EDITORIAL

Dent. Med. Probl. 2014, **51**, 1, 19–25
ISSN 1644-387X

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Contemporary Orthodontic Diagnostics – Macroesthetics, Microesthetics, Miniesthetics

Współczesna diagnostyka ortodontyczna – makroestetyka, mikroestetyka, miniestetyka

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A – research concept and design, **B** – collection and/or assembly of data, **C** – data analysis and interpretation, **D** – writing the article, **E** – critical revision of the article, **F** – final approval of article

Abstract

Attractive facial appearance and smile has a significant impact on the quality of psychosocial life. Among the multitude of medical specialities the most desired today are achievements in aesthetic medicine and cosmetic dentistry. Contemporary orthodontics also aims to meet the high expectations of patients and deals not only with correction of teeth and occlusal abnormalities, but also focuses on the appearance of facial soft tissues. Accurate assessment of the lateral cephalometric radiographs and plaster dental casts is the foundation of orthodontic diagnosis. Of great importance, however, is the macroesthetic analysis regarding measurements of facial soft tissue, miniesthetic analysis defining the relevant elements of the smile and microesthetic analysis assessing size and shape of teeth. All test parameters are intended to correct orthodontic treatment plan that corrects malocclusion and at the same time improve esthetics of the face and smile of patients (**Dent. Med. Probl. 2014, 51, 1, 19–25**).

Key words: orthodontic diagnosis, macroesthetics, miniesthetics, microesthetics, facial esthetics.

Streszczenie

Atrakcyjny wygląd twarzy i uśmiechu ma istotny wpływ na jakość życia psychospołecznego. Spośród wielu specjalności medycznych szczególnie pożądane są dzisiaj osiągnięcia z zakresu medycyny estetycznej oraz stomatologii estetycznej. Naprzeciw dużym oczekiwaniom pacjentów wychodzi również współczesna ortodoncja, która zajmuje się już nie tylko korektą nieprawidłowości zębowo-zgryzowych, ale również koncentruje się na wyglądzie tkanek miękkich twarzy. Dokładna ocena zdjęć bocznych czaszki oraz modeli gipsowych to podstawa diagnostyki ortodontycznej. Duże znaczenie jednak ma także analiza makroestetyczna dotycząca pomiarów tkanek miękkich twarzy, analiza miniestetyczna określająca odpowiednie elementy uśmiechu oraz analiza mikroestetyczna oceniająca kształt i wielkość zębów. Wszystkie badane parametry mają na celu zaplanowanie prawidłowego leczenia ortodontycznego, aby korygując nieprawidłowości zgryzu, poprawiać jednocześnie estetykę wyglądu twarzy i uśmiechu pacjentów (**Dent. Med. Probl. 2014, 51, 1, 19–25**).

Słowa kluczowe: diagnostyka ortodontyczna, makroestetyka, miniestetyka, mikroestetyka, estetyka twarzy.

Nowadays, attractive face and smile have a significant impact on psychosocial quality of life. Attractive people compared to the less attractive are considered smarter, wiser, better educated, endowed with social trust. The attractiveness of the face is significantly affected by bilateral symmetry, the right proportions, neotenic, childlike features and is ordinarity. Any anomalies, disproportions and deviations from the norm, as well as asymmetry informs of lesser efficiency, and therefore stands for degraded attractiveness in society [1]. Contemporary patients, primarily interested in improving the image of their face, place considerable demands on esthetic medicine, and as for dentistry, the high expectations concern especially cosmetic dentistry and orthodontics [2]. Modern orthodontics currently deals not only with the correction of teeth and occlusal abnormalities, but primarily focuses

on the analysis of facial soft tissues. In order to prepare a proper treatment plan, one should provide standard plaster dental cast diagnostics, the assessment of panoramic and lateral cephalometric radiographs. When carrying out macroesthetic, miniesthetic and microesthetic analysis, it is crucial to have intraoral and extraoral photographs taken: *en face,* profile and smile. The application of appropriate anthropometric points on the faces of patients makes it possible to determine important lines and angles used to assess appropriate proportion of the respective sections of the face for careful planning of treatment that aims to restore not only the quality and function of chewing, but also to improve the appearance of the face, thereby improving the quality of patients' psychosocial life.

Aesthetic Facial Analysis (Macroestethics)

Based on the analysis of the *en face* and profile photos proportion, harmony of the face is estimated in order to identify any abnormalities. The standard for facial harmony established in 1922 by Simon assumes that symmetry is determined by the median plane passing through the appropriate anthropometric points on the face (Fig. 1). The perfect symmetry of the face is divided into 5 equal parts: centre, 2 middle ones and 2 lateral ones. Nose and chin should be in the middle of the central 1/5, so its width is equal to the width of the nose or slightly narrower than it. The width of the mouth should be equal to the straight line contained between the lines carried by the medial borders of the pupils (Fig. 2) [3]. The midline between the maxillary central incisors should, when the patient smiles, correspond with the facial midline. Studies show, however, that even shifted to the left or right by 4 mm, it does not visibly compromise the harmony of the face provided that is parallel to the midline of the face and perpendicular to the occlusal plane, which in turn should be parallel to the horizontal line (Fig. 3) [4–6].

