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RESEARCH ARTICLE

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STATIC AND DYNAMIC PHOTOGRAPHY PROTOCOL IN THE ANALYSIS OF FACIAL ESTHETICS USING THE METRIC PENDULUM

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ABSTRACT

Introduction: Photographic records are of utmost importance in the field of “facial esthetics”. The lack of a photographic standardization hinders the quality of imaging records and renders the validation of procedures and products impossible. Moreover, no simple device, much like that used in cephalometric radiography, has been established to resize the photographic image in such a way as to enable and develop facial-esthetic cephalometric traces in frontal and lateral incidences. **Aim:** This study sought to develop a protocol for standardized photographic documentation that is able to represent and reproduce static and dynamic incidences with the aid of a metric pendulum. **Methods:** The present study developed a metric pendulum for reproducibility and the standardization of facial photographs, as well as a protocol to obtain photographic images considering environmental parameters, photographic parameters, static and dynamic photographic incidences, and the positioning of the patient’s body and head. For the correct positioning of the patient’s head, the metric pendulum was used, which allows one to determine the true vertical, in addition to ensuring safety in the reproducibility of the photographic images with proper resizing. **Conclusions and Relevance:** A photographic protocol allows for a greater assertiveness and efficiency in the diagnosis, planning, and evaluation of results. Such a protocol was possible due to the use of a pendulum, which allows for an intra-individual and inter-individual longitudinal evaluation of patients, as well as for prospective and retrospective comparative studies.

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INTRODUCTION

The value of photography for a professional who works with facial esthetics is inestimable. To this day, there is still no reproducible method which faithfully portrays the reality of one’s face at different moments in the treatment process. A standardized and objective photographic documentation can be justified to better evaluate the patient’s face, and thus plan the procedure with more specific criteria and in a more detailed manner (Rhee, 2017 and Beckeu, 1999). For numerical analyses of facial distances and for their correlation with beauty and facial harmony, considering cephalometric points, the two or three-dimensional photographic standardization is necessary (Bonomi, 2012). To achieve a faithful analysis of the photograph, it is important for the photo to be resized on a scale that is proportional to the real size of the object (Bartley, 2012; Sandler et al., 2012 and Plooij et al., 2011). In facial esthetics, there are no well-defined norms for the publication or demonstration of results, with these

being subject to diverse forms of bias, which often fail to demonstrate the effects of techniques and applied products (Sommer et al., 2004 and Parker et al., 2007). Other health areas count on well-defined norms for the recording of images, In orthodontics, for example, the American Board of Orthodontics (ABO), which grants the title of specialist to orthodontists, demands the proper photographic documentation of the clinical cases, according to well-defined norms that are respected by these professionals. To obtain an appropriate standardization of facial photographic documentation in esthetic procedures, it is necessary to implement a systematization of conduct to be adopted. However, care with the positioning of the patient’s head constitutes the biggest challenge for the professional taking the photos, due to the need for constant attention to detail regarding the positioning for the photographing of each incidence (Sommer, 2004 and Rowe et al., 2013). Considering this challenge and the establishment of a reproducible protocol, a metric pendulum was created to reproduce and standardize the facial photographs, which

have the core function of determining a true vertical to aid in the positioning of the patient's head, in addition to the proportioning of a true resizing in a software that measures facial cephalometrics. It is imperative that a standard be established for the action of taking photographs, which, in the end, should allow the photos to reflect the same conditions at the different moments in which they are taken. The analysis of the results must be neutral and exempt of camouflage or any artifices that can deviate from reality.

METHODS

This section will elaborate on the main parameters for the formulation of a photographic documentation in facial esthetics.

