekta. Njihova osnovna karakteristika je u tome što podržavaju zamenu objektivu i uglavnom brže reaguju od ostalih fotoaparata.

Poprečni presek SLR aparata prikazuje kako se svetlost, prolazeći kroz sistem sočiva (1) reflektuje na ogledalu (2) i projektuje na mat ekranu za fokusiranje (5). Preko kondenzujućeg sočiva (6) i unutrašnje refleksije u pentaprizmu (7) slika se pojavljuje na okularu (8). U postupku fotografisanja ogledalo se kreće u smeru strelice, zatvarač žižne površine<sup>3</sup> se otvara i slika se projektuje na film (4).<sup>1,8</sup> (Slika 1.)



flash. Reflex cameras are equipped with a mirror placed between the objective and the film, i.e. the optic sensor, as well as with a pentaprism in the upper part of the camera. The picture seen by the photographer through the ocular, i.e. on the LCD (Liquid Crystal Display) screen is a realistic picture of the object. The basic feature of these cameras is that they support replacement of the objective and generally react faster than other cameras.

The cross-section of the camera shows how the light, passing through the system of lenses (1), is reflected on the mirror (2) and projected on the matte focusing screen (5). Through the condensing lens (6) and internal reflection in the pentaprism (7), the picture appears on the ocular (8). As a photograph is being taken, the mirror moves in the direction of the arrow, the shutter of the focal surface (3) opens and the picture is projected on the film (4). (1,8) (Figure 1.)

Slika 1. Poprečni presek SLR aparata sa prikazom smeru svetlosti  
Figure 1. Cross section SLR of the camera

Osnovna razlika između “klasičnog” (35 mm) SLR aparata i digitalnog SLR-a je u tome da je film zamenjen CCD (charge-coupled device) ili CMOS (complementary metal-oxide semiconductor) senzorima slike, odnosno dodata je elektronska podrška koja stvara fotografiju u samom aparatu. Savremeni SLR aparati takođe imaju digitalan softver koji izoštrava i dodatno poboljšava kvalitet fotografija.

SLR aparati imaju TTL (through the lens) merenje, odnosno tehniku kojom se meri nivo svetlosti kroz sočivo kamere. Time se kontroliše količina svetlosti koja će se emitovati iz blica, merenjem intenziteta svetlosti koja pada na senzor blica kroz sočivo aparata. Kada je fotografija dovoljno osvetljena zatvarač se automatski zatvara.<sup>1,2</sup>

Za dobre fotografije, sočiva treba da imaju minimum aperture (otvora blende) od f22, a najbolje bi bilo f32, što znači malo svetla u jedinici vremena. Ona se takođe biraju zavisno od daljine predmeta fotografisanja. Sočiva od 100 mm fokalne dužine obezbeđuju fotografije dovoljne veličine bez ugrožavanja pacijentovog prostora i komfora. Iako sočiva sa automatskim fokusom nekada mogu vrlo

A basic difference between a “classical” (35 mm) SLR camera and a digital SRL lies in the fact that the film has been replaced by CCD (charge-coupled device) or by CMOS (complementary metal-oxide semiconductor) picture sensors, namely an electronic support has been introduced, which produces a picture within the camera itself. Likewise, contemporary SRL cameras are equipped with digital software that sharpens the picture and additionally improves its quality.

SRL cameras also have a TTL (through the lens) measuring system, namely a technical device that allows the light level to be measured through the lens of the camera. In this way, the quantity of light released from the flash is controlled by measuring the intensity of the light cast through the camera lens on the flash sensor. When the photograph is sufficiently illuminated, the shutter closes automatically.<sup>1,2</sup>

Good photographs call for lenses with a minimum of f22 aperture (opening in the lens that admits the light), while a f32 aperture, meaning a small amount of light per time unit would be optimal. The choice of lenses is also determined by the distance of the object photographed.

