

Digital dental photography.

Part 1: an overview

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VERIFIABLE CPD PAPER

IN BRIEF

- Digital dental photography is useful for every discipline of dentistry, and is an essential part of contemporary practice.
- A usable dental image should have correct colour rendition and sufficient detail to show the oral clinical scenario.
- The aim of this series is to simplify technical jargon about digital photography, and present protocols that can be readily incorporated into a busy dental practice.

PRACTICE

This paper is the first article in a new ten-part series on digital dental photography. Part 1 previews and outlines the contents of the subsequent papers and in addition, defines the aims and objectives of a digital dental image and the features that are required for an ideal intra-oral picture.

INFINITE POSSIBILITIES

The possibilities of dental photography, as with photography for other applications, are limited only by the imagination (Fig. 1). As a profession, dentistry can either be a source of immense satisfaction or a routine treadmill. One of the ways to enhance satisfaction is by using dental photography, which is a wonderful means to appreciate what can be achieved with current therapy, gratifying to both the clinician and patient, and helping to transform routine practice into a passionate pleasure. However, like any occupation, it is ultimately the individual's input



Fig. 1 The possibilities of dental photography are limited only by the imagination

FUNDAMENTALS OF DIGITAL DENTAL PHOTOGRAPHY

1. Digital dental photography: an overview
2. Purposes and uses
3. Principles of digital photography
4. Choosing a camera and accessories
5. Lighting
6. Camera settings
7. Extra-oral set-ups
8. Intra-oral set-ups
9. Post-image capture processing
10. Printing, publishing and presentations

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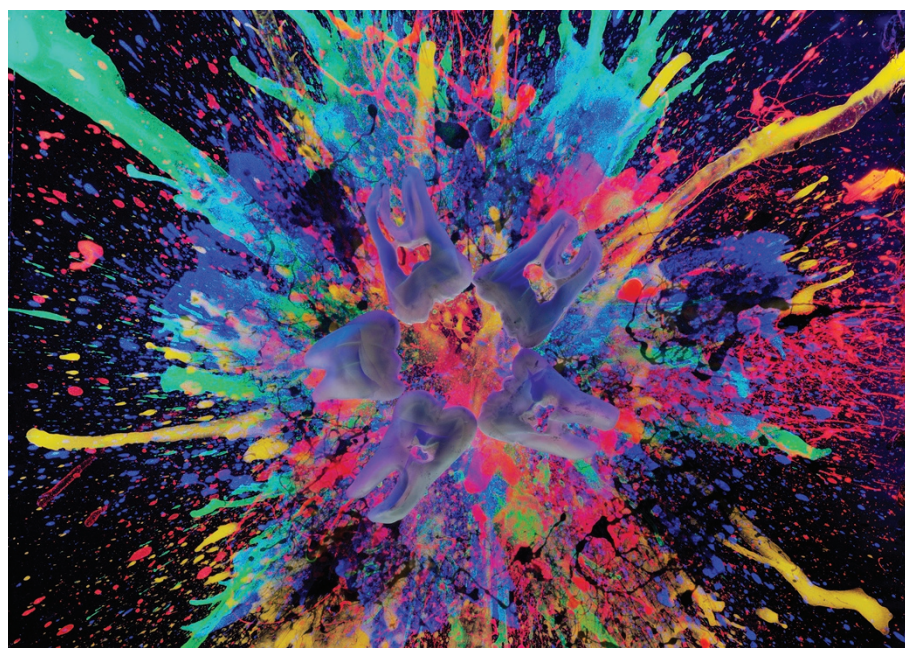


Fig. 2 Dental photography can be elevated to almost an art form

and subsequent gains that yield gratification. This series will endeavour to elevate dental photography to almost an art form, especially in the case of aesthetic dentistry, which is no less than painting a picture or moulding a sculpture (Fig. 2). But photography is not just reserved for aesthetic dentistry; it is also invaluable in other disciplines such as orthodontics, periodontics, implantology, dental technology and oral surgery, to name but a few examples (Fig. 3).

