REVIEWS

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Gingival Smile as a Complex Problem of Aesthetic Dentistry

Uśmiech dziąsłowy jako złożony problem stomatologii estetycznej

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Abstract

The article presents an increasing problem experienced by certain patients connected with aesthetics and life quality – the so-called gingival smile/gummy smile. Multifactorial and varied causes of this disorder have been presented, which may be of dental, skeletal, muscular, or mixed nature. Determining the correct etiopathogenesis is particularly important in terms of selecting the right treatment and required interdisciplinary cooperation of many specialists in the fields of periodontology, periodontal surgery, orthodontics and prosthodontics. This interdisciplinary approach is the basis for success in correcting the gingival smile (**Dent. Med. Probl. 2013, 50, 3, 362–368**).

Key words: gummy smile, gingival smile, etiopathogenesis, pink aesthetics.

Streszczenie

W artykule przedstawiono, narastający z punktu widzenia estetyki i jakości życia, problem niektórych pacjentów związany z uśmiechem dziąsłowym. Omówiono wieloczynnikowe, zróżnicowane przyczyny powstawania tego zaburzenia, które mogą mieć charakter zębowy, anatomiczno-szkieletowy, mięśniowy lub mieszany. Ustalenie właściwej etiopatogenezy jest szczególnie ważne z punktu widzenia wyboru właściwej metody leczenia i koniecznej współpracy interdyscyplinarnej z zakresu periodontologii, chirurgii periodontologicznej, ortodoncji czy protetyki. Takie wielospecjalistyczne podejście jest podstawą sukcesu w korekcie uśmiechu dziąsłowego (**Dent. Med. Probl. 2013, 50, 3, 362–368**).

Słowa kluczowe: uśmiech dziąsłowy, etiopatogeneza, różowa estetyka.

A gingival smile (also called gummy smile) is the result of an improper relationship between the position of the maxilla, teeth setting, the lower border of the upper lip, on the one hand, and the position of the gingival festoon in relation to the crowns of teeth, on the other hand.

The smile plays an important role in interpersonal relationships, determining the first impression. It allows us to express positive emotions, such as politeness and kindness. A smile should reflect the morphological and psychological profile of a person. It is connected with the mutual relation of anatomical components, such as the mouth – making up the smile line, teeth in the upper and lower dental arch and gingiva with a distinctive, harmonious festoon associated with the concept of pink aesthetics. A lack of balance between the above components can manifest itself in the form of gingival smile, characterized by excessive exposure of gums in a smile (Fig. 1 and Fig. 2).

The aim of this paper is to present the essence of the aesthetic problem which is the gingival smile, its causes, diagnosis and usefulness of modern methods of periodontal surgery in its correction. It is a challenge for many professionals who, thanks to the appropriate treatment methods, pro-

Fig. 1. Gingival smile – disorders of maxilla height and occlusal relationships, VME – vertical maxillary excess (from the collection of the individual dental practice R. Kryściak)

Ryc. 1. Uśmiech dziąsłowy – zaburzenia wysokości szczęki i relacji okluzyjnych, VME – *vertical maxillary excess* (ze zbiorów indywidualnej praktyki stomatologicznej R. Kryściak)

Fig. 2. Gingival smile – VME – vertical maxillary excess (from the collection of the individual dental practice R. Kryściak)

Ryc. 2. Uśmiech dziąsłowy – zaburzenia wysokości szczęki, VME – *vertical maxillary excess* (ze zbiorów indywidualnej praktyki stomatologicznej R. Kryściak)

vide the smile with a new, corrected expression, thus improving the mood of many patients.

