Digital Dental Photography

Abstract
Photography has always been an integral part of dentistry. The journey goes back to the time when film photography was used only for documentation and referral purpose which has now evolved to digital photography. Its application in dental practice is simple, fast, and extremely useful in documenting procedures of work, education of patients, and pursuing clinical investigations, thus providing many benefits to the dentists and patients. The article describes the added benefits of digital dental photography over film photography, basic armamentarium for obtaining good photographs, and how digital dental photography is beneficial in the field of prosthodontics.

Keywords: Dental photography, digital camera, digital photography

Introduction
Digital photography has now penetrated into all the segments of science, medicine, industry, fashion designing, communication, and arts, and it would be difficult to imagine any form of our existence without photography. It has influenced the conscience of people so much that the saying “an image is worth a thousand words” is accepted as an undeniable fact.

Film photography was a great step forward which was introduced over a century ago. The major advance in dental photography centers on the shift from film-based photography to digital imaging.

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 benefits to dentists and patients.

History
The history of dentistry and photography began in 1840 when the first dental school was opened with the world’s first photographic gallery and was operated by a dentist turned photographer. Since then, photography and dentistry have been partners as photography became an integral part of a patient’s record and treatment plan.[1]

Photography provides the operator the ability to record patient data, events, and document scientific discoveries in a unique way. Alexander Wolcott (1804–1844) played the key role in the history of photography. He obtained the patent for his inventions of a camera in 1840 and developed a system for photographic studio lighting. Soon after 1 month, he made history by opening the first commercial photographic studio.[1]

In 1848, Dr. R. Thompson and W. Elde of Columbus, Ohio, marked the first time use of before and after photographs of dental procedure and an article was published creating a new frontier in diagnosis and treatment planning dentistry.

More recently, dental profession has started to use clinical photography as part of diagnostic and treatment planning processes. Its value in documenting cases, presenting information, and educating patients has increased to the point that it has become integral to diagnosis and treatment planning decisions.[1]

Digital photography arrived in mid-1990 with digital cameras available at the marketplaces. Although its resolution was low, it had already started to create ripples of interest among the purists and enthusiasts. Within 10 years or so, digital photography has completely displaced film photography in science and medicine. New software has come which allow things to be measured, changed, shared, and integrated into new communication tools with just a
Reasons Why to Use Digital Dental Photography

With the advent of digital technologies, imaging has now become easier and more readily accessible. Still, few are reluctant to implement them in their daily practices for reasons such as lack of knowledge of photography equipment and technique, interruption in workflow, and cost factors. However, as new technologies are continuously emerging, the equipment cost is declining as well, thus every practitioner can implement photography into his or her practice with minimal interruptions in their patient workflow.

The following are the reasons why to use digital dental photography in everyday dental practice:

1. Diagnosis and treatment planning.\[2,3\]

There are 34 views required for all clinical case examinations. Of the 34 views, 17 should be taken 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.

The cosmetic standard series include the following 17 views.\[4,5\]
1. Full face (1:10)
2. Right profile view (1:10)
3. Tooth show at rest (1:2)
   (Lick lips, swallow, slightly part your lips. Tooth show at rest is critical to determine IEP)
4. Full exaggerated smile (1:2)
5. Horizontal view (1:2)
6. Tipped forward (1:2)
7. Right lateral smile view (1:2)
8. Left lateral smile view (1:2)
9. Retracted view anterior teeth closed (1:2)
10. Retracted view anterior teeth slightly open (1:2)
11. Right lateral retracted view teeth closed (1:2)
12. Left lateral retracted view teeth closed (1:2)
13. Close-up anterior centrals view (1:1) with block-out paddle
14. Close-up right lateral retracted view (1:1) with block-out paddle
15. Close-up left lateral retracted view (1:1) with block-out paddle
16. Maxillary occlusal views (1:2) (photograph the reflection in an occlusal mirror)
17. Mandibular occlusal views (1:2) (photograph the reflection in an occlusal mirror)

Intraoral and extraoral photographs provide a static, in-depth look at the patient’s dentition and profile, which can be easily reviewed and compared with the other patient records.\[31\]

2. Enhanced patient education and communication

Till now, there were audio and visual aids such as videos, models, and brochures, for patient education purpose, but none of these modalities thoroughly covered the information. Utilizing a tablet display and presentation software, tailored presentation on dental procedures could be created with graphed 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.\[2,3\]

3. Legal Documentation

Digital photographs in their raw format (nonedited) 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.\[2,3\]

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.\[2,3\]

5. Specialist consultation

Charted radiographs and written reports were the only means to present our patients to other doctors. Now, with photographs, an entirely new dimension has been introduced. A complete case history with high-resolution photographs may be sufficient enough for 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.\[2,3\]

6. Laboratory communication

Most often, 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 exhibits. Hence, here, a color-corrected photograph can provide the much-needed information to create a final restoration with more accurate hue, value, and chroma.\[2,3\]

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.\[2,3\]

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.\[2,3\]

9. Self-education/improvement

As professionals, we continuously learn throughout our careers. Courses and other forms of continuing education
are important educational vehicles. Digital photography in such occasion is a boon.[2,3]

10. Treatment philosophy and work ethic

Taking efforts and time to clean surgical sites for photographs requires patience and painstaking attention to detail. This attitude propels us to execute our work at the high levels of accuracy. Hence, preparing the patient for photographs in return helps improve our own skills.[2,3]

Basic armamentarium

The following are the list of basic instruments required for digital dental photography:

1. Digital camera[6]
   a. Compact point-and-shoot cameras or
   b. Digital single lens reflex
      More the pixels, greater would be the detail of the image. In digital dental photography, minimum of 10 Mega Pixels is required.
   c. Intraoral cameras
2. Camera accessories:
   a. Lens:
      Macrolens of fixed focal length of 85–105 mm.