dobro da posluže, intraoralna sredina često može da završi sistem za fokusiranje proizvodeći nezadovoljavajuće rezultate.<sup>1,3,8-10</sup>

Nedostatak digitalnih aparata je to što slika koja se dobije ne odgovara onoj koja se vidi u trenutku fotografisanja, već je to slika sa malim zakašnjenjem, za šta je odgovoran softver aparata. Logično, kašnjenje je minimalno ili ga uopšte nema kod 35 mm SLR aparata, nešto je veće kod digitalnih SLR-a, a najveće kod kompaktnih digitalnih aparata. Problem kod digitalnih aparata je i kontinuirano fotografisanje, odnosno softverska obrada svake fotografije ponaosob što dodatno oduzima vreme u uslovi- ma ne baš prijatnim za pacijenta. (Slika 2.)



100 mm focal length lenses ensure sufficiently sized photographs, while the patient's space and comfort are not impaired. Although lenses with automatic focus can sometimes be of good service, the intraoral environment may often have a misleading effect on the focusing system, resulting in a poor performance.<sup>1,3,8-10</sup>

On the other hand, a shortcoming of digital cameras is that the obtained picture does not match the one seen by the photographer while being taken. Instead of that, the picture appears somewhat delayed, which should be attributed to the shortcomings of the camera software. Logically, in 35 mm SLR cameras the delay is either minimal or nonexistent, it is somewhat bigger in digital SLRs, while it is the biggest in compact digital cameras. Another problem associated with digital cameras is related to continuous photographing, i.e. the software processing of each photo is carried out separately, which further consumes the time in the situations that can hardly be comfortable for the patient. (Figure 2.)

Slika 2. Digitalni SLR aparat  
Figure 2. Digital SLR camera

Međutim, u doba savremenih informacionih tehnologija digitalni aparati nude mnogo više mogućnosti stomatolozima u svakodnevnoj praksi od aparata sa filmom. Jedna od osnovnih i najbitnijih je LCD monitor. On se nalazi na zadnjoj strani svakog aparata i omogućava trenutno posmatranje dobijene fotografije, i ukoliko je potrebna korekcija, odmah se može ponoviti fotografisanje, što kod aparata sa filmom nije moguće do razvijanja filma. Svi digitalni aparati imaju ugrađen autofokus što osigurava oštrinu fotografije. Kvalitetniji aparati imaju i stabilizatore slike čime je dodatno olakšano rukovanje aparatom, posebno kod zumiranja i fotografisanja gracilnih detalja u usnoj šupljini. Važno je napomenuti da digitalni aparati za skladištenje fotografskih zapisa koriste memorijske kartice. One mogu biti različitog memorijskog kapaciteta omogućavajući skladištenje i do nekoliko stotina fotografija.

### **Rezolucija i optičke karakteristike digitalnih aparata**

Piksel je najmanji element digitalne fotografije i kada se složi mozaik piksela različitih boja dobija se digitalna fotografija. Ukoliko se pomnoži horizontalni sa vertikal-

However, in the era of modern information technologies, digital cameras represent better choice than those with films, as they can provide dentists with far wider range of possibilities to be applied in their professional daily routine. One of these basic and most essential possibilities is an LCD monitor. Situated at the back of every camera, it enables momentary observation of the picture obtained; if a correction is needed, the recording can be repeated, which can be done with a film camera only after the film has been developed. The sharpness of the image is ensured by the inbuilt autofocuses, which are common in all digital cameras. Higher-quality cameras are also equipped with picture stabilisers, which additionally facilitate handling, particularly while zooming and photographing tiny details in the oral cavity. It is important to note that digital cameras use memory cards for photographic record storage. These cards can have various capacities, allowing storage of as many as several hundred photographs.