One of the major reasons dentists shy away from dental photography is its perceived technical complexity, requiring laborious efforts to achieve the desired results. This is analogous to computers. When computers were first introduced a few decades ago, they also faced similar objections. However, with the passage of time, computers have become commonplace and indeed indispensable in nearly all walks of life. Another factor which has added to dental photography technophobia is the introduction of digital photography, which has alienated many already reticent practitioners; and quite rightly, there is ample truth to support this reluctance. Firstly, photography is unnecessarily and perhaps perversely presented as a complex procedure; secondly, the technical aspects can be daunting, especially when choosing a camera and accessories for dental use. Thirdly, technology is perpetually changing, making purchases of even a few years earlier inferior and obsolete. However, these obstacles are readily overcome and should not be a deterrent, especially when the benefits outweigh the initial expenditure and learning curve.

To counteract these concerns and demystify many misconceptions about dental photography, consider the following. First, photography is no more complicated than many of the procedures routinely performed in dental practices. However, similar to learning a new technique, a degree of perseverance and patience is necessary. Secondly, choosing photographic equipment for dental purposes depends on the intended use, which is discussed below. Thirdly, it is true that technological advances make equipment dated, not unlike computers, cars, electric consumer goods or even dental



Fig. 3 Dental photography has many applications, eg for assessing shade in a dental laboratory using a shade guide (Vita Classic)

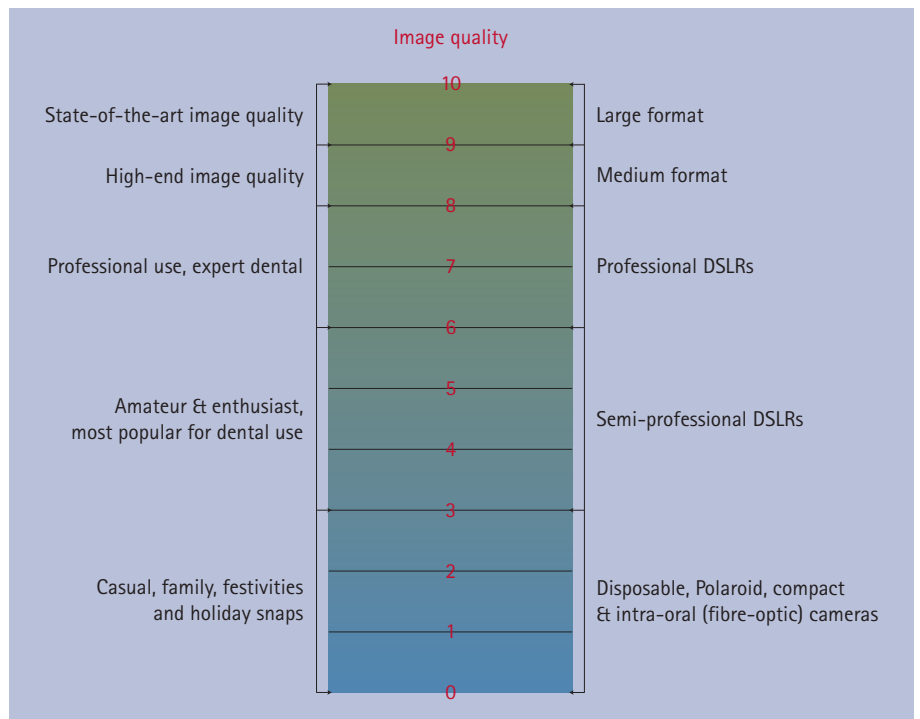


Fig. 4 Image quality and equipment represented on a scale from 0 to 10

equipment. It should be a fact of life that one accepts, rather than being the deciding factor for not incorporating dental photography into routine practice.

The aim and objectives of this series is to dispel fallacious misconceptions about dental photography, simplify technical aspects and concentrate on the bare essentials necessary for dental applications. After all, driving a car does not require the driver to know the workings of an internal combustion engine. After reading the ensuing chapters, most novices will be able to purchase the necessary equipment and start taking dental

pictures in less than a day, while the aficionados will find many helpful hints to enhance their productivity and achieve superlative images.