There are different types of lens available and each one for different uses. The lens that mostly concerns us for documentation and record purposes are mainly the macro lenses. These lens systems allow a sharper focus in the close-up pictures as they have larger diaphragm and we get a higher magnification than with other armature lenses. In medical and technical documentation, the objects and the images are dealt in close ranges. Using a macrolens will help the user to focus better and obtain sharper images.[7,8]

However, these macro lenses are further distinguished from one another by the focal length, which varies from one lens to another. Focal lengths are normally 16 mm, 28 mm, 35 mm, 50 mm, 85 mm, 100 mm, 135 mm, 200 mm, 300 mm, 400 mm, etc. The lenses that are of our interest for medical and technician offices are mainly those with a focal length of about 100 mm.[7,8]

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. With poor light, the diaphragm expands to let more light pass through; on the other hand, if there is plenty of light, the diaphragm closes to the minimum to be able to see without being blinded. The aperture size or diaphragm width directly affects the sharpness of the image. As smaller the diaphragm size, sharper would be the image.[9]

Hence, with true macro lenses, the operator can take advantage of the depth of field and obtain sharper and focused images at their original magnification.

b. Light and electronic flash systems
   • Ring flash
   • Point flash
   • Twin flash
c. Memory card: for storage of data[6]
d. Filter: It serves the dual purpose of lens protection and if required changing the lighting conditions[6]
e. Batteries: An extra battery pack with a quick charger ensure that we never run out of battery during shoot[6]
f. Camera bags: This is useful to protect the camera and be able to carry our lens, camera, and other accessories in an organized fashion[6]

3. Clinical dentistry photographic accessories
   a. Cheek retractors
      • Columbia wire lip retractor: This combines buccal mirror and cheek retractors[6]
      • The martin metal retractors[6]
      • Intraoral mirrors: Like long-handled front-silvered rhodium-coated glass mirrors,[6]
   b. Black background/contrasters[6]

4. Other accessories equipment for intraoral photography[6]:
   a. Plastic or glass spatula
   b. Disposable plastic spoons
   c. Dental mirrors
   d. Gauze strips
e. Air syringes or aspirators.

Application of digital photography in prosthodontics

Dental operators as well as dental technicians use digital photographs as adjunct or aids for the following technical analysis.[10]

Photographic-assisted diagnosis

The standards of practice are often influenced by the techniques used, methodology processes, or activity which is believed to be more effective at delivering a particular outcome than any other technique. Digital dental photography has certainly raised the bars of our treatment standards as they have proved to be very useful in diagnosis and treatment planning.[11]

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.[11]

Smile line, smile width, and buccal corridor

Prosthetic observations such as establishing a correct gingival display and emergence profile in relation to the patient’s smile line can be determined using frontal view of the patient while smiling.[10]

Similarly, 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.10

**Midline, incisal horizontal plane, and occlusal plane**

A midline drawn on the photograph from the center of the forehead through the tip of the nose and chin (or by using more reliable landmarks such as cupid bow or philtrum) can help the operator to determine any asymmetries if present [Figure 1]. Similarly, interpupillary line drawn through the center of the pupils and the facial midline form a cross, through which harmonious facial geometry can be assessed.10

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

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 line and commissural line. Prosthetically, this feature would be useful in realigning the occlusal, horizontal, and interpupillary plane to re-establish a more harmonious smile.10

**E-line, facial profile line, Frankfurt line, esthetic plane, camper’s plane**

E-line can be determined by the line that connects the tip of the nose to tip of the chin [Figure 2]. This helps the operator to determine the lip support and in classifying anterior malocclusions such as overjet.10

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.10

Frankfort plane can be assessed when the patient tilts the head slightly forward. Conversely, when the patient’s head is held erect with the eyes gazing toward the horizon, the Frankfort plane forms an angle of about 8° with the arbitrary horizontal plane commonly referred to as the esthetic plane.10

The esthetic plane helps the operator to articulate the upper cast on a fully adjustable articulator in its correct superior vertical inclines.10

Camper’s plane determined from the inferior border of the ala to the tragus helps making prosthetic considerations in denture, partial, or full mouth rehabilitation case.10

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.10

On frontal smile profile [Figure 3], the display of the teeth and gingiva is measured. The incisal most points of each tooth is depicted as line 1 and the lip 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 the line 2 and line 3 gives the lip line height. If not visible, the length of the tooth is measured in intraoral frontal view.12

These markings are important to determine the percentage of the tooth expressed which has to be calculated for each tooth. If the tooth is not visible, the percentage of tooth display is considered as zero.

**Gonial angle**

In lateral profile photo, one can also determine the patients’ gonial angle giving the operator an insight about the skeletal classification of occlusion and better understanding about the wear patterns on the remaining teeth.10

**Curve of Wilson/curve of Spee**

Curve of Wilson, curve of Spee, and maximum intercuspation can be determined in anterior-posterior view [Figures 4 and 5]. These observations have an important role in prosthetic rehabilitation from technical, esthetic, and functional aspects.10

**The golden proportion**

In esthetic smile makeovers or laminates, concepts of golden proportion can be easily applied and assessed onto a digital photograph [Figure 6].10

**Shading**

Photographs taken with an absolute dark or absolute white tab with 30° angled photos and a matching shade tab help a dentist to easily communicate with the laboratory technicians [Figures 7 and 8]. By assessing these digital photographs, exact shade can be verified for the final result, eliminating shading errors and in turn excellent patient satisfaction.5

**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 results.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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