### **Resolution and optical features of digital cameras**

Pixel is the smallest element of a digital photograph; pixels of different colours are arranged in a mosaic to constitute a digital image. If the number of horizontal pixels

nim pikselima dobija se ukupni zbir (površina) koja se izražava u milionima piksela odnosno u megapiksela (MP). Na primer, fotografija na aparatu sa 3 megapiksela se sastoji od  $2,048 \times 1536 = 3,145,728$  piksela. Povećanjem broja megapiksela povećava se i rezolucija slike.

Megapikseli ili rezolucija ne moraju obavezno da daju zadovoljavajući kvalitet fotografije. Boja i tonalitet su mnogo značajniji sa tehničke strane. Stoga nisu retki slučajevi da aparat sa manje MP proizvodi bolje fotografije nego drugi sa većim brojem piksela. U suštini, broj megapiksela ne predstavlja ništa drugo do mogućnosti uveličanja dimenzija fotografije a da se ne izgubi oštrina fotografije. Optički zum predstavlja vrlo bitnu karakteristiku svakog aparata, međutim u stomatologiji kod izoštravanja predmeta koji su već blizu, dubinska oštrina se gubi što znači da bez dodatnih objektivna dobijena slika neće biti oštra.

**Makro(macro)** fotografija je fotografija koja nastaje kao posledica fotografisanja iz blizine. Može se definisati kao fotografija čiji je odraz na filmu ili elektronskom senzoru iste veličine ili veći od samog objekta fotografisanja. Međutim, u savremenoj fotografiji, pojam *makro* ima izmenjeno značenje, odnosno kamera ima mogućnost da fokusira toliko da na fotografiji 10x15 mm objekat bude iste veličine ili veći.<sup>3,10,11</sup>

Za fotografisanje u makro modu SLR aparatima neophodna je dodatna optička oprema. To su specijalna, takozvana, makro sočiva (neki ih nazivaju i mikro), koja imaju mogućnost fotografisanja iz blizine. Ona su najčešće optimalizovana za odnos 1:1, ali postoje i sočiva nekih proizvođača koja mogu da uveličaju i do odnosa 5:1 čime se i najsitnije strukture kao što su oči insekata ili snežne pahuljice mogu zumirati u neverovatan fokus.<sup>3</sup>

Kod digitalnih kompaktnih aparata su za tu svrhu proizvođači uvrstili softversku opciju *macro* (obeleženu ružom), koja omogućava fotografisanje predmeta iz apsolutne blizine bez potrebe za dodatnim zumiranjem. Kada je aparat u *macro* modu otvor blende je najmanji i postiže se velika dubinska oštrina. Međutim, koriscenjem *macro* opcije kod ovih aparata javlja se problem osvetljenja, odnosno zbog apsolutne blizine objektivna aparata ostaje vrlo malo prostora za svetlost. Ovo je posebno važno za intraoralne snimke koji zahtevaju dubinu i oštrinu pri fotografisanju.

Objašnjenje za prednosti digitalnih kompaktnih aparata nad SLR aparatima sa filmom, kod snimanja makro fotografija, je vrlo jednostavno. Definicija dubinske oštine je žarišna dužina objektivna odnosno dijagonala čipa ili filma. Digitalni aparati imaju dijagonalu čipa (senzora) oko 5 puta manju od dijagonale 35 milimetarskog filma, što znači da je dubinska oštrina na istoj blendi 5 puta veća. Drugim rečima, digitalni aparati koji i sa dodatnim objektivima imaju maksimalnu blendu nekoliko puta manju od SLR aparata, daju fotografiju u *macro* modu najmanje istog, ili boljeg kvaliteta.<sup>1,8</sup>

are multiplied with vertical ones, total (surface) expressed in millions of pixels is derived, i.e. in megapixels (MP). For example, a photograph taken by a 3 MP camera is composed of  $2,048 \times 1536 = 3,145,728$  pixels. When the number of pixels is increased, the image resolution is increased as well. Megapixels or resolution need not necessarily provide a satisfactory image quality. From the technical point, colour and tonality are far more important. Therefore, it is fairly common that a camera with smaller MP capacity produces better images than those with larger pixel capacities. Basically, the number of pixels does not mean anything except the indication of the extent to which the dimensions of an image can be increased without affecting its sharpness. An optical zoom is a very important feature of any camera type; in dentistry, however, it is important to note that, as the sharpness of an already close object is increased, the depth dimension of the image becomes less sharp, which leads to the conclusion that the obtained picture will lack sharpness unless additional objectives are used.

