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A review on clinical digital photography

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Abstract
Technology is flattering day by day a more important method in most of clinic activities and, thus, orthodontists are increasingly adding technology to the patient's records. In this article we want to discuss the advantages and guidelines related to the use of digital photography. Photographs are an essential component of orthodontic diagnosis and treatment planning. High-quality photographs admit the clinician to evaluate both the skeletal tissues and the soft-tissue drape.

Keywords: photography, human, patient care, orthodontists, medical records

Introduction

Modern orthodontics, as a fraction of complete therapy plan, consist the whole of the patient's face. A photograph contributes important visual citation for observing growth and development that would provide the patient and the clinician with a view of the changes occurring and it is also a creditable visual material for teaching and research [1].

However, authentication of the treatment with the pre-treatment and post-treatment photographs can be deceptive if the features on one or both photographs are crooked. Clinical photographs give an access to the orthodontist for carefully observing the patient soft tissue pattern while the treatment planning phase [2].

Thus there has always been the need for photographic records for purpose of research and publication. And day by day growing importance of the need of records for medico legal purpose cannot be overemphasized [2].

Hence, this article describes in detail about the various determinants for accurate clinical photography.

The requirement of the photographs is to evaluate the:

- Extra oral feature
- Lip morphology and tonicity,
- The smile arc and smile esthetics from various angles
- The degree of the Incisal show upon smiling[2].

For desired precise reproduction, lens selection, camera position, subject distance and head position should be well determined [2].

Lens selection: A purposeful Macro lens of 105mm is attached to a DSLR camera that support better close-up photos with higher definition and better focus, and is by far the superior choice. It should be associated with the Ring Flash that remove shadows by allowing an even distribution of light during extra and intra-oral photographs, and thus the quality of the image is improved due to overall better illumination. Therefore, it is highly recommended to use a Ring Flash for orthodontic photography [1, 2] (fig 1)

Camera position: In general, 105-mm lens allow a good review of what is considered as a realistic perspective of the human face. When filming with objectives with a fixed focal length, the distance for photographing, of the objective of 105 mm photographing should be at a distance of 3 m (meter), and focus adjustment should be done by moving the camera closer or further from the subject. The perfect position for the camera is when the line of the central lens to the eyes is parallel with the horizontal plane and when the lens is centered between both eyes. Mid-face is generally used as a vertical reference when placing the camera in the anteroposterior position. In the case of some facial deformities, determination of the mid-face can be very difficult [1, 2].

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Subject distance: The reasonable distance for the subject while taking the shot is 4-5 feet. The patient should stand with their head in the Natural Head Position; with eyes looking straight into the camera lens. The patient should hold their teeth and jaw in a relaxed (Rest) position, with the lips in a relaxed position. The patient's head must not be tilted or the face rotated to either side; the shot should be taken at 90° to the facial mid-line from the front [2] (fig 2)

Head position: The patient should stand with their head in the Natural Head Position; with eyes looking straight into the camera lens. The patient should hold their teeth and jaw in a relaxed (Rest) position; with the lips in a relaxed position Natural head position is a standardized and reproducible position, of the head in an upright posture, the eyes focused on a point in the distance at eye level, which implies that the visual axis is horizontal [3]. (fig 2)

Guidelines
Abo Guidelines for Ideal Photographs [4] (Fig 3)
Frontal Photo
Patient simply turns to face the camera
- Eyes are open and looking into camera
- Ears exposed
- No distracting eyewear or jewelry
- Inter-pupillary line horizontal to the frame
- Approximate center of frame is the tip of the nose

Profile Photo
Teeth in Occlusion
- Lips relaxed and in contact
- Natural head position with eyes looking forward
- Entire head and neck displayed
- Left eyelash slightly visible
- Approximate center of frame is 1.0 cm anterior to tragus
- White, or light, background

Smiling Photo
Use the same format as the non-smiling frontal photograph adding a natural smile (social smile)

Interarch Photo
Occlusal plane should be horizontal and bisecting the photograph
- There should be equal display of the posterior dentition
- Teeth in occlusion

Lateral Photo
- Anteriorly-should display the entire ipsilateral maxillary central incisor at minimum
- Posteriorly-include the entire first molars at minimum
- All attached gingiva should be visible
- Occlusal plane should be parallel to the frame

Occlusal Photo
Maxilla
Mid-palatal raphe centered
- Frame the entire arch with minimal lateral soft tissue displayed

Mandible
Fill the frame with the entire mandibular arch at least through the first molars

- Labial surface of the central incisors parallel to the bottom of the frame
- Midline centered in the frame

Imi (Indian Medical Illustrators) National Guidelines Orthodontic Photography [5]
Standards for Extra-Oral Photography
Standardization is the key to good clinical photography. This applies to the background, lighting, magnification and patient positioning.