In accordance with the Kollman's ratio principle (Fig. 4), the face can be divided into thirds. The upper face extends from the hairline or the top of forehead (*Trichion*) to the base of the forehead between the eyebrows (*Ophyron*). The midface extends from the base of the forehead to the base of the nose (*Subnasale*). The lower face extends from the base of the nose to the bottom of the chin (*Gnathion*). The lower third of the face can be further subdivided into thirds, with the upper lip in the upper 1/3 and the lower lip in the lower 2/3 [7]. The correct ratio regarding the width of the face can be

Fig. 1. Anthropometric points (*Tr, On, Sn,* Ls, Li, Gn) determining the line of face symmetry

Ryc. 1. Punkty antropometryczne (*Tr, On, Sn,* Ls, Li, Gn) wyznaczające linię symetrii twarzy

Fig. 2. Division of the face into five even parts (one central, two lateral, two middle)

Ryc. 2. Podział twarzy na pięć równych odcinków (centralny, dwa boczne, dwa środkowe)

Fig. 3. Side dimensions of facial soft tissues. (*Ow-Ow*) width of the root of the nose, (*Al-Al*) width of nasal base, (*Zy-Zy*) upper width of the face, (*Go-Go*) lower width of the face

Ryc. 3. Poprzeczne wymiary tkanek miękkich twarzy. (*Ow-Ow*) szerokość nasady nosa, (*Al-Al*) szerokość podstawy nosa, (*Zy-Zy*) górna szerokość twarzy, (*Go-Go*) dolna szerokość twarzy

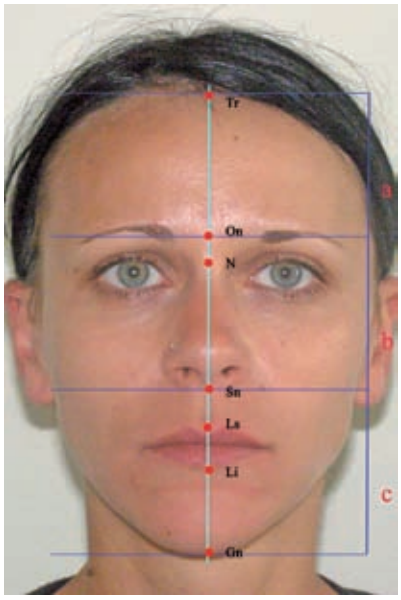

Fig. 4. Kolman's rule of proportion (*Tr – On*) = (*On – Sn*) = (*Sn – Gn*)

Ryc. 4. Reguła proporcji Kolmana. (*Tr – On*) = (*On – Sn*) = (*Sn – Gn*)

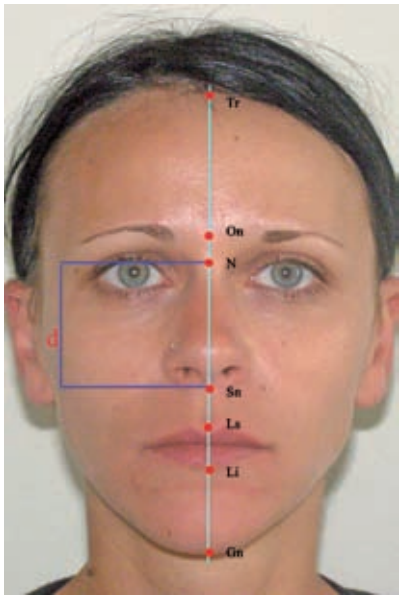

Fig. 5. Height of the nose, part d-(*NSn*)

Ryc. 5. Wysokość nosa, odcinek d-(*NSn*)

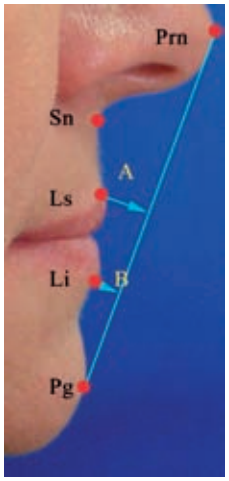

Fig. 6. Ricketts *E* aestetic line which goes through points Prn and Pg, measurement of the placement of the upper lip *Ls* and the lower lip *Ls*

Ryc. 6. Linia estetyczna E Rickettsa, która przechodzi przez punkty Prn i Pg, pomiar położenia wargi górnej *Ls* i dolnej *Li*

calculated on the basis of Garson's morphological index (vertical measurement is made for the morphological face determined by points *Nasion* and *Gnathion,* while the width of the face is designated by points set along most laterally on zygomatic arches *(Zygion-Zygion)* (Fig. 3). Normally, the average height of morphological face is 84–87.9% of its width (Fig. 5) [7–9]. The vertical dimension of the nose should comprise 1/3 of the face measured from point *Trichion* to the point *Gnathion* [10].