A **macro photograph** is obtained at close range. It can be defined as an image whose reflection on a film or on an electronic sensor is of the same size as, or bigger than, the object photographed. Still, the meaning of the term *macro* has been changed in contemporary photography, since cameras' focusing capacities allow for the object recorded in a 10x15 mm photo to be of the same size or even bigger.<sup>3,10,11</sup>

Taking macromode pictures with SRL cameras requires additional optical equipment. These are special, so-called macrolenses (sometimes also referred to as microlenses), which enable video recording at close range. Although lenses are commonly optimised for 1:1 ratio, some manufacturers offer those capable of providing an increase to as much as 5:1 ratio and therefore allowing even the tiniest structures (e.g. insects' eyes or snowflakes) to be zoomed into incredible focuses.<sup>3</sup>

In digital compact cameras, the aforementioned purpose is met by the introduction of a *macro* software option (marked with a rose), which enables objects to be recorded at the closest possible range without the need for additional zooming. When a camera is set to a *macro* mode, the aperture is the smallest, while high levels of sharpness are achieved. On the other hand, the use of *macro* option in these cameras is associated with the problem of illumination, namely due to the absolute vicinity of the camera's objective too little room is left for the light. Intraoral records call for depth and sharpness.

When *macro* photographs are taken, it is very simple to explain the advantages of digital compact cameras over SRL cameras with films. The definition of depth sharpness is the focal length of the objective, i.e. the diagonal of the chip or of the film. The diagonal of a chip (sensor) in a digital camera is around 5 times smaller than that of a 35 mm film, meaning that the depth sharpness with the same aperture is 5 times bigger. In other words, digital cameras, whose minimal aperture, even with additional objectives, is several times smaller than that in SRL cameras, produce *macro* photographs of at least the same, if not of a better quality.<sup>1,8</sup>

## Ogledala

Kod intraoralnog fotografisanja neophodno je koristiti specijalna ogledala. Ogledala za stomatološko intraoralno fotografisanje mogu biti od poliranog metala ili ogledala prekrivena staklom sa prednje površine. Obe vrste daju zadovoljavajuće rezultate. Ogledala se mogu naći u tri različita oblika zavisno od potrebe korišćenja u ustima i to: palatinalno, bukalno i lingvalno. U zavisnosti od uzrasta mogu biti za odrasle ili za decu.<sup>3,12</sup>

Zbog velikog značaja koji imaju o ogledalima se posebno mora voditi računa da bi se postigli zadovoljavajući rezultati. Ogledalo se najčešće čuva na sobnoj temperaturi a da bi se dobila dobra intraoralna fotografija ono mora biti zagrejano do temperature tela. Na taj način će se sprečiti magljenje kada se unesu u usta. Ogledalo mora biti suvo i čisto pre svakog fotografisanja tako da ni najmanja kap tečnosti na ogledalu ne umanjuje kvalitet fotografije. Zbog materijala od koga su izrađena ogledala (staklo ili polirani metal) lako se mogu ogrebat, što zahteva posebnu pažnju u njihovom čišćenju i čuvanju.<sup>10,12-14</sup> (Slika 3.)