A TOY OR A TOOL?

At the outset, it is important to decide whether the dental equipment will serve as a toy or a tool. If it is the former, once the novelty factor has expired, the equipment will be consigned to a corner to accumulate dust. If the answer is a tool, it should be regarded as an indispensable part of the dental armamentarium, similar to a dental handpiece. Furthermore,

the investment in equipment may be wasteful if the initial enthusiasm turns to frustration. This is a crucial point that is addressed throughout this series by making technical jargon palatable, and techniques easy to follow and incorporate into a busy daily schedule.

IMAGE QUALITY VS INTENDED USE

Before choosing and purchasing a digital camera system, the most important factor to consider is the quality of an image required for dental purposes. The market is awash with a myriad of cameras and photographic accessories. For dental use, the primary factor is deciding which camera format is suitable for yielding the required image quality. Image quality is paramount because every dental image is a medico-legal record and therefore accurate documentation is essential. To simplify matters, image quality can be represented on an arbitrary scale from 0 to 10, with zero representing a poor or unacceptable quality and ten representing the best possible image reproduction (Fig. 4). At the bottom of the scale are disposable, instant Polaroid®, compact and intra-oral cameras. All of these cameras offer convenience, portability and accessibility at the expense of poor image quality, and are unsuitable for documenting a dento-legal record. Further up the scale are single lens reflex (SLR) and rangefinder cameras, which are both capable of delivering better image quality.

However, rangefinders can be eliminated for dental use because for macro or close-up photography, parallax is an unacceptable drawback. Parallax is when the lens and viewfinder do not share the same optical axis, and what is seen in the viewfinder is not the same as what is recorded on the film or digital sensor. While this phenomenon is negligible or irrelevant for landscape or family snaps, it is of paramount concern for taking pictures of small objects such as teeth.

The SLRs are the most ubiquitous cameras employed for semi-professional and professional uses. The template of digital SLRs is based on their analogue precursors for film photography. With the advent of digital photography, they are allocated the prefix 'digital' and therefore termed digital single lens reflex

(DSLR). Since their introduction in the early 1960s, the basic design of SLRs has remained almost unchanged. In fact, all the features of DSLRs such as lenses, aperture and shutters are identical as those for conventional film cameras. The popularity of SLRs is that they are immune from parallax, since the viewfinder, lens and image sensor, or films, all share the same optical axis. Therefore, what you see is what you get, which is crucial when taking macro pictures. Another advantage of this format is that it offers immense versatility and unlimited accessories. Camera bodies, viewing screens, film winders, a massive array of lenses ranging from ultra-wide angle to super telephotos, auto-focus and manual lenses are all interchangeable. Furthermore, a DSLR system can be tailored to almost any kind of photographic application. In addition, portability, auto-exposure, dedicated synchronised flashes and studio lighting make the task at hand easier and more predictable.

Depending on budget, two types of DSLRs are available, the amateur or semi-professional and full professional varieties. The former are suitable for the keen enthusiast as well as dental applications. The more expensive, professional versions have additional features, which are often superfluous for dental applications and the extra cost is probably unjustifiable for dental use unless the slightly improved image quality is an overriding concern.

Travelling further up the image quality scale, the next encounter is the medium format cameras. These have the advantage of a larger sensor than DSLRs, usually with a 50% greater surface area and a comparable improvement in image quality. Before digital sensors, these cameras were the choice for fashion, portraiture and high-end film photography, since they are capable of producing images that are ten times the size of a 35 mm SLR format. The medium format also offers enormous flexibility since the camera body, lenses, attachments and accessories are based on a modular concept. Hence, even to a greater degree than SLRs, a medium format system can be assembled bespoke to a specific photographic need. However, the entire assembly is cumbersome, requiring

expert training and knowledge to exploit the format to its maximum potential. If quality is the ultimate concern, then a medium format camera is the ideal choice, but perseverance and patience is the downside. For a dental practice, their physical size and a steep learning curve would deter the majority of practitioners from entertaining this format.

