

# Shrink Your Dental Camera: Introduction of Mirrorless Camera System for Dental Photography



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## Abstract

The use of digital photography is an inseparable part of modern dentistry. With so many cameras to choose from, this study aims to compare available cameras in the Iranian market by comparing them with their type: digital single lens reflex (DSLR) and mirrorless. After comparing the models in different aspects such as size and weight, Focus and lens support, Videography, user-friendly, lens and accessories, focus peaking, Magnify and MF assist, Live view display Effect, and Inside body image stabilization. the use of higher-quality bodies in mirrorless models, resulting in increased weight for improved internal image stabilization. Additionally, cropped-sensor cameras are deemed more suitable for dental photography. They offer advantages such as reduced weight and size, enhanced effective focal length, and superior depth of field results with equivalent apertures, making them a favorable choice for dentists seeking an affordable, user-friendly camera option.

**Keywords:** Dental photography; Photography; Restorative Dentistry; Dental Technology; Mirrorless Camera)

**Abbreviations:** MF: Manual focus assist; IBIS: Inside Body Image Stabilization; DSLR: digital single lens reflex

## Introduction

Photography has long been an essential component in dentistry, with its origins tracing back to the era when film photography was primarily utilized for documentation and referral purposes, a practice that has since transitioned to digital photography [1]. In contemporary dentistry, digital single-lens reflex cameras have become favorites [2]. Photography serves as an easily accessible and straightforward tool that, when mastered, allows dentists to perform esthetic dentistry at the highest and most predictable level. However, like other facets of dentistry, proficiency in photography necessitates consistent practice to attain confidence and skill that consistently ensures excellent outcomes. Notably, photography plays an important role in enabling patients to identify and select dental practices; its absence would significantly impede the practice of esthetic dentistry [2]. Since 2013 since the introduction of newly introduced mirrorless cameras, these models are becoming more and more popular and widespread due to many advantages over DSLR cameras [3]. The mirrorless

cameras have numerous advantages over traditional DSLR cameras which we've been using for almost the past two decades. If we compare the structure of old analog cameras (like Yashica dental eye) (Figure 1) with DSLR cameras, the only difference is the recording medium. In analog cameras, the recording medium is a film and in DSLR cameras is a digital sensor. DSLR cameras' other parts and mechanisms are almost unchanged [4]. In the past seven years with the introduction of mirrorless cameras, very useful and effective innovations were brought into digital cameras which will deeply change how we use cameras in general and also in our professional usage. These innovations and new features can be very helpful in dental photography which we address in this article.

## What is a Mirrorless Camera?

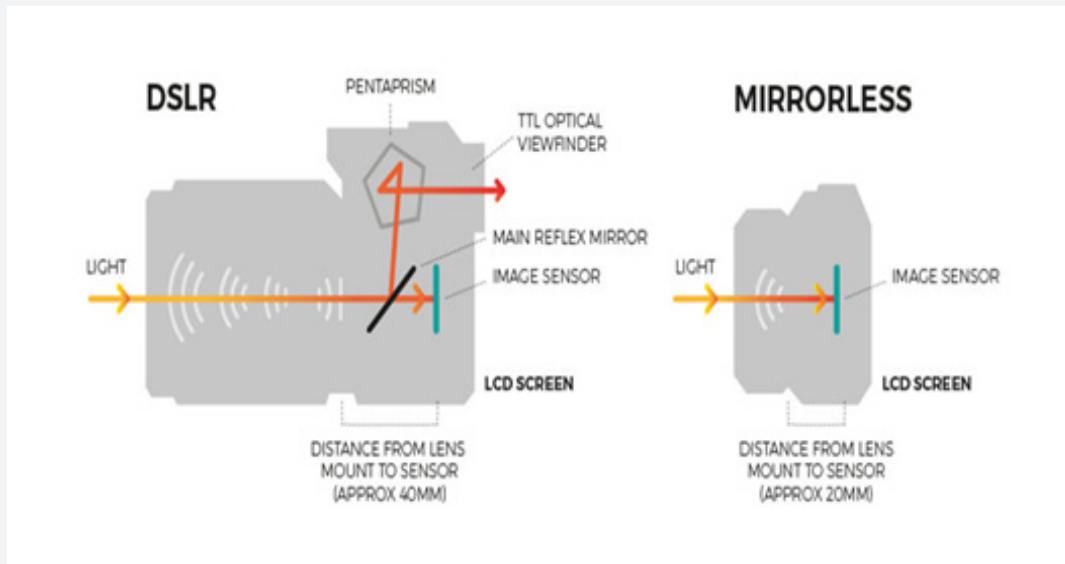
Traditional DSLR cameras have a complex mechanical system with a moving mirror to provide an optical viewfinder. To make

