Digital Dental Photography-A Modern Revolution

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Abstract

Digital photography has multilevel significance and represents the synonym of contemporary dentistry. Its application in dental practice is simple, fast, and extremely useful in documenting procedures of work, effectuating the education of patients, and pursuing clinical investigations, thus providing many dentists and patient. This article aims to review the various features and advancements in the field of dental photography and its application in prosthodontics.

Keywords: *Dental photography, DSLR, Macro lens, Light setup, Advancement in dental photography, Probe lens.*

Introduction

Digital photography has multilevel significance and represents the synonym of contemporary dentistry. Its application in dental practice is simple, fast, and extremely useful in documenting procedures of work, effectuating the education of patients, and pursuing clinical investigations, thus providing many dentists and patient. Digital photography is described as the images that are stored in a computerized file format referred to as a digital image file. Digital photography has become a vital part of dentistry [1].

History of Photography:

Photography provides the operator the ability to record patient data, events, and document scientific discoveries in a unique way. Alexander Wolcott played the key role in the history of photography. In 1848, Dr.R.Thompson and W. Elde Marked the first time use of before and after photographs of dental procedures. Digital photography arrived in mid-1990 with digital camera available at the marketplace. New software has come which allow things to be measured, changed, shared and integrated into new communication tools with just a click of a mouse. The images also can now be animated, used in reports, and published in websites. These applications are unparallel in film technology [2].

Classification:

Digital dental cameras can be divided into 3 categories.

***a) The compact point-and-shoot cameras, without* interchangeable lenses:**

This type of camera allows varying amounts of exposure control and mixed results in the unique setting of the oral cavity. Full-face photos can be acceptable, but intraoral and close-up views remain variable. The amount of noise in the images is also quite significant. A slightly higher variant is available called Prosumer cameras in which, the size and form of the Prosumer camera is smaller than a Digital SLR camera. Prosumer camera is light and equipped with a super zoom lens. It is cheaper than entry level Digital SLR camera.

b) The second type of camera used is the DSLR (Digital single lens reflex) camera:

DSLR cameras are designed for semi-professionals to professionals. DSLR cameras have the advantage of

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interchangeable lenses, including macro (or Micro in a Nikon System), telephoto and metered lenses. They also have ports for accessories such as a ring flash or a dual flash system. All controls can be set manually. An 85mm- to 105mm telephoto macro lens is used ideally- the reason is quite simple to maintain natural height-width ratio when reproduced in a photograph. A ring flash is placed around the lens to distribute the light evenly with intraoral exposures. Some cameras are also fitted with point flashes to reduce red-eye with full-face views. A drawback is that these cameras can be expensive and bulky.

c) Intraoral cameras:

An intraoral camera is a tiny device with a video camera that moves around inside the mouth and generates a surface video examination of the teeth. The images or videos can be stored, and later enlarged and showcased. Patients can see their teeth and any issues such as a fractured tooth, plaque, decay, and gingival disease, among others. This allows for better education of the patients and also allows dentists to catch problems in the early stages for analysis or to record patient progress.

BASIC ARMAMENTARIUM:

1.Digital camera

A. compact point –and-shoot camera

B. Digital single lens reflex

More the pixels, greater would be the detail of the image. In digital dental photography, minimum of 12 Mega pixels is required.

C. Intraoral cameras

2. Camera accessories.

A***. Lens:***

Fixed focal length of macro lens should be 24-105mm. The lens that mostly concerns us for documentation and record purposes are mainly the macro lenses. The lens system allows a sharper focus in the close-up pictures as they have larger diaphragm and we get a higher magnification than other immature lenses. These lenses have mechanisms that are defined by the term "diaphragm". It consists of sheets that let more or less light in it, similar to the function of iris in human eye. As smaller the diaphragm size, sharper would be the image. Hence with true macro lenses, the operator can take advantage of the depth of the field and obtain sharper and focused images at their original magnification[3].