Background
The background should be plain and not distracting. Black or white matt backgrounds are commended. If a white background is used, it should be levelly lit with no distracting shadows hiding the patient's facial profile.

Lighting
Lighting should be standardized. Ideally, studio lights should be used, positioned at 45° to the patient and aligned to the patient's head. To obtain 'softer' repeatable lighting, without prominent specular highlights, soft boxes or reflector umbrellas should be used

Magnification
All the extra-oral views should have the same magnification, so they form a matching set and can be repeated exactly. To accomplish consant magnification, the photographs should be taken using a lens set to a fixed focal length, switched to manual focus and turned to the predispose focusing distance. The camera is then moved backwards and forwards, until the image is in focus. If the camera has a full frame (24 x 36mm) sensor, a scale of 1:8
For cameras with a different sized sensor, a set focal length and fixed focusing distance should be chosen to give the same view as shown in these guidelines. Then' focal length should be equivalent to between 100mm and 135mm (for a full frame sensor) in order to provide sufficient subject to camera distance, to avoid deformity

Retractors and Mirrors
A range of mirrors and retractors are required to contend with the variety of dentitions, patient's age, size of mouth and shape of the lips. Mirrors are available in either stainless steel or surface coated glass. Glass mirrors are preferable for higher reflectance and are available in a wide range of shapes. A standard set of mirrors should include palatal for both adults and children.
Palatal mirrors are necessary for photographing the palate and maxillary views of the dental arch. Mirrors must be able to be autoclaved.
Retractors are most commonly plastic and come in pairs. It is important that the design ensures excellent retraction of the lips and mucosa, pulling them away from the gums and teeth, to avoid the lips obscuring the teeth. (Fig 3)

Patient positioning – for all views
Orthodontic Photography • Patients' coats and jumpers should be taken off and shirt collars turned down.
- Removable appliances should be taken out
- Glasses, all visible jewellery and body piercings should be removed.
- The patient's hair should not obscure their face or ears.
- The patient's eyes should be open.

- The patient should have suitable seating, ideally a supportive swivel chair on fixed legs.
- The patient's face and lips should be in a relaxed natural position.
- The patient's teeth should be in occlusion.
- The camera should be positioned with the lens axis horizontal, so that it is not the patient's head should not be tilted, the median plane should be patient's head should be level, with the Frankfort Plane.
- The patient should be sitting upright and looking directly ahead, in their natural.

Patient positioning – for specific views (fig 5)
Anterior Posterior
The patient should be sitting up and looking directly ahead.
The median plane of the face should be centralizing in the frame.
The lens should be focused on the outer canthus of the patient's eye.

Anterior Posterior Smiling
Ensure patient head is in the same position as for the anterior full face view. Patient should be at full smile, in order to evaluate the lip line.

Face Right and Left Lateral views
The patient should be sitting up straight and looking directly ahead of themselves.
The median plane of the face should be at 90° to the camera axis.
The patient's ear and tip of their nose should be included in the frame.
The lens should be focused on the outer canthus of the patient's eye.

Face Right and Left Oblique views
- The patient should be sitting up and straight and looking directly ahead of themselves
- The median plane of the face should be at 45° to the camera axis. To achieve this, the outer canthus of the patient's eye, which is furthest from the camera, should be just out of view.
- The patient's ear and tip of their nose should be contained in the frame.
- The lens should be focused on the outer canthus of the patient's eye which is nearest to the camera.
- The 'Frankfort Plane' or 'Reid Horizontal Plane' can be used as a adviser to acquire an precise lining up for standardized facial views. Since both planes are parallel, either may be used for correct adjustment.