this possible these cameras have so many fragile moving parts which results in very big, heavy, slow, and not very useful big monitors which photographers rarely use for taking pictures. In mirrorless cameras, whole moving parts and mirrors are removed and instead of an optical viewfinder, they use a small HD monitor. This mechanical difference from DSLRs makes a big change and

as a result, these cameras are relatively smaller, lighter, and faster and the big monitor is as useful as its viewfinder (Figure 2). We compare these systems from different aspects, size, and weight, new features in mirrorless systems, camera and lens prices, different lens support, videography and viewfinder, and user-friendly usage.



**Figure 1:** Yashica dental eye. An especially designed camera with an attached lens with an integrated ring flash for intra-oral photography.



**Figure 2:** Simplified comparison of internal compartments of a DSLR and a mirrorless camera.

### Comparison

#### Size and Weight

If we look inside a mirrorless camera, we see little mechanical parts, and all moving components of a DSLR are gone, this change allows the manufacturer to reduce the size and weight by close to half. We should mention that some Mirrorless bodies have no viewfinder which results in less camera weight. When using mirrorless cameras for dental photography viewfinder isn't a must, because all you have in your viewfinder you also have in your monitor and we believe that's another very useful feature in using mirrorless cameras in dental photography; removing the part that's not necessary in our work which results in less weight and more user-friendly setup. In most cases, we use one hand to

take intraoral photos, so less weight, and size are very important features in long-term usage. We compared same-level cameras for size and weight: Canon 80D weighs 730gr and Canon EOS M50 with the same sensor weights 390gr. (46% less) (Figure 3) Canon 7D weighs 860gr and Canon EOS M with the same image quality (dxomarks) weighs 298 gr. EOS M has no viewfinder but other models with viewfinder weigh 50gr more and that's still less than half what 7D weighs. (EOS M 65% less) (EOS M5 60% less) (Figure 4). Even when we compare two popular cameras with the same picture quality like Nikon D5500 (DSLR) with the Sony a6000 (mirrorless) which respectively weigh 480gr and 344gr (30% less) with the latter having very high built quality (Figure 5). As we see, mirrorless cameras have significantly lower weight which ranges from 40% to 80% of the weight of DSLR cameras.



**Figure 3:** Canon EOS 80D is 20% (22.7 mm) wider and 19% (17.1 mm) taller than Canon EOS M50. Canon EOS 80D is 34% (19.8 mm) thicker than Canon EOS M50. Canon EOS 80D [730 g] weighs 89% (343 grams) more than Canon EOS M50 [387 g]. Canon EOS 80D dimensions: 139x105.

#### Manual focusing and Lens support

One of the most important aspects of dental photography is the proper lens for the intended photo. In dental photography, for taking standardized photos it's always recommended to use manual setting and manual focus instead of auto. Therefore, in dental photography autofocus and automatic aperture are almost useless because we use to fix one and then start our shooting (16-22). There are three features in almost every mirrorless camera that help to have perfect and precise when using manual focus: 1. live view on a big monitor with the same response time as viewfinder 2. focus peaking 3. Manual focus assist (instant magnification). So practically we don't need expensive auto-

focusing macro lenses for dental photos but with DSLRs because of the absence of the three features mentioned above we are usually limited to expensive and big autofocus macro lenses and usually these lenses have very low variation in terms of specifications.

To explain this unique feature, we have to remember that in DSLR cameras for using manual focus we have to use the viewfinder and because it gives the user a very small view, taking a picture with the intended focus will be inaccurate and depend on chance. But mirrorless cameras by providing these three unique features using different lenses even analog lenses are very convenient. Another point of using mirrorless cameras is that you can attach almost every DSLR lens (digital and analog) to them

with the proper adapter. For example, if you have a Sony a6000, you can either use Sony lenses which are not cheap or you can use any Canon lens, any Nikon lens, and also almost every vintage lens in the market. Every brand that made their mirrorless after DSLRs provides an automated adapter to support their old lenses.