Lastly, for superlative quality surpassing even that of a medium format system we have the view or large format cameras. These are based on the original camera designs from the genesis of photography over a century ago. Their use is restricted to still life, product shots, fashion iconography and documenting works of art such as paintings, sculptures and crafts. Besides prohibitive cost, the sheer size of these contraptions can be overwhelming. Depending on the modular attachments for a specific assignment or application, once assembled they can have dimensions of four metres in height and three metres wide. Hence, their use is obviously contraindicated for a dental surgery set-up. It is worthwhile noting that currently, both medium and large format cameras use the same size of image sensors, and the higher image quality yield with large format systems is primarily due to the higher resolution lenses.

In addition to quality, camera equipment for dental use must be adaptable for a practice environment with regard to accessibility, health and safety compliance, cross-infection control and ease of use. Considering all factors, the choices available are either a DSLR or medium format. But if ease of use is the deciding factor, then the only choice is a DSLR. Most of the discussion in this series on digital dental photography will therefore concentrate on DSLRs, which are widely accepted as the most versatile and compatible for dental applications.

IDEAL FEATURES OF AN INTRA-ORAL IMAGE

To simplify matters there are two features that are essential for a useful dental image. The first is correct colour rendition, which also includes correct exposure, and the second is sufficient resolution to record both soft and hard tissue details.

The first item to consider is colour rendition. It is crucial that a dental image precisely records the colour that is perceived by the eyes. This implies that the colour rendition should be as close as possible to what is observed during a dental examination. Eliminating the influence of different light sources or illuminants, the image should faithfully reproduce the colour of both hard and soft tissues as they appear in the mouth. There should be no colour casts and the gingivae, oral mucosa, teeth and any prostheses should be conveyed with extreme colour accuracy. The correct colour rendition of soft tissue is an excellent method for distinguishing between healthy and diseased tissue and for recording pathological changes such as white patches, inflammation, ulceration, burns, lacerations, carcinoma, etc. Similarly, a correct colour rendition of the teeth reveals enamel translucency, decay, erosion and abrasion, as well as cervical dentine exposure and sclerosis. Correct colour reproduction is also an essential communication tool for shade analysis during composite filling placement, bleaching and for ceramists endeavouring to match artificial prostheses with surrounding natural dentition.

The second item to consider is sufficient detail. Besides a dento-legal record of the prevailing clinical situation, recording detail is fundamental for examination, diagnosis, treatment planning and assessing outcomes of therapy. If the resultant image lacks fine detail and resolution, it serves little clinical purpose and is no more useful than a poor quality radiograph. Although not exhaustive, the list below gives a few salient items that should be recorded with accuracy for a useful dental image:

- Distinction between healthy and diseased tissue, especially pathological changes
- Attached gingivae, showing degree of stippling (texture) for assessing certain dental biotypes
- Transition between keratinised and non-keratinised oral mucosa for assessing width of keratinised tissue (attached gingivae, free gingival margin, gingival groves, clefts, scarring)