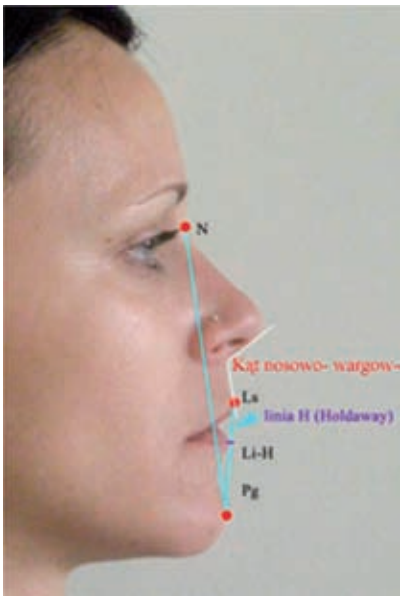

Fig. 7. Holdway's line measurement of the placement of the lower lip *Ls.* Nasolabial angle

Ryc. 7. Linia Holdawaya pomiar położenia wargi dolnej *Li.* Kąt nosowo-wargowy

The facial profile should be assessed anteroposteriorly and vertically. The convex profile may indicate the presence of skeletal class II and a concave profile – skeletal class III**.** The position of lips is assessed in relation to the Ricketts *E* aesthetic line, or in relation to the Holdaway's *H* line, the upper lip in ideal conditions should be placed 2–4 mm off the *E* line [6, 7, 11]. The *E* Line, set from the point on the tip of the nose *(Prn)* and the most prominent point on the chin (*Pg*), determines also the nasal protuberance which changes with age (Fig. 6). Line *H* set from the point on the vermilion border of the upper lip (*Ls*) and the most prominent point on the chin (*Pg*) estimates chin protuberance (Fig. 7). The more prominent the nose and the chin, the more attractive to the patient fuller lips will be [12].

The nasolabial angle is formed between the upper lip and base of the nose (*columella*) (Fig. 7). The angle should be within the range of 90° and 95° for men and 100° to 105° for women [6, 7, 11]. It gives an indication of upper lip drape in relation to the upper incisor position. A high or obtuse nasolabial angle implies a retrusive upper lip, whilst a low or acute angle is associated with lip protrusion [13, 14].

Tooth Analysis – Microesthetics

Each tooth in the arch is characterized by a specific anatomical structure, and any disturbance of its shape and size impairs the aesthetics

Fig. 8. "Black triangle" as a result of incomplete filling of the alveolar space between the central incisors and interdental papilla

Ryc. 8. Nieestetyczny „czarny trójkąt" jako wynik niecałkowitego wypełnienia przestrzeni dziąsłowej między zębami siecznymi przyśrodkowymi a brodawką międzyzębową

Fig. 9. Correct height of gingival line. The arrow marks the correct size of interdental papilla

Ryc. 9. Prawidłowa wysokość linii dziąsła. Strzałką jest zaznaczony właściwy wymiar brodawki międzyzębowej

of the smile. For the ancient Greeks, the idea of perfect beauty was based on the "golden ratio" and based on the rule that the ratio of the shorter section to the longer section of the line is equal to the ratio of the longer section to the whole line. The point at which the line is divided is known as the golden section and is represented by the symbol Φ (phi) derived from the name of the Greek sculptor Phidias. The number is 0.618 for the length of the longer segment of a line of length 1 when it is divided in the golden proportion. These rules also apply to dentistry, because on the basis of several studies, it has been demonstrated that the width of the 6 anterior teeth remains in the "golden ratio" to the width of the smile. In turn, the width of the smile keeps identical proportions to the width of the face [15–17]. Each tooth has a specific value obtained by dividing its width, which is the mesial-distal distance, by its length (distance from incisal to cervical). The ideal maxillary central incisor should be approximately 80% width compared with height, but it has been reported to vary between 66% and 80%. A higher width/height ratio (greater than 80%) means a squarer tooth, and a lower ratio (less than 75%) indicates longer appearance [18]. The shape of teeth can vary depending on gender. Female teeth are characterized by small size and rounded shapes, while male teeth are larger and more angular [19, 20]. The attractive appearance of teeth also depends on the shape and the harmony of surrounding soft tissues. The invalid outline and size of the interdental papilla may impair it, when too short, it leaves the alveolar space open, creating an unattractive "black triangle" (Fig. 8). The cause of "black triangles" are often triangular shaped crowns (contact point is shifted closer to the incisal) or destructive changes in the amount of dentoalveolar bone due to periodontitis [21]. The level of the gingival margin according to esthetic principles should be in the correct configuration in relation to the maxillary anterior crowns. Above the central incisors and canines, the gingival margin should be on the same level, with the lateral incisors 1.5 mm lower (Fig. 9) [22, 23].