Standards for Intra Oral Photography
General
- The camera and flash should be held with two hands, in order to provide stability which allows good adjustment for close up photography. One hand should grip the camera body and the other should support the lens, by holding the ring flash.
- Conclude whether removable appliances should be removed or if they should remain in place.
- Make sure there is no impression material or food stuck to the teeth.

Alignment
- Ideally the patient should be photographed throughout in a dental chair. The chair should be raised to enable the photographer to perform easily, without having to reach or bend uncomfortably, to obtain the correct viewpoint.
- For the anterior, left and right buccal, upper occlusal and overjet views, it is easier to obtain consistent views if the patient's head is kept level, with the Frankfort plane horizontal.

Use of Retractors
- For good retraction use the largest retractors with which the patient can comfortably contend. If the retractors are too small, the lips can come together in the midline.
- To help the retractors slide easily against the patient's lips, either wet the retractors, by running under cold water, or ask the patient to lick their lips.
- Take care when inserting retractors, be aware of appliances, wires and elastics.
- For the anterior and buccal views, place the retractors on the lower lip first and then rotate them until their handles are horizontal.
- Make sure the retractor is holding the lip securely, so that the lips can be pulled forward away from the teeth. (fig 4)

Use of mirrors
- Ensure the patient removes any elastic before taking occlusal views.
- Warn the patient that the mirror is made of glass and that they should not bite it! Remind them they must keep their mouth open wide.
- The largest mirror that the patient can comfortably accommodate should be used. This helps to push the buccal mucosa away from the teeth.
- Gently heat the mirror by holding it under warm running water and then dry it carefully with a soft cloth or tissue. Warming the mirror will prevent it from steaming up when it is placed in the patient's mouth.
- To place the mirror in the patient's mouth, ask the patient to open wide, angle the mirror slightly to the horizontal and feed one corner in first, pushing this against the inside of the cheek, then straighten the mirror to feed in the other corner. Then turn the mirror so that it is horizontal and slide it slowly towards the back of the patient's mouth. Take extra care if the patient has a gagging reflex, it may help to ask the patient to breathe slowly through their nose (fig 4).

Problems with saliva
- Ask the patient to swallow before each view, especially for the lower occlusal view.
- Ensure the patient's tongue is not pushing against their teeth.
- If there is still excess saliva and bubbles, dry the area to be photographed with a cotton wool roll, a folded tissue or an air gun.

The Anterior View (fig 5)
A scale of 1:2 should be used if the camera has a full frame sensor.

- Place retractors around the lips, assure they are holding the lips securely.
- Pull the retractors forward, towards the camera and out to the side.
- Keep both retractors in a straight line, which is at 90° to the patient's midline.
- Ensure that the lips do not conceal the teeth or gums.
- The teeth should be in occlusion, with the patient gently biting together on their back teeth.
- The patient's centre-line should be in the centre of the photograph.
- Keep the occlusal plane horizontal and in the middle of the frame; it should appear as a straight line all the way across the picture, from the left to the right molars.
- Keep the lens axis in line with the occlusal plane, so that the camera is not looking up or down at the teeth.
- Focus on the second incisors.
- The centre-line should equally divide the image horizontally.

The Right and Left Buccal Views (fig 5)
- A scale of 1:2 should be used if the camera has a full frame sensor.
- One retractor should be in a central position.
- The other retractor should be pulled back towards the patient's ear and slightly away from their cheek. This should lift the buccal mucosa away from the molars.
- With some patients, it can help retraction if a smaller retractor is used at the side and a larger retractor is used in the central position.
- Aim to show from the central incisor to the 2nd molar and if possible, to the 3rd molar.
- Focus on the first premolar tooth.
- The camera should be positioned at 45° to the patient's midline.
- Keep the occlusal plane horizontal and in the middle of the frame; it should appear as a straight line all the way across the picture, from the central incisors to the molars.
- Keep the lens axis in line with the occlusal plane so that the camera in not looking up or down at the teeth.