## Mirrors

The use of special mirrors is indispensable in intraoral video recording. Mirrors for intraoral video recording in dentistry can be made of polished metal or with glass covering their front surface. Both types provide satisfactory results. Mirrors come in three different shapes depending on whether they are to be used palatally, buccally or lingually. As to the patient's age, there are those intended for adults, as well as for children.<sup>3,12</sup>

Due to their exceptional importance, mirrors should be devoted particular attention, since they are essential for satisfactory results. Mirrors are commonly kept at room temperature and for a good intraoral image, they should be warmed to the body temperature. This will prevent them from fogging when inserted into the mouth. Prior to its use, the mirror should be clean and dry, because the image quality could be compromised by a slightest drop of liquid possibly left behind on the mirror surface. Due to the material they are made of (glass or polished metal), mirrors can easily get scratched, and therefore call for particular care while cleaned or stored.<sup>10,12-14</sup> (Figure 3.)

Slika 3. Palatinalno i bukalno ogledalo  
Figure 3. Palatinal and buccal mirror



Slika 4. Plastični retraktori  
Figure 4. Plastics retractors

### **Retraktori**

Za lakše fotografisanje određenog polja unutrašnjosti usne duplje korišćenjem ogledala, neophodni su odgovarajući retractori usana. Zbog nepoželjne refleksije svetlosti, plastični retractori su se pokazali poželjnijim od metalnih.<sup>3</sup> (Slika 4.)

### **Osvetljenje**

Da bi se osigurao maksimalan kvalitet i verodostojnost u fotografisanju upotreba blica predstavlja imperativ. Dnevna svetlost ili reflektor na stomatološkoj stolici nisu dovoljni i neće dati zadovoljavajuće rezultate. Blic može biti manuelni, koji zahteva kalibraciju u različitim situacijama, ili automatski.

Takođe, blic može biti kružni (ring), iz jedne tačke (point light) ili kombinacija ova dva sistema. Ring blic je vrlo jednostavan za korišćenje jer ne baca senku kod intraoralnih fotografija. Svetlo je uniformno i sa malim kontrastom. Blic iz jedne tačke, koji se nalazi kod svih kompaktnih digitalnih aparata, pruža takođe vrlo zadovoljavajuće rezultate. Ova vrsta blica baca određenu senku i većeg je kontrasta od ring blica. Ovo je poželjno u nekim slučajevima npr. kod registrovanja promena, odnosno anomalija sluzokože usne duplje. Pravac pružanja svetlosti blica treba odrediti u zavisnosti od senke koju daju obrazi i usne, da ne bi došlo do preklapanja senke sa zubima i tkivima u dubini usne duplje.<sup>3,9,10,12,13</sup>

Osvetljenje ponekad može predstavljati i problem. Neki aparati mogu zumirati objekat toliko blizu da ga dodiruju prednjom površinom sočiva. To je skoro bez izuzetka slučaj kod kompaktnih digitalnih aparata gde su proizvođači unapredili **makro** optičke karakteristike (čak do 0 mm), ne računajući na fotografisanje u uslovima nedostatka adekvatne svetlosti kakav je slučaj u stomatološkim ordinacijama. Tada je nemoguće osvetliti površinu između objekta i sočiva što čini fotografisanje iz apsolutne blizine nepraktično i neadekvatno. Da bi se dobilo veće rastojanje između objektiv (odnosno blica) aparata i objekta mogu se koristiti telefoto macro sočiva fokalne dužine 100-200 mm, čime se omogućava adekvatno osvetljenje. U ovim slučajevima je posebno indikovano koristiti ring blic. U skorije vreme pojavili su se ring blicevi sa LED (Light-Emitting Diode) osvetljenjem čime je omogućeno kontinuirano osvetljenje macro fotografije.<sup>13,14</sup> (Slika 5.)

Danas je poznato da se digitalne fotografije lako mogu menjati i prilagođavati sopstvenim potrebama korišćenjem odgovarajućih računarskih softvera koji su prisutni na tržištu. To može biti prednost ukoliko je potrebno iskorrigovati kontrast ili boju. Međutim, te prednosti se u kliničkoj stomatologiji mogu i zloupotrebiti čime se dovodi u pitanje autentičnost fotografije. Imajući ovo na umu, neke kompanije su počele da ugrađuju u svoje aparate softverski sistem koji dodaje digitalni vodeni žig svakoj fotografiji. Ukoliko se fotografija promeni na računaru odgovarajući softver detektuje oštećenje vodenog žiga čime se potvrđuje neautentičnost fotografije.