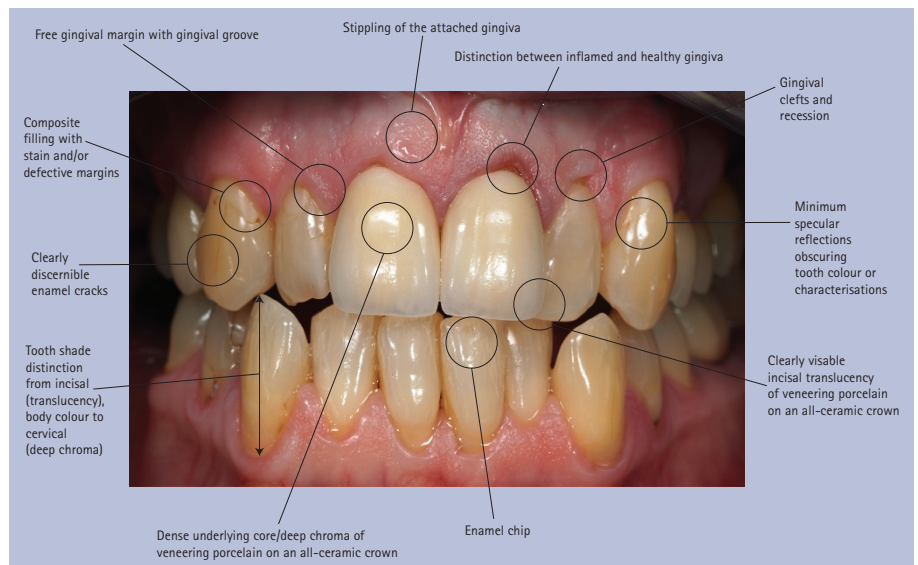


Fig. 5 An intra-oral view showing salient features that should be recorded and discernible on a dental image

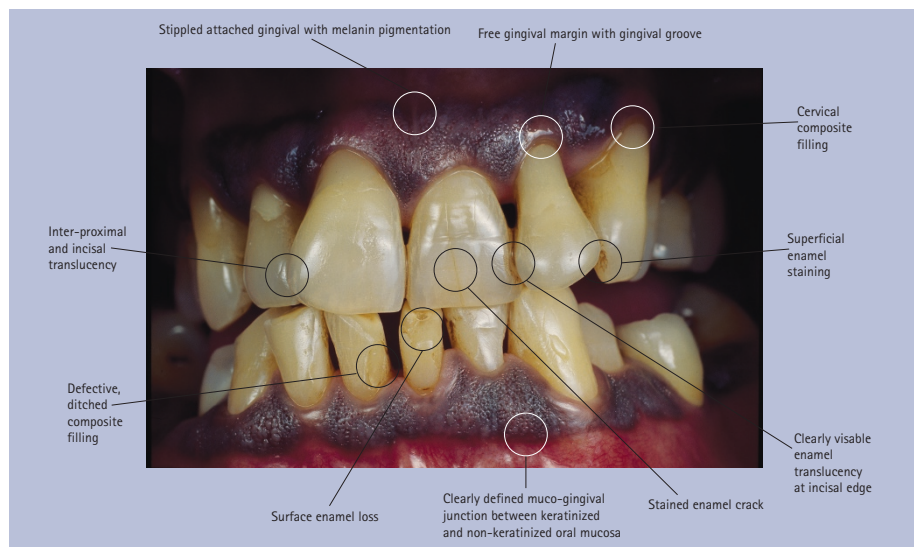


Fig. 6 A second intra-oral view showing salient features that should be recorded and discernible on a dental image

- Shade transition of teeth traversing from cervical/body/incisal edges
- Enamel characterisations, lobes, mottling, stains, chips, texture, hypoplasia, cracks, fractures and perikymata
- Incisal, interproximal translucency and mamelons
- Attrition, abrasion, erosion, abfraction lesions
- Hypo-calcification, fluorosis, tetracycline stains
- Cervical dentine exposure, stains
- Defective restorative margins
- Secondary caries, restorative material wear, chips and staining.

Off course it is impossible to show all the above features in a single picture, but

throughout the remaining chapters, all these features will be demonstrated with numerous images. However, to highlight some of the above features, Figures 5–8 show some of the items that should be clearly discernible.

RESUME OF THE SERIES

The following list shows the contents of the subsequent chapters in this series.

Chapter 2

Digital dental photography: purpose and uses.

- Dento-legal documentation
- Communication
- Portfolios
- Marketing.