Environmental parameters: The specific lighting of the photographic recording room in this study was set up using continuous indirect light, by means of two tripod light fixtures, positioned laterally to the camera, with an angulation of 45° in relation to the patient, forming a virtual triangle with the object to be photographed.¹⁰ The lamps should be staggered very slightly in the vertical and horizontal plane to avoid flooding of a dual flash (Figure 1). The back of the room must be uniform and dull. The color blue is recommended by the Clinical Photography Committee of the Plastic Surgery Educational Foundation. This color provides an optimum contrast for all skin colorations. This tone of blue is pleasing to one's eyes and allows for a broader field depth with less shadows. One should also consider a distance between the patient and the background of 30 to 45 cm in order to avoid shadows (Swamy, 2010). The camera must be positioned one meter away from the patient, changing the height according to the patient's face, using the eyes as the recommended height. It is important to note that the camera must be centered on the patient's face (Sommer, 2004 and Shah et al., 2005).

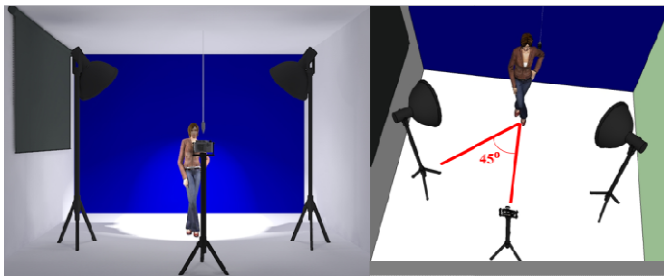


Figure 1. Environmental lighting, with the use of indirect and continuous light, using two tripod light fixtures, positioned laterally to the camera, with a 45° angulation in relation to the patient. The color blue represented here is merely illustrative.

Photographic parameters: The face should be in the center of the photographic field, with symmetric margins surrounding the picture. Adornments, such as necklaces and earrings, should be removed. The hair must be pulled back and the ears exposed. Make-up must be completely removed. For the standardization of the images concerning the exhibition of anatomical structures, the professional should perform an anatomical framing with the aid of an optical zoom. The vertex of the patient's head and the sternal furculum are easily identifiable anatomical points and should thus be considered optimum references for the upper and lower limits of the full face, in both the frontal and oblique incidences. In the profile incidences, as the sternal furculum is not visible, one should consider the top of the collarbone as the lower limit (DiBernardo et al., 1998). We recommend that the patient be standing. The oblique incidences should be performed with the patient positioned at 45° , and for profile pictures, with the patient positioned at 90° . Not only should the body be positioned at 45° and 90° , but the head must also be in perfect alignment with the body.

In static incidences, some parameters should also be considered, for example: the position of the patient's body, the alignment of the head with the body, the relaxing of the facial and cervical muscles, the position of the head (flexion, extension, rotation, and lateralization of

the head), position of the neck, opening of the eyelid slots, position of the mandible, lip seal, and dental occlusion. Here, the metric pendulum becomes important. To standardize the position of the head, avoiding positions of lateralization and rotation, one should use a virtual vertical line that passes through the head's median plane and must be parallel to the true vertical plane, obtained with the metric pendulum fixed to the ceiling. It is important to note that, regardless of the ground leveling, what acts is gravity, making the pendulum always shows its true vertical. The line of the pendulum must be positioned beside the patient's head, with the base of the pendulum aligned with the tragus, aimed at correctly positioning the head and providing a proper resizing in the software to measure facial cephalometrics, offering standardized distances to compare the results. The metric pendulum is constructed in stainless steel, with 7 cm in length and 2 cm in diameter. It presents 3 armholes of 0.5 cm each, in its center (body), which can be used as a reference for facial measurements (Figure 2).

