Review Article

Photographic Analysis: Static versus Dynamic

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Abstract

Background: Photography has become an essential tool in modern orthodontics, particularly in clinical documentation and facial aesthetics. High-quality photographs, captured before, during, and after orthodontic treatment, are crucial for accurate assessment, tracking malocclusions, and documenting treatment progress. When executed properly, clinical photographs provide more valuable insights than traditional records, aiding both clinicians and patients in visualizing treatment outcomes. Digital dental photography (DDP) has revolutionized orthodontics, offering enhanced documentation, patient communication, and treatment planning. It also addresses medicolegal concerns and boosts patient motivation. Best practices in orthodontic documentation require capturing comprehensive extraoral and intraoral images to ensure precise analysis and treatment progress. Additionally, dynamic photography, including videography, allows for a deeper understanding of functional and aesthetic changes, providing new insights into jaw movements, speech, and smile dynamics. Combining static and dynamic imagery offers a holistic approach to orthodontic care, improving diagnostic accuracy, treatment planning, and patient outcomes. While digital technologies like 3D systems and specialized software have advanced the field, errors in the photography process—such as those related to technique, patient cooperation, or equipment design—require careful management to ensure high-quality results. Ultimately, leveraging both static and dynamic photography enhances comprehensive patient care by addressing structural, functional, and aesthetic concerns simultaneously.

Keywords: Digital dental photography, Photographic analysis, Static photography, Dynamic photography.

Introduction

Photography has become a vital component in modern orthodontics, particularly for clinical documentation and facial esthetics. High-quality images taken at various stages of orthodontic treatment are essential for accurately evaluating malocclusions, monitoring treatment progress, and documenting outcomes.[1] When executed correctly, clinical photographs provide deeper insights than traditional records, helping both clinicians and patients visualize treatment progress.

The advent of digital dental photography (DDP) has significantly improved orthodontic practices by enhancing documentation, facilitating patient communication, and aiding treatment planning. In addition, DDP addresses medicolegal concerns and increases patient engagement.[2] Best practices in orthodontic photography involve capturing a series of extraoral and intraoral images to ensure comprehensive analysis and tracking of treatment milestones. Dynamic photography, including videography, offers further advantages by providing a clearer understanding of functional and esthetic changes, such as jaw movements, speech, and smile dynamics.[3] The combination of static and dynamic imagery provides a more complete approach to patient care, improving diagnostic precision, treatment strategies, and overall outcomes. While technologies, such as 3-dimensional (3D) imaging and specialized software, have advanced the field, challenges related to technique, patient cooperation, and equipment design still need to be carefully addressed to ensure high-quality results. Ultimately, integrating both static and dynamic photography enhances comprehensive orthodontic care by addressing structural, functional, and esthetic factors in tandem.

This article explores the comparison between static and dynamic photography in orthodontics, highlighting the strengths and limitations of each approach. Static photography, which captures still images, is commonly used for documenting facial and dental structures at specific moments in time,

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providing detailed snapshots for diagnosis and treatment planning.[4] However, dynamic photography, including videography, offers a more comprehensive analysis by capturing movements and changes over time, such as jaw motion, smile dynamics, and facial expressions during different activities, as well as changes due to growth.[3] While static images excel in providing precise measurements and detailed comparisons, dynamic photography adds a temporal dimension, offering deeper insights into functional and esthetic aspects of orthodontic treatment.[5] The article discusses the various advantages and disadvantages of both modalities, which can help clinicians to enhance their diagnostic accuracy, treatment outcomes, and patient communication, ultimately leading to more personalized and effective orthodontic care.

Discussion

Historical context

The history of facial and smile analysis in dentistry has evolved from a purely functional focus to an approach that integrates esthetics, recognizing the relationship between dental structures, facial harmony, and emotional expression. This history reflects a gradual shift from treating oral health issues in isolation to recognizing the integral relationship between dental structures, facial esthetics, and emotional expression.

In 1947, Margolis introduced a method combining profile photographs and cephalometric radiographs to classify occlusion scientifically, laying the foundation for precise orthodontic diagnosis. His method included craniofacial skeleton analysis, dento-craniofacial orientation, and detailed occlusion classification.[6] Over time, research expanded to include esthetic considerations, such as the 2003 study by Fernandez-Riveiro *et al*., which analyzed soft tissue facial profiles in young European adults, identifying sexual differences in facial angles and highlighting variability in nasolabial and mentolabial angles using photographs.[7]

Further advancements emphasized dynamic analysis of facial esthetics and function. Ackerman *et al*. studied lip-tooth relationships during speech and smiling, emphasizing the need to evaluate anterior tooth display across different expressions.[8] Nanda *et al*. introduced 3D facial mapping, utilizing mathematical functions to generate color-coded surface deviation maps, allowing for precise orthodontic and surgical planning. This method demonstrated the potential of 3D superimposition in diagnosing and analyzing facial soft tissue changes.[9] Collectively, these studies mark the transition of facial and smile analysis from traditional static evaluation to dynamic and 3-D approaches, improving both diagnostic precision and treatment planning in dentistry.