B. Light and electronic flash systems

- Ring flash
- Point flash
- Twin flash

C. Memory card for storage of data.

D. Filter: It serves the dual purpose of lens protection and if required changing the lighting conditions.

E. Batteries: An extra battery pack with a quick charger ensures that we never run out of battery during shoot.

F. Camera bags: This is useful to protract the camera and be able to carry our lens, camera and other accessories in an organized fashion.

3. Clinical dentistry photographic accessories:

A. Cheek retractors.

Columbia wire lip retractor: This combines buccal mirror and cheek retractors like martin metal retractors.

Intraoral mirrors: It should have long handled with silver rhodium coated glass mirrors.

B. Black background: Contraster

The Shadow Box:

It is a portable photo studio for macro photography. Taking photos of restoration, models and small products has never been easier. Shadowbox can be configured for many different types of lighting and coloured backgrounds. As shown in the photos above, the Shadow Box starts with the "box". The base of the Shadow Box is reversible (white / black) and the back of the box is white with an extra panel that is also reversible (black / red) (Figure.1) [15].

Figure 1: Shadow Box

4. Other accessories equipment for intraoral photography:

- Plastic or glass spatula.
- Dental mirrors.
- Gauze strips.
- Air syringes or aspirators.

CAMERA ACCESORIES

A) Lens: A lens selected for dental purposes must be able to capture diagnostic and accurate views of teeth, gingiva and surrounding structures.

Specially fixed focal length macro lenses are able to capture an image of a subject while focusing at a very close range. Macro lenses with a fixed focal length designation of 85 to 105 mm provide the ideal combination of magnification ability and working distance convenience for dental purposes. The quality of the lens has a significant influence on the sharpness, clarity, and ultimate quality of the final image (Figure.2)

The magnification ratio is the ratio of the size of the image projected on the sensor compared to the actual size of the object. A magnification ratio of 1:10 means the image on the sensor is one-tenth life-size, while a 1:1 magnification ratio signifies a life-size image on the sensor. The 1:1 setting is ideal for close-up imaging of teeth while the 1:10 setting is useful for full-face views[4].

Figure 2- Macro lens

Probe lens

Figure 3: Probe lens Features

Probe lens is one of the new revolution in the field of digital camera lens, it has a feature of 2:1-macro and infinity focus, it also consist of tiny lens tip which is supported with ring light which gives full dept of coverage, since it has tubular barrel which is water proof it can be safely recommended for intra oral pictures (Figure: 3) [4].

B) Light and Electronic Flash Systems: Proper illumination is one of the most significant factors in achieving a quality image. Since natural ambient light is usually inadequate to illuminate all the dark areas in most intraoral photographic situations, a supplemental electronic flash source is needed. An electronic flash can provide light with neutral color temperature i.e. relatively high output light for a short duration[5].

In flash photography, the lighting effect is dependent on the form and arrangement of the flash sources. There are three types of electronic flash system configurations available for dental photography:

i. ***Ring Flash***: It is considered the universal flash system for general macro- photography. This system furnishes either a single ring flash tube or individual sector flash tubes that surround the lens. The specular or mirror-type reflection created by this type of flash tends to eliminate shadows in the image. The disadvantage in the reduction of shadows is that the image may appear to "flatten out" with reduced discernable contours (Figure: 4) [6].

Figure 4: Ring Flash

ii. Point flash: This provides a single strobe light source mounted in different positions around the lens to provide a unidirectional light from different angles. Photographic compositions for frontal, right lateral and left lateral views require the flash to be placed at the 12, 9, and 3 o'clock positions, respectively. Control of the light direction allows shadows to be cast by the three-dimensional topography of the objects in the scene. The appearance of shadows improves the visual definition of contour and texture to emphasize the apparent depth

within the image. The advantage of this flash system design is its ability to record surface texture detail and contour. However, it is suggested that multiple images with several flash positions be taken to establish adequate information. This type of flash system requires considerable experience and additional set-up time to maneuver the flash position before each exposure [7].

iii. Twin flash: Its configuration consists of two flash units that are mounted next to the lens. The light sources can be positioned to create custom mild shadowing to reveal texture with depth and life-like effects. Mastering the use of this lighting system will yield professional photographic results. While requiring more experience and thought for proper use, the twin flash design system may offer the best combination of soft, uniform illumination because it simultaneously reveals surface detail, color transitions, translucency variations, and crack lines (Figure:5).