So, finding a lens for a mirrorless camera is not much of a problem. On the other hand, for DSLRs, you will have few options for macro lenses. Also, some DSLRs support old lenses with adapters but still, they are harder to use compared to mirrorless cameras.



**Figure 4:** Canon EOS 7D is 36% (39.6 mm) wider and 66% (44.2 mm) taller than Canon EOS M. Canon EOS 7D is 128% (41.2 mm) thicker than Canon EOS M. Canon EOS 7D [860 g] weights 189% (562 grams) more than Canon EOS M [298 g]. Canon EOS 7D dimensions: 148.2x110.7x73.

### Videography

In our work area, videography is not common. But for those who want to also make educational or commercial videos, Mirrorless cameras will be much better than DSLRs. They have better live view, Image stabilization (the most important thing), focus peaking, and magnification while you record your video. You can see instant exposure changes while you record, you can change the aperture, shutter speed, and ISO while you record with most of them. 30% to 50% lighter weight will result in less camera shake and fatigue. One of the main reasons people choose mirrorless cameras over DSLRs is videography superiority.

### User-Friendly Interface

Most mirrorless cameras are much easier to use compared to DSLRs. You can do all your photography and videography only with your live display and that's why many of them don't have a viewfinder. For beginners who choose cropped-sensor cameras and want an easy-to-use camera also Mirrorless cameras are best. They are cheaper, lighter, and have a simpler menu. In some of

them, you can have access to all you're setting with one button at the same time your display still works such as Olympus or Sony cameras.

### Lenze and Accessories

The next step after choosing the camera is choosing the proper lens and accessories for dental photography. As we will discuss later, our suggestion is to use cropped-sensor cameras instead of full-frame cameras for dental photography because they are lighter, cheaper, and easier to use, and more importantly, they have a wider effective focal depth of field for dental photography. As we suggest cropped sensor cameras, the proper lens would be a 50mm or 60mm lens which will have an effective focal length around 90mm or 100mm (Effective Focal length= lens focal length\* body crop factor). Using 100mm lenses made for full frame cameras on cropped sensors (eFL=160) has some disadvantages; the image will have conduction distortion, they are bigger, heavier, and more expensive and because of more focal length, we will have a narrower depth of field in the same F number. The narrower

depth of field is a big disadvantage for dental photography because we want to capture all the teeth in the dental arch from anterior to posterior.

For example, using F16 for a 50mm lens equals F22 for a 100mm lens and that will cause Diffraction which will decrease our sharpness. Here is a DOF stimulator, we see that in a 1:2 magnification ratio, which is 23.4 cm for a 50mm lens and 39cm for a 90mm lens, we have less DOP in a 90mm lens on an APS-C sensor (Figure 6): example: canon). Now we see why we should

buy a 50-60mm lens for a cropped sensor. Now we see some of the lenses on the market. Another thing we should consider is that in our work we don't need an aperture number less than 8 or 11 because of less DOF and in bigger aperture numbers, we don't see quality differences in lenses and we can use cheaper macro lenses with bigger F number that makes them lighter and cheaper and even we don't need lenses with autofocus another reason for bigger and heavier and more expensive lenses. So, any macro lens would be enough. Let's see some lenses now:



**Figure 5:** Nikon D5500 is 3% (4 mm) wider and 45% (30.1 mm) taller than Sony Alpha a6000. Nikon D5500 is 55% (24.9 mm) thicker than the Sony Alpha a6000. Nikon D5500 [470 g] weighs 37% (126 grams) more than Sony Alpha a6000 [344 g]. Nikon D5500 dimensions: 124x97x.

### Extra features

There are very useful features that can be found even on cheap mirrorless cameras and rarely on DSLRs like focus peaking, magnify and MF (manual focus assist), the live effect of changed settings, ISIB (inside body image stabilization), and silent shooting.