Photographic analysis

According to Ackerman *et al*., "Photographic analysis in orthodontics serves as a critical tool for evaluating lip-tooth relationships, incisor display, and facial dynamics in a structured and reproducible manner, enabling more accurate treatment planning and assessment of esthetic and functional outcomes." In 2004, Ackerman *et al*. analyzed lip-tooth relationships in adolescents by reviewing pre-treatment video recordings of 1,242 consecutive patients with Class I skeletal and dental patterns. Their study highlighted the importance of documenting anterior tooth positioning separately during speech and a posed social smile while considering them within a dynamic context.[8] When planning orthodontic treatment for the vertical positioning of incisors, orthodontists should assess the full range of anterior tooth display, including rest position, speech, posed social smile, and Duchenne smile.

Static and dynamic photography are complementary techniques used in orthodontics to document and analyze facial and dental features, aiding in diagnosis, treatment planning, and outcome evaluation.

Static photography

It captures fixed images of patients in pre-determined poses (e.g., frontal, profile, or occlusal views). These images are used primarily for diagnostics, monitoring treatment progress, and assessing facial symmetry, dental alignment, and soft tissue relationships.[9] They provide reliable documentation and serve as a visual record of the patient's condition at various stages. Advances in digital technology have enhanced the clarity and precision of static photos, making them essential for both clinical and educational purposes.[10]

Stoner MM first proposed the use of photogrammetry in orthodontics to analyze facial photographs (Figure 1). He compared pre- and post-treatment profiles of patients with ideal profiles.[11] A simpler, cost-effective solution would be the application of photogrammetry on standardized photographs used in daily orthodontic practice, he stated. Photogrammetry may be defined as "The art, science, and technology of obtaining reliable information about physical objects through processes of recording, measuring, and interpreting photographic images."[12] Simple photogrammetric techniques objectively evaluate standardized digital extra-oral and intra-oral photographs, which could be used in treatment planning and assessment.

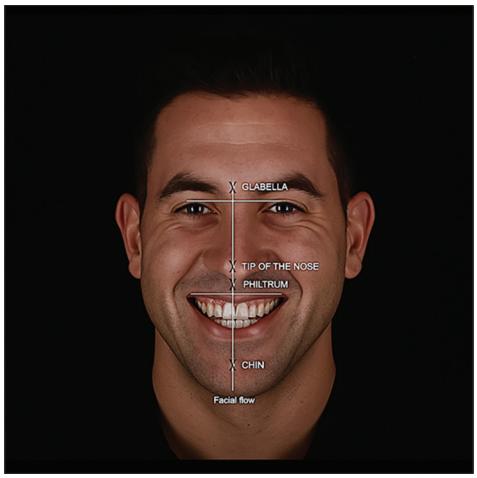

Figure 1: Facial reference lines: The interpupillary line, the commissural line, and the facial flow line

Ozdemir *et al*. established facial soft tissue norms. He measured linear anthropometric measurements of the facial soft tissue from 281 female and 149 male Turkish adults aged between 18 and 24 years using frontal photographs. The soft tissue facial profiles were digitally analyzed using linear (17 vertical and 10 horizontal) measurements made with standardized photographic records, taken in a natural head position, to determine the average soft tissue facial profile for males and females. The facial soft tissue measurements after being analyzed by using 2-dimensional (2D) digital photogrammetry and average facial soft tissue data, concluded that in most of the parameters related to cranial, facial, nasal, and orolabial areas, there was a significant gender dimorphism. The most prominent differences between the sexes were observed in the measurements taken from the face region.[13]

Arnett and Bergman described an analysis of the soft tissue facial profile on photographic records in natural head position using profile/lateral photographs. Their analyses of the symmetry, both vertical and horizontal, the contour of the smile line, the facial middle lines, and the facial contour were important. In their linear measurements, they analyzed the position of the upper and lower lips in relation to the Sn-Pg line (previously used by Burstone), the length of the upper (Sn-Ls) and lower (Li-Me) lips, the upper incisor exposure at rest (1–5 mm), and the interlabial gap. The authors defended the equality in the facial thirds Tri-G/G-Sn/Sn-Me (55–65 mm).[10]