The Upper Occlusal View (fig 5)
- A scale of 1:2 or 1:2.5 should be used, if the camera has a full frame sensor.
- Place one retractor over the upper lip and pull forward and upwards, away from the anterior teeth.
- If the patient has a large mouth and/or very fleshy lips, it may be necessary to use two retractors to hold the top lip away from the teeth
- Place the mirror into the mouth, far enough back so that the molars can be seen.
- The mirror should be angled downwards, at 45° to the occlusal plane, with the lens axis of the camera at an angle of 45° to the mirror, in order to obtain a view that appears to be taken from 90° to the occlusal plane.
- The image from the camera should be rotated through 180° and flipped horizontally in order to provide a true image.

The Lower Occlusal View (fig 5)
- A scale of 1:2 or 1:2.5 should be used, if the camera has a full frame sensor.

- Place retractor over the lower lip and pull forward and downwards away from the lower anterior teeth.
- If the patient has a large mouth and/or very fleshy lips, it may be necessary to use two retractors to hold the lower lip away from the teeth.
- The patient should be asked to tilt their head up, or to 'look at the ceiling'. This enables the camera to be kept level rather than the photographer having to get down low and take the photograph looking up into the mirror.
- Place the mirror into the mouth, going far enough back to include the lower molars.
- The mirror should be angled upwards, at 45° to the occlusal plane, with the lens axis of the camera at an angle of 45° to the mirror, in order to obtain a view that appears to be taken from 90° to the occlusal plane.
- Ask the patient to take their tongue down to the back of their mouth.
- The image from the camera should be rotated through 180° and flipped horizontally in order to provide a true image.

The Overjet View
- A scale of 1:1.5 should be used, if the camera has a full frame sensor.
- Place the retractors around the lips; ensure they are holding the lips securely.
- Pull the retractors back towards the patient's ears.
- Ensure that the lips do not obscure the teeth or gums.
- The teeth should be in occlusion, with the patient gently biting together on their back teeth.
- You may want to hold a sheet of white card, next to the patient's face, to act as a background.
- If the flash lights can be controlled independently, turn off the left hand side in order to provide more directional lighting and to prevent a shadow being thrown onto the background.
- Keep the occlusal plane horizontal, across the picture.
- Keep the lens axis in line with the occlusal plane, so that the camera is not looking up or down at the teeth.
- Focus on the second incisor. (fig 7)

The Close up Smile View
- A scale of 1:2 should be used, if the camera has a full frame sensor.
- The patient should be at full smile, in order to assess the lip line.
- The occlusal plane should be horizontal.
- Keep the lens axis in line with the occlusal plane, so that the camera is not looking up or down at the patient's mouth.
- Focus on the second incisors. (fig 7)

Conclusion
Photographs in standard sizes in standard positions of the head allow additional measurement of the craniofacial complex and with uniformity of medical photography that they become a valuable augment to clinical charts/records[1]. In photography, the clinician should be clear with the basic fundamentals and should know how to apply them in a given situation. Good quality accurate clinical photographs can easily be obtained using the correct equipment and appropriately trained staff [6].

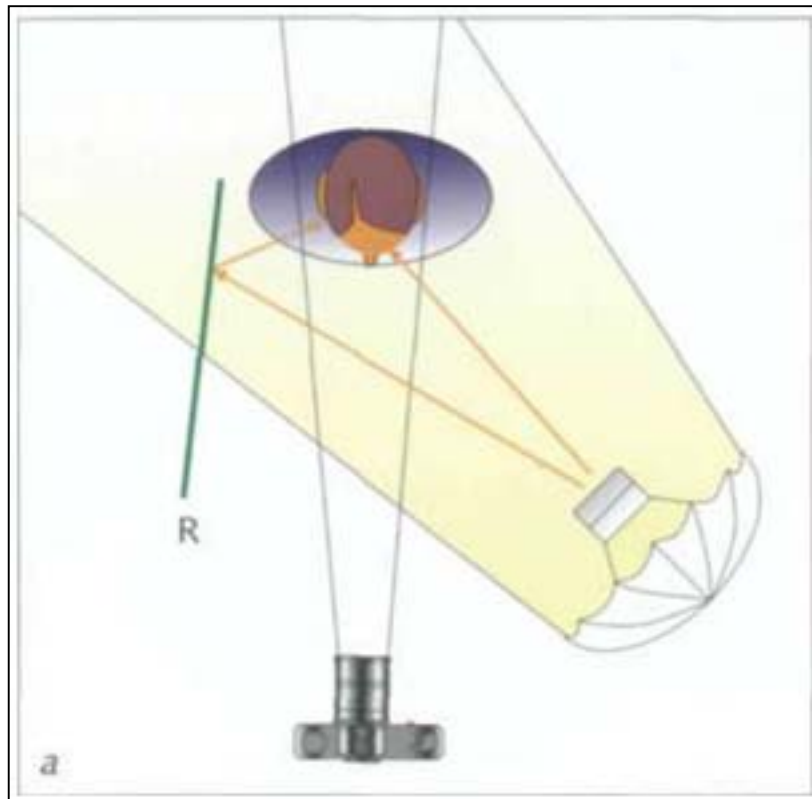**Fig 1:** lens selection and fixed zoom cameras[2]