Diagnosis

The gingival smile manifests itself with the exposure of gums during a smile in the vertical dimension greater than 4 mm above the most apical points of clinical crowns in the maxilla (tooth zeniths), in a situation when they are, in the majority of cases, short and square [1–7]. This problem affects twice as many women as men [7–10]. During the diagnosis, the following factors are assessed: facial and lip symmetry in a smile, the relationships between the facial median line and the teeth, the incisal plane and occlusion; crowns, roots and alveolar bone; other considered elements include the level and the harmony of the gingival margin, gum exposure, interpapillary line (smooth and/or irregular), the location of the gingival margin in relation to the muccogingival attachment and the margin of alveolar bone in maxilla as well as the course of the smile line [7, 11]. Many authors pay attention to such parameters as the symmetry and proportions of the face, upper lip length at rest, exposure of maxillary central incisors at rest, the height of gum exposure (at rest, when speaking, smiling and laughing wide), smile line and contour of the gum line – forming the festoon [7, 12]. The symmetry and proportions of the face are assessed taking into account a number of reference parameters – facial lines (mutually parallel or perpendicular). The reference is the pupil line, which can be helpful in the orientation of the occlusal plane and maxillary gingival contour. Also important is the length of the upper lip, which is measured from the subnasal point to the lower limit of the upper lip at rest. On average, in young adults it ranges from 20 to 24 mm, and increases with age. Similarly, upper incisors become less visible with age, which are exposed 2 to 4 mm at rest, depending on the gender [13].

The course of the smile line and the gingival line in the maxilla are important for diagnosis. In a natural smile the position of the lower border of the upper lip in relation to the incisal edges of incisors and to gingiva, corresponds to the curvature of the lower lip. Depending on the lip position during a smile, and thus the visible gingiva, three types of smiles can be distinguished [14]:

- In a low smile, while talking and in the neutral position of lips, the gums are not shown, and the teeth are barely visible, less than 75% (they are revealed in a full smile).
- The medium type, which is optimal from the aesthetic point of view, when the lips in the rest position expose 1–3 mm of incisal edges, while in full smile, peaks of interdental papillae and a small part of the gums are visible.
- The high type is characterized by revealing the whole tooth crowns with copious portion of gums during a moderately wide smile. The gingival aesthetic line (GAL) has a shape of a symmetrical and harmonious festoon [15]. It is parallel to the pupil line, and this in turn is parallel to the line joining canines' cusps. The gum forms triangular papillae that fill the interdental spaces. The shape of gingival festoon has a varied course, which is conditioned by the morphology of teeth. Marginal gingiva becomes flatter from the canine towards the second molar. Palatal sloping of premolars makes it seem that gingiva in this area is longer than

it actually is. During a full smile the upper lip should reveal the upper central incisors, at the same time covering the main zone of gingiva. All the teeth to the first molars should be visible and the incisal edge curvature should run parallel to the lower lip. The setting of lips is aesthetic if the line between lip commissures runs parallel to the line of the pupils and the occlusal plane [16].

Clinical Studies

Intraoral examination includes an assessment of the occlusal surface, harmony of dental arches, anatomy, proportion and color of teeth. In turn, determination of the width and length of the teeth allows us to establish, if short clinical crowns present during gingival smile result from tooth attrition or from coronally positioned gingiva. The teeth should match the course of the dental arch and facial morphology.

In practice, specialists use Chu's Aesthetic Gauges, which are a set of special rulers and probes, to estimate the proportion of teeth, bone and soft tissues, used in accordance with known principles of dental aesthetic in crown reconstruction and during surgical crown lengthening of clinical crowns (Fig. 3). Chu's Aesthetic Gauges [17] refer to:

– Proportions (to assess the optimal ratio of the length and width of the clinical crown of the tooth),
– Crown lengthening,
– Probing rate (to assess the gingival sulcus and biological width).

Their use is to determine, possibly quickly and easily, the differences relating to the size of teeth, the level of the alveolar bone, to take accurate measurements in millimeters, and then to implement the appropriate adjustments to the given parameter by the dentist. Another important element is periodontal examination, which measures:

– The width of alveolar gingiva,
– The level of attachment and bone in relation to the cementum enamel junction (CEJ)
– The position of the gingival margin in relation to the CEJ and the gingival biotype (thick, normal, thin) [12].

Attention is also paid to the decisive role in the anterior section, relating to central incisors: their shape, size and setting. It is associated with harmonious arrangement of these teeth. In optimum proportion, the absolute width is 8.37–9.3 mm and the length: 10.4–11.2 mm. In the latest aesthetic concept of a front view, they should gradually taper distally from the median line. The optimum ratio of the width to the anatomic crown length is then 78%, and the central incisor should be wider by 60% than the lateral one, which, in turn, should be 60% wider than the canine. These values are valid for both genders in all races [13].