Fernández-Riveiro *et al*. (2015) quantified average parameters that defined the soft tissue facial profile of a young adult Caucasian sample of Galicians. In this analysis, angular measurements are defined in a standardized photogrammetric technique to analyze the profile. Standardized photographs are shot. The photographic records, 35-mm slide format, are digitized and analyzed using Nemoceph®. The program is previously customized with the landmarks used in this investigation. The software can calculate all the measurements once they are identified on each landmark record after being digitized and scaled to life size. The results showed sexual differences in five of the measurements: The nasofrontal, the nasal vertical, the nasal, and the nasal dorsum angles. Another important finding was the high method error and large variability for the nasolabial and mentolabial angles.[14]

Yang *et al*. (2015) studied to explore the importance of sagittal and oblique smiling profiles (OSP) in evaluating facial esthetics. For facial esthetic evaluation, the position and inclination of maxillary incisors are essential in the sagittal smiling profile (SSP) view, whereas the dental curvature of maxillary and mandibular smile arc is important in OSP view. Photographs from patients, including front, front smiling, profile, sagittal profile smiling, and oblique profile smiling images before and after treatment, are collected and synthesized into 6 categories. Thirty judges give scores to these photographs based on their own esthetic conception with a 1-week interval for each category. He concluded that along with OSP, SSP is crucial in evaluating facial esthetics for orthodontic treatment and orthognathic surgery. They suggested it to be integrated in routine photographic assessment of facial attractiveness evaluation before and after treatment, especially in orthognathic surgery for facial esthetic evaluation.[15]

Smile analysis in orthodontics was pioneered by Ackerman and Ackerman (1998)[2] and later expanded upon by various researchers, including Sarver and Ackerman (2003).[16] They emphasized the importance of evaluating the smile dynamically, considering factors, such as lip position, gingival display, and tooth alignment. Their work laid the foundation for modern orthodontic treatment planning, integrating esthetic principles with functional considerations.

Dynamic photography

It captures functional and esthetic aspects of facial movements (such as smiling, speaking, and chewing). This technique provides deeper insights into how treatments affect real-life functions, such as speech and smile esthetics, and highlights issues, such as asymmetry or soft tissue strain. Dynamic photos help assess dynamic symmetry, which static images may miss, and are crucial for treatments that aim to improve both form and function.[16]

In 2003, Sarver and Ackerman also advocated the use of video recordings instead of static images and added a profile view to the more customary frontal view to obtain pseudo-3D) information (Figure 2).[17] Other researchers have used frontal and left and right profile video captures to acquire

Figure 2: Digital technology enables clinicians to record and evaluate anterior tooth display during speech and smiling

true 3D data. Such research material is regarded as superior in terms of amplitude of facial movement, which 2D imaging methodologies generally tend to underestimate, but technical difficulties persist.

The dynamic recording of smile and speech is accomplished with digital videography. Digital video and computer technology enable the clinician to record anterior tooth display during speech and smiling at the equivalent of 30 frames/s. 5 s of video for each patient is taken yielding 150 frames for comparison. The videos are recorded in a standardized fashion with the camera at a fixed distance from the subject. One segment of the video is taken in the frontal dimension and another segment of the video is taken from the oblique view. These clips, taken before and after treatment for all patients, allows to match frames to analyze changes in smile characteristics.[17]

Static versus dynamic photography

Together, static and dynamic photography offer a comprehensive evaluation of both the static alignment of teeth and the dynamic functionality of facial and dental systems. While static photos excel in documentation, dynamic photography reveals the real-time effects of orthodontic treatments, offering a more holistic understanding of a patient's condition.

Integration of both techniques enhances diagnostic precision, especially in complex cases, such as orthognathic surgery. Although each method has its limitations – static photography lacks insight into facial movements, and dynamic photography requires advanced equipment and expertise – together they provide a complete picture, enabling treatments that balance esthetic and functional goals.

Studies, such as those by Schabel *et al*., compared clinical photographs and digital video clips for smile analysis, finding that both methods offer strong correlations in assessing smile characteristics, with video clips providing dynamic insights, while still images provide immediate review advantages.[18] Further studies (e.g., Chaudhary *et al*., 2017) reaffirmed the utility of digital video for dynamic smile analysis and emphasized the practicality of static photography for immediate evaluation.[19]

The technological advancements in imaging systems have further facilitated the use of both static and dynamic photography in orthodontics. High-resolution cameras and sophisticated video equipment allow for the capture of clear, detailed images and videos, enhancing the accuracy of analyses.[20] In addition, the availability of software for cephalometric tracing, motion tracking, and smile analysis has made it easier to extract meaningful data from both static and dynamic images. These tools not only improve diagnostic precision but also streamline the documentation and presentation of treatment outcomes,