Figure 5: Twin Flash

C) Memory card: Memory cards are available in different formats such as CF (Compact Flash), Micro SDHC (Secure Digital High Capacity), Micro SD (Secure Digital) and SDHC. They can reach up to 512 GB in size and store thousands of images. Blue/Standard for Point and Shoot cameras and Ultra for DSLRs should suffice the needs of the dental setup.

D) Filter: It serves the dual purpose of lens protection and if required changing the lightening conditions.

E) Batteries: It is required to get an extra battery pack with a quick charger, to ensure you never run out of battery during a shoot.

F) Camera Bags: This is useful to protect the camera and to be able to carry your camera, lenses and accessories in an organized fashion [8].

GUIDELINES FOR DENTAL PHOTOGRAPHY

To achieve a good digital photograph, standardization is very important, i.e. consistent lighting, exposure, patient positioning, perspective, depth of field and background. Photographs should be stored and presented appropriately for their use in publications. Three types of intraoral cameras are used like 35 mm film camera with Macro lens and ring flash, intraoral video camera (Orthoscan camera) or 5 and 6-megapixel extra oral digital camera. Several views should be taken for all the patients like frontal view that incorporates full facial profile and entire dentition. Other views

like lateral and oblique lateral, occlusal Mandibular-maxillary and a three quarters profile view for esthetic purposes [9]. Photography can be divided into three broad area namely, preparation of the patient, background and intraoral sites, preparation of camera. Comparison of light reflection on mesial and distal line angle with different flashes (Figure: 6).

Guidelines for Radiographic photographs :

Radiographs are only composed of white and black areas. Therefore, an imperfect photograph can be the result of four characteristics, non homogeneous illumination, variable color, flicker and limited brightness.