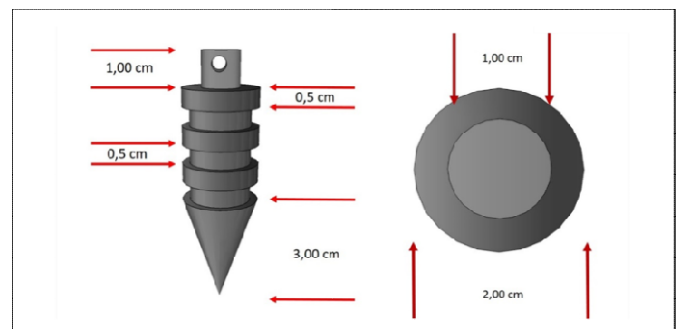


Figure 2. Metric Pendulum and its dimensions

To neutralize the movements of the flexion and extension of the head, we recommend maintaining the horizontal Frankfurt plane perpendicular to the vertical line obtained with the pendulum. In the oblique profile incidences, the horizontal line of the grading in the camera's display aids in positioning the Frankfurt plane horizontally. The photographs must be taken with the patient's head in a natural position, the shoulder muscles relaxed, looking into the camera lens in the frontal position or looking to specific marks on the walls, in oblique and profile positions. The eyes should be kept open but with the opening and closure musculature of the palpebral opening relaxed, looking to the camera lens in the frontal position or looking to the specific marks on the walls in the oblique and profile positions. An equal relaxation of the facial muscles is requested of the patient in static photographs. The patients should be advised not to protrude or retract the spine. The patients should be advised not to make random movements of the mandible, such as protrusion or retraction. It should be requested that the patient keep his/her teeth in maximum intercuspitation, with no contraction of the masticatory muscles and no muscle force in the lip seal.

Incidences

Different incidences are necessary and the analysis should be done statically and dynamically (movement), since minimally invasive procedures produce different effects with and without facial mimicry.

Static incidences

- 1- **Anterior:** Patient standing with erect spine and feet aligned with his/her shoulders at 0° with the camera, staring at the horizon line. The metric pendulum is located laterally to the face. The frontal photograph enables an overall view of the proportions between the facial elements, as well as a subjective, two-dimensional analysis, considering the vertical and horizontal distances. This is the first photograph taken and serves as the overall parameter for the analysis of the results. In addition, it allows one to specifically evaluate the widening of the chin line and possible distortions of the shape of the lower portion of the face.

- 2- **Right and left profile:** Patient standing with erect spine and feet aligned with the shoulders at 90° with the camera, staring at the horizon line. The metric pendulum is placed anterior to the face. It is possible to evaluate the main promontories of the facial profile, such as the projection of the chin, nose, and mouth, and even relate them to the projection of the forehead, glabella, and nasal root.
- 3- **Left and right anterior oblique:** Patient standing with erect spine and feet aligned with the shoulders at 45° with the camera. The half-profile images allow one to evaluate the degree of the projection of the malar region and of the contour of the cheeks, as well as establish the relationship between them, in an analysis of an important esthetic parameter: *the ogee curve*. Allows one to evaluate the degree of flaccidity of the skin near the modiolus, sagging of the jaw, and alterations in the mandibular contour, as well as facilitates the evaluation of the position of the sides of the upper eyebrows and eyelids.
- 4- **Anterior in Extension:** Patient standing with erect spine and feet aligned with the shoulders at 0° with the camera, with the base of the mandible perpendicular to the vertical line of the metric pendulum. The axial incidence is used to evaluate the lower portion of the nose, the nasal base, and the alar outline. In addition, using the axial incidence, it is possible to evaluate the best projection of the medial malar region and the latero-lateral asymmetries.
- 5- **Anterior in Half Flexion:** Patient standing with erect spine and feet aligned with the shoulders at 0° with the camera, with the orbitalmeatal line (OML) perpendicular to the vertical line of the metric pendulum. The anteroinferior sloped incidence in the sagittal plane shows the flaccidity of the face, which accumulates around the mouth, on the mandible, and in the submental region. It is an important incidence to evaluate the outcome of treatments for flaccidity and view the effect of lifting procedures.
- 6- **Right Anterior Oblique And left in Half Flexion:** Patient standing with erect spine and feet aligned with the shoulders at 0° with the camera, with the OML perpendicular to the vertical line of the metric pendulum. This allows one to evaluate the facial flaccidity, with emphasis on the change in the mandibular contour.

Dynamic incidences: In the analysis of the face, initially the same basic static incidences are requested with the patient smiling (full smile, not forced). To conduct these incidences, the positioning will be the same as items 1 to 3, as described above.