### Focus Peaking

Focus peaking works by detecting edges of highest contrast in your scene (and therefore most in focus) and highlighting them in a bright color (yellow, red, or green, usually of your choice). This mechanism is very similar to the contrast-detect focusing function found in many cameras and, in a way, it is. It requires the processing of the live image from the sensor in real-time and a screen on which to view it. For years SLRs and rangefinders have dominated the scene with their optical viewfinders, but with the emergence of mirrorless cameras and the use of high-quality electronic viewfinders, manufacturers have been able to

add numerous features that were not possible with the simple OVF. DSLRs can also benefit from focus peaking through the implementation of Live-View and articulating screens that permit composing and focusing but at a cost of delayed shutter reaction. It is best when we use MF and also with old lenses that can be used on Mirrorless cameras. In Dental photography most of the time we should use MF and with optical viewfinder on DSLRs it's nearly impossible to take the correct shot in the first shot. But in mirrorless cameras, we can use it either in viewfinder or live view display and sometimes it's very accurate that we don't need to magnify to test the focus area.

### Magnify and MF assist

Almost every mirrorless camera can magnify the image (not the digital zoom) with one button (3x or 5x or 7x up to 14x) and it helps to see exactly the details you want to be in focus by pressing the same button one other time it goes back to main display or by pressing the shutter button it captures the full image.

<b>Camera, film format, or circle of confusion</b> Canon 1000D, 500D, 450D, 400D, 350D, 300D	<b>Subject distance</b> 39 cm
<b>Focal length (mm)</b> 90	<b>Depth of field</b>
<b>Selected f-stop</b> f/16	<b>Near limit</b> 38.6 cm
<b>Subject distance</b> 39 cm	<b>Far limit</b> 39.4 cm
Calculate	<b>Total</b> 0.88 cm
	<b>In front of subject</b> 0.43 cm (49%)
	<b>Behind subject</b> 0.44 cm (51%)
<b>Camera, film format, or circle of confusion</b> Canon 1000D, 500D, 450D, 400D, 350D, 300D	<b>Subject distance</b> 23.4 cm
<b>Focal length (mm)</b> 50	<b>Depth of field</b>
<b>Selected f-stop</b> f/16	<b>Near limit</b> 22.9 cm
<b>Subject distance</b> 23.4 cm	<b>Far limit</b> 23.9 cm
Calculate	<b>Total</b> 1.05 cm
	<b>In front of subject</b> 0.51 cm (49%)
	<b>Behind subject</b> 0.54 cm (51%)

Figure 6: Example: Canon.

### Live view display Effect

It's the ability to see exactly what image will your camera take. It's unavailable in the optical viewfinder and not very accurate on DSLR's Display. But in mirrorless cameras, it's available both in Digital viewfinder and live view display. This feature is another big and important reason to use Mirrorless cameras for Dental Photography because in most DSLRs we have to take the shot in OVF and that's hard to use manual focus and in their Display it's not accurate also we can't have a good view in most of their Display, but in Mirrorless cameras its available on both and very easy and fast to focus and shoot especially when it's combined with focus peaking and one button fast magnify.

### Inside Body Image Stabilization (IBIS)

Manufacturers were able to fit an image stabilizer in the body of their mirrorless cameras and still have the compact form factor. We believe it's one of the reasons we should consider when buying a camera. Most lenses now have image stabilization but they have some problems; they are heavier, bigger, and more expensive and some of them use more battery and their stabilization isn't on par compared to inside camera stabilization. In Dental photography, these lenses are not optimal and may cause a handshake and they are harder to work. With this feature, we can use lighter, cheaper, and older lenses (in our case macro lenses), and also most new mirrorless even not expensive ones, have a very effective IBIS that balances the camera and also neutralizes the handshaking

therefore we will have better pictures with lower bad focused and also, we can use lower shutter speeds that leads to lower ISO and better quality.

### Camera Recommendation

Our focus is mostly on comparing crop-sensor cameras because most of the full frames have the same size and weight because mirrorlesses used better-made bodies and that caused the extra weight and also better inside image stabilization needs more weight. Also on full frames, most lenses don't have much difference from each other. Secondly, we believe that cropped-sensor cameras are better for dental photography because of less weight and size and more importantly, better effective focal length and better results with the same aperture on depth of field.

### Final Word

Using a camera for dental photography happens in almost all dentist careers, be it for legal reasons, commercial reasons, or educational reasons, Dentists take pictures before during, and after their procedure for different reasons. Choosing a good affordable camera is hard, especially in such a market filled with various options, a young new dentist might not have the knowledge to pick nor the resources to do trial and error to find the best fitting camera. The purpose of this paper was to give the unique benefits of mirrorless cameras, their affordability and user-friendly use make them one of the best choices to pick from, be it for a new dentist or an experienced one.

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