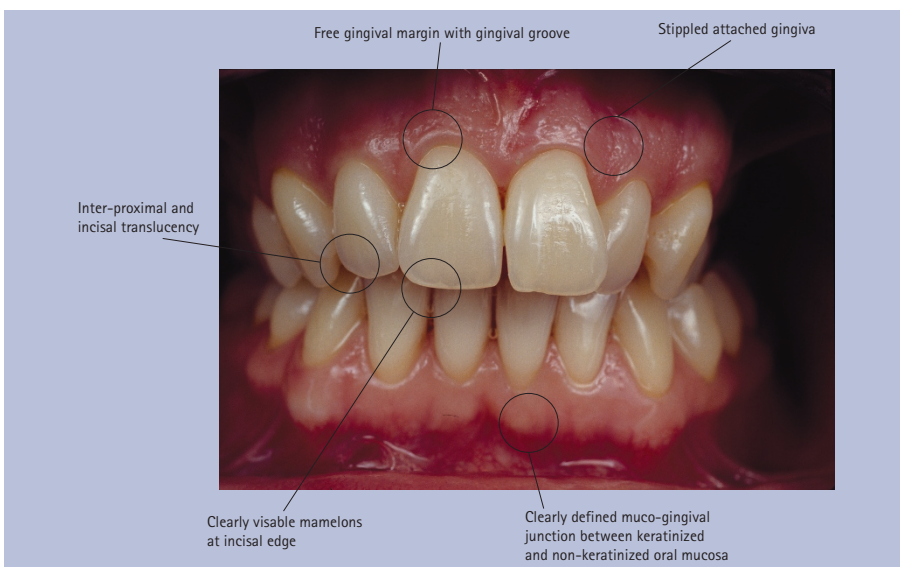


Fig. 7 A third intra-oral view showing salient features that should be recorded and discernible on a dental image

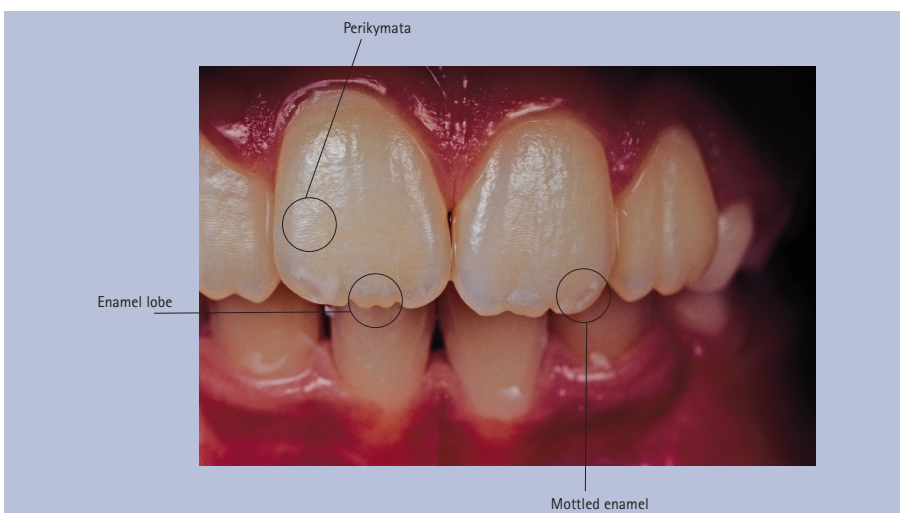


Fig. 8 A fourth intra-oral view showing salient features that should be recorded and discernible on a dental image

Chapter 3

Principles of digital photography.

- The sensors
- Technical aspects of digital photography.

Chapter 4

Choosing a camera and accessories.

- Digital single lens reflex
- Image quality
- Photographic accessories
- Dental armamentarium.

Chapter 5

Lighting.

- Characteristics of light
- Types of lighting for dental use
- Electronic flashes for dental applications
- Manipulating light.

Chapter 6

Camera settings.

- Depth of field
- Exposure
- Colour spaces
- Synopsis of camera settings.

Chapter 7

Extra-oral set-ups.

- Portraiture
- Dental laboratory set-ups.

Chapter 8

Intra-oral set-ups.

- Cross-infection control
- General guidelines
- Full arch
- Quadrants
- Magnification views
- Oral mucosa
- Texture, dentine layer, enamel cracks
- Translucency
- Shade analysis
- Posterior teeth.

Chapter 9

Post-image capture processing.

- Initial processing
- Correcting orientation, exposure, laterally inverting and cropping
- File formats
- Scaling
- Image storage and transfer.

Chapter 10

Printing, publishing and presentations.