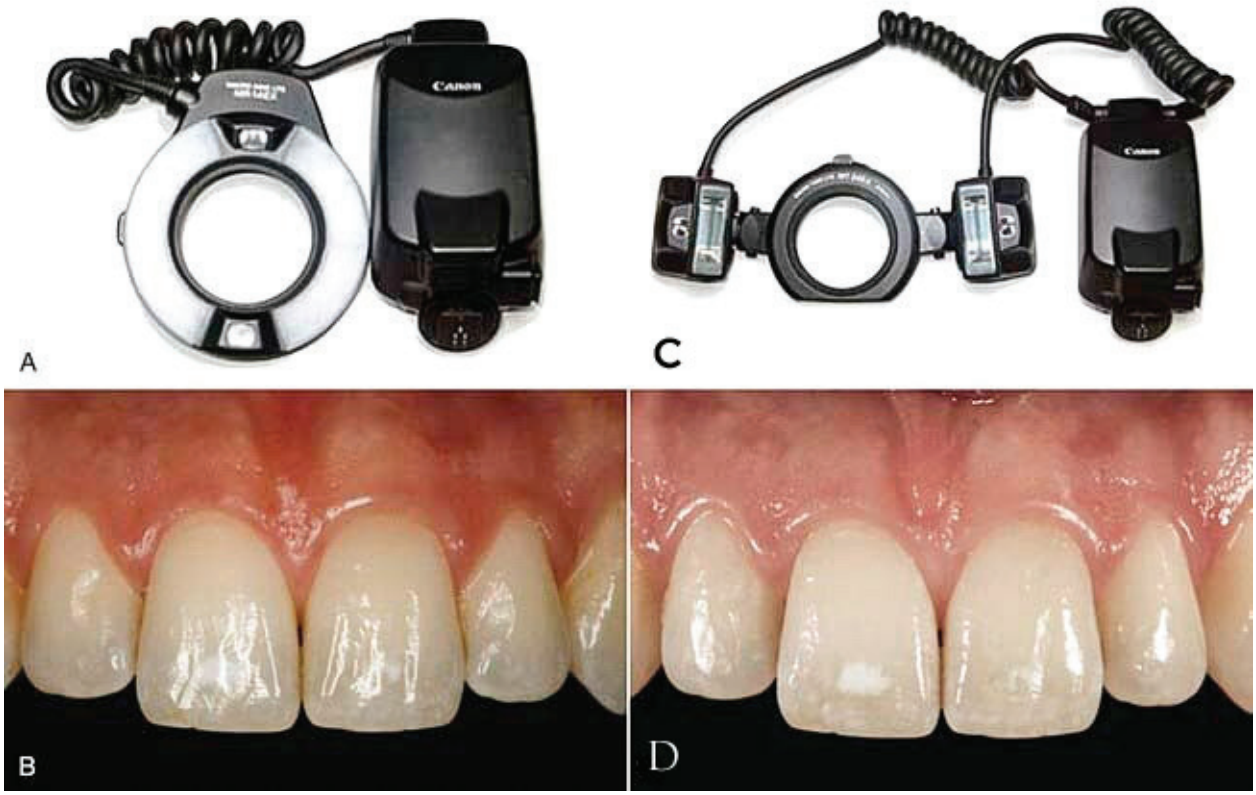

Figure 6: A – Ring Flash, B- image taken using ring flash, C- Dual Point Flash, D- Image taken using Dual point flash.

REQUSITIES OF DENTAL PHOTOGRAPHY IN DENTISTRY:

1. Diagnosis and treatment planning:

There are 34 views required for all clinical case examinations. Of the 34 views, 17 should take before treatment and 17 after treatment. Additional views are required for the technique documentation. The images should be captured in either manual or TTL mode. All intraoral images should be captured using high F-stops to maximize the depth of field. Intraoral and extra oral photographs provide a static, in-depth look at the patient's dentition.

2. Enhanced patient education and communication:

Utilizing a tablet display and presentation software, tailored presentation on dental procedures could be created with photographed cases. These detailed pictures showing anatomy, surgical steps, materials, and completed cases can help in educating the patients on diagnosis and proposed treatment and thereby improving their understanding and case acceptance.

3.Legal Documentation:

Digital photographs in their raw format can be used as a legal document proof. This can help a mistreated patient or defend a colleague who has provided appropriate treatment or can be helpful in malpractice lawsuits.

4. Insurance Verification:

Periodontal charting, radiographs, or a narrative is required by insurance companies before disbursement of benefits to the consumer. Therefore, a digital photograph can be used to support a narrative.

5. Specialist consultation:

A complete case history with high resolution photographs may be sufficient enough foe an over-the-phone consultation with a specialist. Similarly, photographs from referring dentist of mutual patients and their recent accomplishments could be transferred or received so that the operator may assess the condition without being physically present in the office [10].

6. Laboratory communication:

A shade guide is required to convey information on tooth or gingival character, shade, or color. This procedure is mostly accompanied by demerits like falling short in describing the complexity of depth and shadowing a tooth exhibit. Hence, here a color-corrected photograph can provide the much- needed information to create a final restoration with more accurate hue, value, and chroma.

7. Professional advertising and marketing:

Before and after photos are powerful aids to motivate the patients for accepting the treatment plan or for showcasing any particular skill.

8. Professional instruction:

Only texts and bullets are often inadequate in describing dental concepts or specific surgical procedures. A photo is worth more than a thousand words and sparks more interest and discussion than written matter.

9. Self-education and improvement:

As professionals, we continuously learn throughout our careers. Courses and other forms of continuing education are important educational vehicles. Digital photography in such a occasion is a boon.

10. Treatment philosophy and work ethic:

Talking efforts and time to clean surgical sites for photographs requires patience and attention to detail. This attitude propels us to execute our work at the high levels of accuracy [11].

APPLICATION IN THE FIELD OF PROSTHODONTICS

Photographic-assisted diagnosis*:*

Diagnosis and treatment planning of esthetic cases requires the use of photographs that are specifically designed to give the practitioner the information required to make that diagnosis and develop a sequential treatment plan.