### **Retractors**

When mirrors are used in video recording of certain fields inside the oral cavity, the process is significantly facilitated with suitable lip retractors. Due to the undesired light reflections produced by metal retractors, they have proved to be less suitable than plastic ones.<sup>3</sup> (Figure 4.)

### **Illumination**

For maximum quality and truthfulness of a video recording, the use of flash is mandatory. The daylight or a reflector are not likely to produce satisfactory results on a dentist's chair. There are either manually flashes, which need to be calibrated in different situations or automatic ones.

Likewise, there are ring flashes and point light flashes, as well as those combining these two systems. A ring flash is very easy to handle as it does not cast a shadow in intraoral imaging. The light is uniform and with little contrast. A point light flash, which is found in each compact digital camera, can also provide fairly good results. While flashes of this type cast some shadow, they produce higher contrasts than ring flashes, which can be desirable in certain cases, e.g. when changes or anomalies in the oral cavity mucous membrane are to be registered. The direction of the flashlight extension should depend on the shadow cast by the cheeks and lips, so as to avoid the overlapping of the shadow with the teeth and tissues in the depth of the oral cavity.<sup>3,9,10,12,13</sup>

The illumination issue can sometimes be associated with certain problems. Some cameras are capable of zooming the object so close as to touch it with the lens front surface. This is almost invariably the case with compact digital cameras, where *macro* optical features have been significantly upgraded (even up to 0 mm), while possible lack of adequate light, as it is likely to be the case in dental offices, has been largely disregarded. In such situations, it is impossible to illuminate the surface between the object and the lens, which renders the video recording from absolute vicinity impractical and inadequate. Larger distances between the objective (i.e. the flash) and the object are achieved with the use of telephoto macro lenses of the focal length ranging from 100 to 200 mm, which enable adequate illumination. In such cases the use of a ring flash is particularly indicated. Recently, ring flashes with LED (Light-Emitting Diode) illumination have been offered by some manufacturers and continuous illumination of *macro* photos has become possible.<sup>13,14</sup> (Figure 5.)

Nowadays, it is well known that digital photographs can easily be modified and accommodated according to anyone's particular needs by means of adequate electronic software systems available on the market. This may be an advantage in cases when contrast or colour corrections are needed. On the other hand, these advantages can easily be abused in dentistry, where the image authenticity may become highly questionable. Having this in mind, some companies have recently offered cameras with inbuilt software systems that provide each picture with a water seal. If the image is modified in the computer, the appropriate system detects the damage of the water seal, thereby proving its inauthenticity.



Slika 5. Aparat sa kombinacijom ring blica i blica iz jedne tačke  
Figure 5. Ring flash of the camera

## Zaključak

Uvođenje i korišćenje digitalnih aparata, kompaktnih ili SLR, u stomatološku praksu još uvek predstavlja korak ka budućnosti. Međutim, njihova upotreba u naučno istraživačkoj sferi sa ciljem registrovanja i praćenja odgovarajućih promena predstavlja svakodnevnu potrebu. Sa druge strane, praktičnost, relativna jednostavnost u korišćenju ovih aparata kao i ekonomska pristupačnost su bitne odrednice koje opredeljuju stomatološke ordinacije u pravilnom odabiru dostupnih foto aparata i kamera.

## Conclusion

The introduction and use of digital cameras, either compact or SRL ones, in the dental practice is still a matter for the future. However, their use in the sphere of scientific resaearch for the purposes of registering and monitoring certain changes has become a daily need. On the other hand, their practicability, relative simplicity of handling and affordability are the key determinants that dental practitioners have in mind when making appropriate choices among cameras and video cameras available on the market.

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