1. **Anterior in full smile:** one should observe the effects of the smile regarding its esthetics in general, the degree of exhibition of the teeth, the line of the smile, the presence of other esthetic changes in the smile, the degree of closure of the eyelid slot when smiling, and the widening of the nasal base.
2. **Right and left profile in full smile:** one can evaluate the possible gingival exposure lateral to the canines, the possible drop in the nasal point (indicating a depressor muscle of the strong nasal septum), and the position of the chin when smiling.
3. **Right and left anterior oblique in full smile:** one can observe the dynamic of the fat compartments of the cheeks. These, when retracted by a transversal facial septum tensioned by the smile, and limited supero-laterally by the orbicular and zygomatic ligaments, can present a volumetric accumulation in the oblique view. Such an alteration can indicate a non-esthetic to dynamic alteration, contraindicating fillings in this region.

For a specific analysis of the effects of the botulinum toxin, we suggest the following facial expressions and dynamic contractions. It is important to highlight that the positioning of the patient is always anterior, as mentioned above.

4. **Anger:** Contraction of the corrugator, procerus, and depressor muscles of the eyebrows, causing dynamic wrinkles in the region between the eyebrows.

5. **Surprise:** Contraction of the frontal muscle causes transversal wrinkling of the forehead.
6. **Forced Smile:** Contraction of the orbicular muscle of the eyes, showing the wrinkles in "crow feet".
7. **Upset:** Contraction of the depressor muscle of the oral angle to evaluate the action of this muscle retracted to the lateral side of the mouth downwards.
8. **Contraction of the platysma muscle:** Allows one to evaluate the formation of the platysmal bands and repercussion of its contraction on the angle of the mouth.
9. **Appearance of bunny lines:** Action of the Elevator of the Upper Lip and Nasal Wing muscle and its repercussion on the wrinkling of the lateral region of the nose.
10. **Contraction of the orbicular muscle of the mouth:** Allows one to evaluate the centripetal contraction of this muscle and its repercussion on the formation of perioral wrinkles or "smoker lines".

RESULTS

Figure 3 shows the results of the static incidences; Figure 4 shows the results of the dynamic incidences in the full smile; and Figure 5 shows the dynamic incidences with facial expressions.



Figure 3. Static incidences: (A) anterior, (B) left profile, (C) right profile, (D) anterior in extension, (E) left anterior oblique, (F) right anterior oblique, (G) anterior in half flexion, (H) left anterior oblique in half flexion, (I) right anterior oblique in half flexion

All of these images used the metric pendulum to determine the standardizations and to make real photographic resizing possible (1:1), following the protocol of the proper positioning of the patient's body and head.

DISCUSSION

The facial movements were not previously contemplated, as is necessary today, to evaluate the important details related to myomodulation, to the transversal facial septum, to the herniation of the infraorbital bags, and to the wrinkles related to the many facial expressions (DiBernardo, 1998). Today, there are modern concepts in

photographic documentation about facial esthetics, but there are also no specific parameters for the face, which would encompass the majority of the objective analyses of results of esthetic procedures, in addition to the lack of a standard for incidences in the static state and in movement. Moreover, no international norm has been established for medical communities and societies (Rhee, 2017).



Figure 4. Dynamic incidences with full smile: (A) anterior in full smile, (B) right profile in full smile, (C) right anterior oblique in full smile.

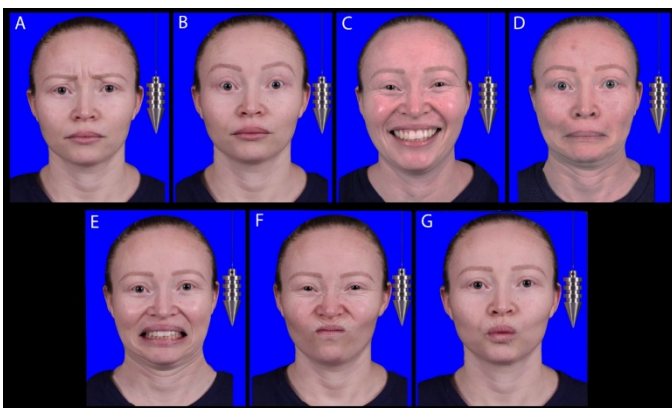


Figure 5. Dynamic incidences with facial expressions: (A) anger, (B) surprise, (C) forced smile, (D) upset, (E) contraction of platysma muscle, (F) appearance of bunny lines, (G) contraction of the orbicular muscle of the mouth