Causes

The gingival smile is determined by a combination of multiple etiological factors, whose sources can be: dental, skeletal, muscular, or mixed [7, 8]. This condition is caused by gingival hyperplasia, most frequently resulting from poor oral hygiene, which initiates periodontal inflammation associated with the presence of dental plaque. Also certain drugs: phenytoin, cyclosporin, calcium channel blockers, can cause gingival hyperplasia [15]. Other predisposing factors include: a high lip

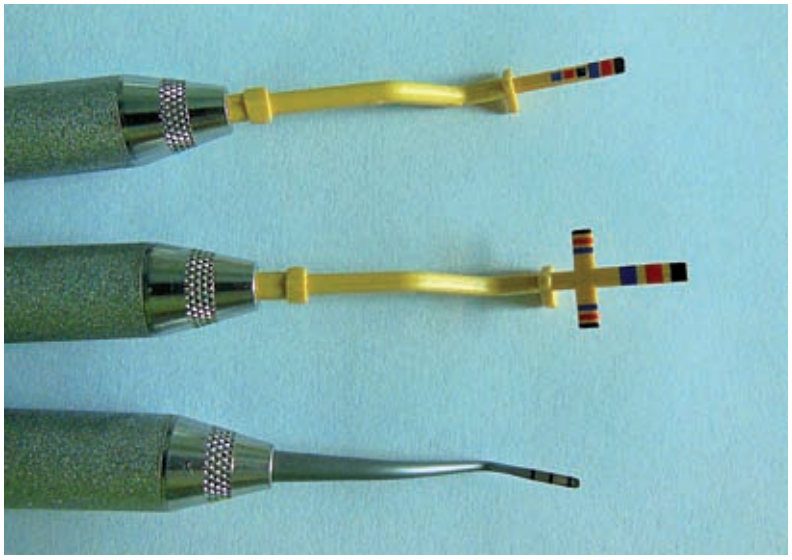

Fig. 3. Chu's Aesthetic Gauges for estimating the proportion of clinical crowns of teeth, bone and adjacent soft tissues (from the collection of the individual dental practice R. Kryściak)

Ryc. 3. Wskaźniki estetyczne Chu's do oceny proporcji koron klinicznych zębów, tkanki kostnej oraz przylegających tkanek miękkich (ze zbiorów indywidualnej praktyki stomatologicznej R. Kryściak)

line when its value is lower than the average, i.e. about 18–21 mm [12, 17], abnormal skeletal structure – vertical maxillary excess (VME) [12, 17], supraeruption of maxillary teeth in patients with orthodontic class II – dental-gingival disorder, or altered passive eruption (APE) [12, 17], attrition of incisors with compensatory eruption [12, 17], bruxism [12, 17], upper lip levator muscle hyperactivity, which tucks the upper lip causing an imbalance between the outer ring and the tongue [12, 17], irregularities in the setting of teeth: mesial defects causing exposure of teeth and gums, including gingival smile, often concern individuals with bimaxillary protrusion and trauma, which resulted in a change of tooth „emergence profile" [12, 16, 17].

Other causes leading to the formation of gingival smile include mechanical factors that may interfere with tooth eruption and associated with unerupted or supernumerary tooth, root ankylosis, odontogenic cysts and tumors, as well as endocrine disorders: an underactive pituitary gland, hypothyroidism, hypogonadism, growth hormone disorders. Bone disorders in this case relate to vertical maxillary excess. The reason lies in skeletal dysplasia, which is a vertical hypertrophy of the maxillary bone base. It is diagnosed on the basis of facial proportions and skull X-rays, when the middle section of the face, i.e. the nasal floor, is longer than the other two: the frontal floor and maxillary floor. Cephalometric analysis allows accurate specification the height of the front of maxilla, which is measured between the palatal plane and maxillary incisal edges [12]. Garber et al [18] classify vertical maxillary excess, depending on the amount of displayed gingiva, distinguishing the following Degrees: I (exposure of tissue 2–4 mm), II (4–8 mm), III (≥ 8 mm).

Altered passive eruption of teeth suggests an association with dental periodontal disorders [19]. In this case, a large part of tooth crowns is covered by gingiva (Figure 4). This malformation consists in a delay of the retreat of marginal gingiva and epithelial attachment to the cementum enamel junction during tooth eruption. These are located in the incisal/occlusal part of the anatomical crown. The tooth becomes visible not as a result of eruption, but because of recession of gingiva, which in this case is thick and fibrous, without inflammation, and clinical crowns are square, giving the impression of hidden teeth. Altered passive eruption may be: local, general or associated with periodontal disease [19].