Table 1: The comparison between Static and dynamic photographic analysis

Sr. no.	Aspect	Static photographic analysis	Dynamic photographic analysis
1.	Definition	A single moment in time is captured for analysis and documentation in the form of still images.	Captures and analyses motion or a sequence of movements over time.
2.	Purpose	Primarily used for diagnosis, documentation, and treatment planning.	Used to evaluate functional aspects, such as jaw movement, speech, and smile dynamics.
3.	Applications	• Facial symmetry and profile analysis. • Intraoral documentation of teeth and occlusion. • Smile esthetics.	• Assessing jaw function during mastication or speech. • Smile transitions and facial expressions. • Diagnosing functional habits, such as tongue thrusting or mouth breathing.
4.	Technology used	Digital cameras (DSLR, DSLM) or smartphone cameras with proper lighting setups for still images.	Digital cameras for recording high-quality videos.
5.	Key benefits	• Precise and reproducible. • Easy to standardize and compare across timepoints. • Cost-effective and accessible.	• Provides insight into dynamic functions. • Captures details that are missed in static photos. • Demonstrates functional improvements post-treatment. • Clinician can choose the best segment from the video for smile analysis.
6.	Output	Still images for comparison, measurement, and documentation.	Video or sequential image recordings showing movement and transitions.
7.	Ease of use	Easier to implement in clinical practice; requires basic photography skills.	Requires more advanced equipment and technical expertise for capturing and analysis.
8.	Analysis techniques	Cephalometric tracing, smile line evaluation, and symmetry analysis.	Functional analysis, motion tracking, and dynamic facial expression studies.
9.	Time requirements	Faster to capture and process.	More time-intensive to record and analyze.
10.	Patient interaction	Minimal interaction required.	May involve instructions for specific actions, such as smiling, chewing, or speaking.
11.	Cost	Relatively inexpensive; requires basic photographic equipment.	Higher cost due to advanced cameras, video recording systems, and specialized software.
12.	Limitations	• Limited to static assessments. • Cannot capture functional activities.	• Requires more time and resources to process the data. • Less standardized compared to static photography. • Data storage requirement is high.

enabling orthodontists to communicate more effectively with patients and colleagues.

Key points to remember in static versus dynamic photography as shown in Table 1

Static and dynamic photography each provide distinct benefits in orthodontics. Static photography is highly valued for being precise, reproducible, and easy to standardize, which allows clinicians to reliably compare images over different timepoints. It serves as an essential and cost-effective tool for documenting facial symmetry, dental alignment, and soft tissue relationships for diagnosis and treatment planning. On the other hand, the main benefit of dynamic photography is its ability to capture movement, providing deeper insights into functional aspects like speech, chewing, and smile dynamics that are missed in still images. This method is excellent for assessing real-life function, highlighting issues like soft tissue strain, and demonstrating functional improvements after treatment. By integrating both, orthodontists gain a more holistic view, which enhances diagnostic precision and improves treatment planning by addressing both aesthetic and functional goals simultaneously.

Conclusion

Photographic analysis in orthodontics plays a crucial role in diagnosis, treatment planning, and outcome evaluation, with both static and dynamic photography offering distinct benefits. Static photography captures still images, making it essential for documenting facial symmetry, occlusion, and dental arch forms. It provides standardized, reproducible records that are invaluable for tracking changes over time and conducting cephalometric analysis. The precision of static images allows orthodontists to assess smile esthetics, facial profiles, and intraoral conditions with accuracy. In addition, it is widely accessible and cost-effective, requiring only basic equipment and standardized protocols. In contrast, dynamic photography captures sequences of movement, offering insights into functional aspects, such as speech, chewing, and smile transitions. This technique is particularly useful for evaluating habits, such as tongue thrusting and mouth breathing, which may not be apparent in static images. By revealing the interaction between soft tissue and skeletal structures in real-time, dynamic photography provides a more comprehensive understanding of oral and facial dynamics.

Although static and dynamic photographic analyses differ in their primary applications, they complement each other in orthodontic practice. Static photography excels in precision and documentation, while dynamic photography enhances functional assessment by capturing motion and transitions. Their integration enables orthodontists to create more personalized treatment plans, addressing both structural and functional concerns. For instance, static images document changes in dental alignment, whereas dynamic recordings help assess improvements in speech and jaw movement. Advances in imaging technology, including high-resolution cameras and motion-tracking software, have made it easier to incorporate both methods improving diagnostic accuracy and communication with patients. While dynamic photography presents challenges, such as the need for specialized equipment and technical expertise, its benefits in complex cases outweigh these limitations. Ultimately, the combination of static and dynamic photographic analyses enhances orthodontic care by providing a holistic approach to patient evaluation, ensuring optimal treatment outcomes.

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