The ideal lighting for clinical photography is similar to that of a photographic studio, with the aid of two electronic light sources set on tripods, set at 1 to 1.5 m from the patient, at an angle of 45°. This manner reduces or eliminates the formation of shadows in the photographic background (Yavuzer, 2001). This corroborates with the protocol described here, in which tripods were used at a 45° angle, using a blind with blackout to eliminate the oscillations of sunlight that can occur throughout the day. For the photo background color, blue was chosen here to provide an optimum contrast for all of the skin tones, corroborating with that recommended by the Clinical Photography Committee of the Plastic Surgery Educational Foundation. The photographic background can be obtained with the color of the walls, by means of plotting, fabric, or the use of a continuous blind, or even by recoloring in this blue hue, using personal software to edit the image. The distance between the patient and the photographic device is the most frequently altered parameter in the common sequences of photographs, producing distortions in the different moments in which the photographs were taken. It is an easily adjustable parameter, in which one simply needs to make marks on the floor signaling the position where the camera's tripod should be placed and where the patient's feet should be (Sommer et al., 2004 and Shah, 2005).

Once the patient's body has been placed in the different positions, minor adjustments are made to position the patient's head properly. Minor changes in the position of the head can produce biased results or even invalidate the entire technique of rejuvenation (Sommer et al., 2004). Non-standardized photos can cause different effects in the esthetic interpretation of the face. One study perceived a visible improvement in the line of the mandible and of submental fat in photos before and after of people who had not undergone esthetic procedures, but rather had only undergone minor alterations in the angulation of the head (flexion and extension of the neck in up to 5°-10°) or of the protrusion or retraction of the head in up to 2cm (Sommer, 2004). This demonstrates the importance of the standardization of the photographs with an easy and reproducible protocol, as described above. The correct positioning of the head is crucial, and to aid in this, a metric pendulum, made of stainless steel, was produced and fixed to provide a true vertical line, which must run parallel to the median plane of the patient when positioning the patient's head. In addition, the marks (armholes) of 0.5cm on the body of the pendulum provide a reference for the resizing of the images in the software in order to compare the distances after facial procedures. In the oblique incidences, although the body is aligned at 45° in relation to the camera, the patient often does not present the head aligned with the body, even with the help of marks on the walls. A more faithful approach to the oblique incidence would be the alignment of the nasal tip to the oral commissure, making it possible for a better exposure and evaluation of the facial contours (Beckeu et al., 1999). The present protocol suggests that the correct positioning of the patient's feet at 45° and of the alignment of his/her head in relation to the body, should be sufficient for the correct positioning of the head. Adjustments in the position of the head are conducted by means of the alignment of the vertical mid-sagittal plane given by the metric pendulum and by the parallelism of the Frankfurt plane.

In the profile incidence, the appropriate position for the rotation of the patient's head can be corrected by observing the proper alignment of the filter lines of the upper lips and the absence of the perception of eyelashes or eyebrows on the contralateral side.¹³ The metric pendulum is also an important aid in this case, leaving the Frankfurt plane perpendicular to the true vertical line established by the pendulum. The photographic protocol most likely allows for greater assertiveness and greater efficiency in the diagnosis, planning, and evaluation of results in the short, middle, and long terms. However, further study should be conducted to achieve a better validation of this method.

CONCLUSION

This protocol was better defined using the Metric Pendulum, which allowed for the creation of the true vertical reference for the positioning of the patient's head, an intra-individual and inter-individual evaluation of the patients with guaranteed reproducibility, as well as prospective and retrospective comparative studies, in addition to the possibility to resize the photographs on a real scale. The protocol established here is easy and reproducible, thus enabling photographs to reflect the same conditions at the different moments in which they are taken.

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Conflict of Interest statement: The authors declare that they have no conflicts of interest to disclose.

Informed consent: The patient whose image appears in the study was informed, is aware, and authorized the publication of her photograph.

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