Smile Analysis – Miniesthetics

Miniesthetics relates to the relationship of teeth and surrounding facial soft tissue. Among smiles, there are 2 types distinguished: posed (or social, repeatable), which is used in orthodontic diagnosis, and emotional, which is variable, and as such, difficult to reproduce [24]. The length of the upper and lower lips can be assessed both from the front or the profile. The lower third of the face can be subdivided into thirds, with the upper lip in the upper one-third (*Subnasale-Stomion* distance) and the lower lip in the lower two-thirds (*Subnasale-Gnathion*) [3, 10]. The average length of the upper lip is from 21.6 mm to 22.7 mm, which directly affects the exposure of anterior maxilla teeth [25, 26]. The age of a person will also influence the degree of tooth exposure at rest. The aging process results in the loss of tonicity of the facial muscles and reduced elasticity of the upper lip. As a consequence, with increasing age, there is a reduction in maxillary tooth display and an increase in mandibular tooth display. Gender also influences tooth display, with females generally displaying significantly more tooth structure than their male counterparts [27–29]. The exposure of teeth when smiling can also be determined by race, according to a study for reducing the visibility of the anterior

Fig. 10. Average (correct) height of the smile line

Ryc. 10. Przeciętna (prawidłowa) wysokość linii uśmiechu

Fig. 11. High line of the smile

Ryc. 11. Wysoka linia uśmiechu

Fig. 12. Low line of the smile

Ryc. 12. Niska linia uśmiechu

Fig. 13. Buccal corridors

Ryc. 13. Korytarze policzkowe

Fig. 14. Correct arch of the smile. Curvature of the upper teeth incisal margins parallel to lower lip

Ryc. 14. Prawidłowy łuk uśmiechu. Krzywizna brzegów siecznych zębów górnych równoległa do wargi dolnej

Fig. 15. Flat curvature of the smile

Ryc. 15. Płaski łuk uśmiechu

maxilla teeth in favour of the lower incisors is most pronounced among Caucasians, less pronounced among Asians and least pronounced among black population [30–32]. Relative position of the upper lip to the anterior teeth crowns while smiling is defined as the height of the smile line [33–37]. Upper and lower smile lines can be described as being high, low, or medium. Medium smile lines will display teeth in their entirety, as well as the interdental papillae and 1–2 mm of the gingival margin (Fig. 10). A high smile line, also described as a "gummy smile" will expose a large portion of the soft tissue, extending from the inferior border of the lip to the free gingival margin (Fig. 11). A low smile line will display the incisal third to half of the teeth below the inferior border of the upper or lower lip (Fig. 12). The medium smile line is generally considered the most desirable, with a nominal exposure of 1–2 mm of the gingival margin. The smile arc is defined as the relationship of the curvature of the incisal edges of the maxillary incisors with the curvature of the lower lip in a posed smile. The most perfect smiles are wide, with narrow buccal corridors (dark spaces between the angle of the lips and the side teeth) (Fig. 13) [36]. In an esthetic smile, the incisal edges of the maxillary anterior teeth should follow a somewhat convex course that coincides with the curvature of the lower lip. The incisal edge curvature should be parallel and just above the level of the lower lip (Fig. 14). As one ages, the plane of the incisal edges of the maxillary anterior teeth is often flattened or even inverted. This may be due to tooth wear or other dental pathology or poor restorative dentistry (Fig. 15).

Conclusions

Orthodontics of the 20th century aims at providing treatment to gain proper occlusion. The development of new methods of measuring and increasing aesthetic expectations of patients in 21st century resulted in replacing Angle's paradigm with a new one which concerned the analysis of facial soft tissues as an important diagnostic parameter in achieving proper treatment [38]. A thorough macroesthetic, miniasthetic and microasthetic analysis allows to prepare a proper treatment plan that is designed to improve both the function and the quality of chewing and patients' face and smile aesthetics, improving quality of their psychosocial life.

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Received: 5.11.2013
Revised: 4.03.2014
Accepted: 10.03.2014

Praca wpłynęła do Redakcji: 5.11.2013 r.
Po recenzji: 4.03.2014 r.
Zaakceptowano do druku: 10.03.2014 r.