Smile line, smile width and buccal corridor:

Analysis of smile width and buccal corridor can be done with frontal profile photograph of the patient. This can help in correct treatment planning and choice of material to be used for the restoration.

Midline, Incisal horizontal plane, and occlusal plane:

v A midline drawn on the photograph from the center of the forehead through the tip of the nose and chin or Cupid bow or philtrum can help the operator to determine any asymmetries if present. Similarly, interpupillary line drawn from the center of the pupils and facial midline form a cross, through which harmonious facial geometry can be assessed.

v Incisal plane can also be assessed in this view, revealing the length, Incisal curvature and horizontal symmetry of anterior arch.

v Occlusal plane can be evaluated by tracing the Incisal edges of the central incisors, cuspids, and first molar and compare its parallelism to the interpupillary lone and commissural line [12].

E-line, facial profile line, Frankfurt line, esthetic plane, camper's plane:

v E-line can be determined by the line that connects the tip of the nose to tip of the chin. This helps the operator to determine the lip support and in classifying anterior malocclusions such as overjet[13].

v Facial profile line can be evaluated by drawing a vertical line through the glabella and the tip of the chin. The angle formed by these designates a convex, concave, or straight facial profile.

v Frankfort plane can be assessed when the patient tilts the head slightly forward. Conversely, when the patients head is held erect with the eyes facing toward the horizon, the Frankfort plane forms an angle of about 8 degree with the arbitrary horizontal plane commonly referred to as the esthetic plane.

v The esthetic plane helps the operators to articulate the upper cast on a fully adjustable articulator in its correct superior vertical inclines.

v Camper's Line determined from the inferior border of the ala to the tragus helps making prosthetic considerations in denture, partial , or full mouth rehabilitation case.

v These statistics can be obtained by assessing a lateral profile photograph.

Smile width:

This reveals the number of teeth exposed from anterior to posterior. Analysis of smile width determines the correct planning of buccal preparation and the material of choice for the restoration. On frontal smile profile, the display of the teeth and gingiva is measured[14]. The Incisal most points of each tooth are depicted as line 1 and the l8p edge as line 2 (which is drawn parallel to the pupil line). The vertical distance between these lines is measured. This gives the lip position. Similarly, gingival margin (if visible) is marked as line 3. The difference between line 2 and line 3 gives the lip line height. If not visible, the length of the tooth is measured in intramural frontal view. These markings are important to determine the patients' gonial angle giving the operator an insight about the skeletal classification of occlusion and better understanding about the wear patterns of the remaining teeth[15].

Curve of Wilson / Curve of Spee:

Curve of Wilson, curve of spee and maximum intercuspation can be determined in anterior-posterior view. These observations have an important role in prosthetic rehabilitation from technical, esthetic and functional aspects.

The Golden proportion:

In esthetic smile makeovers or laminates, concepts of golden proportion can be easily applied and assessed onto a digital photograph.

Shade selection:

Photographs taken with an absolute dark or absolute white tab with 30-degree angled photos and a matching shade tab help a dentist to easily communicate with the laboratory technicians. By assessing these digital photographs, exact shade can be verified for the final result, eliminating shading errors and in turn excellent patient satisfaction.

Conclusion

In the field of prosthodontics, dental photography has its own impact. Through digital photography, the operator can communicate with the patient as well as among other dentists for referral or treatment documentation purpose. Technical aspects such as smile line, smile width, facial profile, emergence profile, occlusal plane, gingival anatomy, compensatory curves and shade matching can be better visualized through perfect intraoral and profile photographs. It also brings laboratory cases closer to the visualization of the actual patient. With more information at disposal, operators and technicians can deliver better skills to a greater precision and achieve the patient's desired restorative outcome with lifelike skills. Dental photography is very useful for the patient during and after treatment to satisfy form, function and esthetics. It improves the patient's oral health quality of life.

Ethical Clearance: Nil

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