Fig 2: camera and subject position.

Fig 3: All the photographs according to ABO Guidelines.
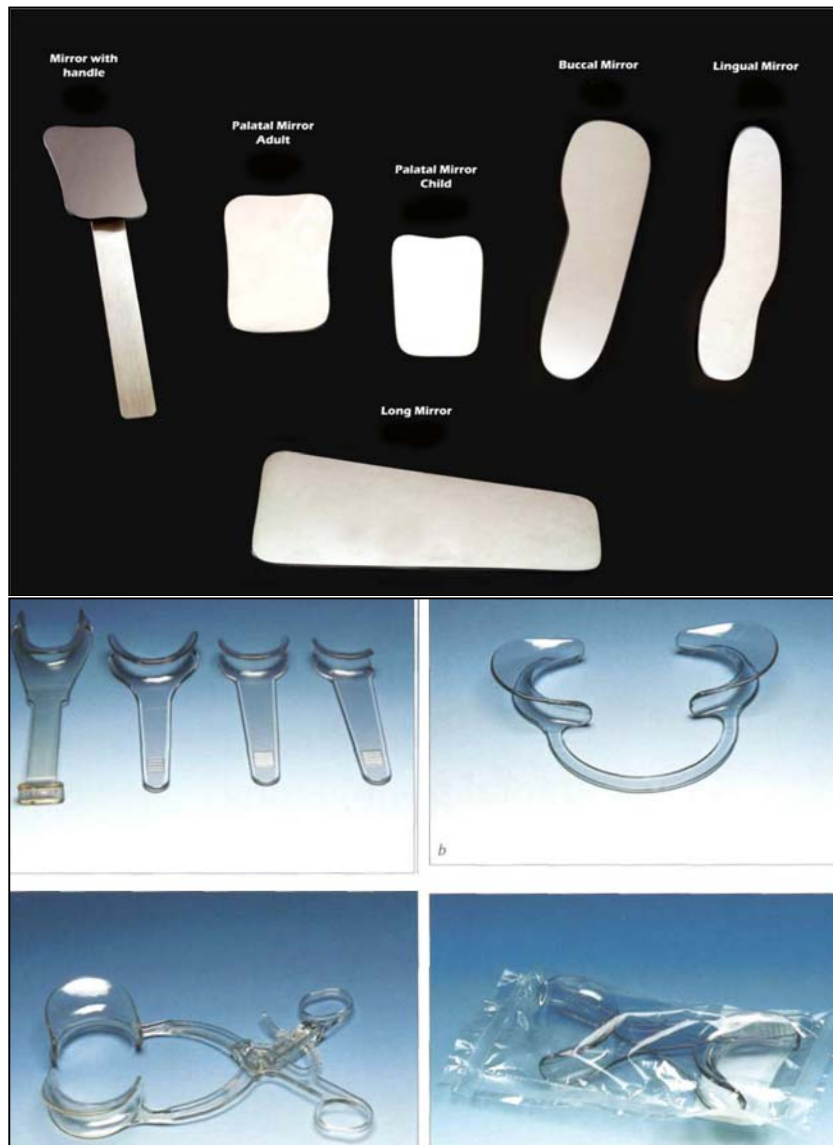

Fig 4: types of mirrors and retractors used in photography.

Fig 5: All standardized photographs to be taken as per IMI guidelines.

Fig 6: optional extraoral photographs.

Fig 7: optional intraoral photographs.

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