Coslet et al. [20], depending on the width of the alveolar gingiva, distinguish between two types of passive eruption of teeth: in each of these there are subtypes A and B determining the ratio of alveolar bone margin to the CEJ. In the first type, the attached gingiva forms a wide belt, gingival margin is toward the incisal edge/occlusal surface with respect to the CEJ, the mucogingival junction is apical with respect to alveolar ridge, and clinical crowns are short. Excess gingiva is between a free gingival margin and mucogingival junction (MGJ). The second type is characterized by alveolar gingiva of normal width, i.e. at least 2 mm, mucogingival junction is almost at the same height as CEJ. The limit value for division between the A and B subtypes is 2 mm.

Sometimes, the vertical maxillary excess co-

Fig. 4. The altered passive eruption syndrome – APE (from the collection of the individual dental practice R. Kryściak)

Ryc. 4. Zespół opóźnionego biernego wyrzynania zębów (APE – *altered passive eruption*) (ze zbiorów indywidualnej praktyki stomatologicznej R. Kryściak)

Fig. 5. The altered passive eruption syndrome – APE – Type 1. Dentogingival disorders, a significant part of the tooth crown is covered by a wide belt of attached gingiva (from the collection of the individual dental practice R. Kryściak)

Ryc. 5. Zespół opóźnionego biernego wyrzynania zębów (APE – *altered passive eruption*) typ 1. Zaburzenia zębowo-dziąsłowe, znaczna część koron zębów przykryta jest przez szeroki pas dziąsła zbitego (ze zbiorów indywidualnej praktyki stomatologicznej R. Kryściak)

Fig. 6. The altered passive eruption syndrome – APE – Type 2. Dentogingival disorders, the mucogingival junction is almost on the same level as the CEJ (from the collection of the individual dental practice R. Kryściak)

Ryc. 6. Zespół opóźnionego biernego wyrzynania zębów (APE – *altered passive eruption*) typ 2. Zaburzenia zębowo-dziąsłowe, granica błony śluzowej i dziąsła znajduje się prawie na tej samej wysokości, co granica szkliwno-cementowa (ze zbiorów indywidualnej praktyki stomatologicznej R. Kryściak)

exists with a high lip line or altered passive eruption. In this situation, prior to the gingival smile correction, the components of altered passive eruption should be removed, the correct relationship between gingival should be restored, and an attractive, anatomically optimal arrangement of the teeth should be created, leaving the surgeon to correct vertical maxillary excess. This gives him the final guidance on the potential lip – tooth relationships.

Treatment

While deciding on the appropriate method of treatment, it is important to determine the etiopathogenesis. Practical criteria usually include the following parameters: the width of alveolar attached gingiva, clinical and anatomical crown height, positioning of teeth, location of frenulum.

In the case of gingival overgrowth, treatment involves a significant increase of health indicators and possible periodontal and surgical treatments. It mainly consists in instruction on proper oral hygiene, and in more advanced cases, additionally in gingival surgery – gingivoplasty. In the event of a high lip line, the treatment of choice are periodontal surgical procedures, including the lengthening of clinical crowns of teeth [21, 22], often requiring supplementary prosthetic treatment. In case of vertical maxillary excess, depending on the clinical situation, various therapeutic options are proposed, such as orthodontic intrusion, periodontal treatment, orthodontic treatment often associated with dental procedures in the field of conservative dentistry, prosthetics and/or orthognathic surgery. In vertical maxillary excess described by Garber et al. [18] as Degree 1, depending on the clinical situation, only orthodontic intrusion and/or periodontal treatment with orthodontic treatment is recommended. One should also consider periodontal treatment in combination with conservative dentistry and/or prosthetics. In the case of Degree II, periodontal treatment is performed – resection or orthognathic surgery (the choice depends on the remaining length of the root embedded in the bone, and on crown proportions). In Degree III, orthognathic surgery combined with periodontal treatment is performed, and – if required due to the clinical situation – intervention in the field of conservative dentistry and/or prosthetics.

An innovative technique that does not require systemic treatment, including hospitalization, is lip repositioning, performed with local anesthesia [23]. The disorder described as altered passive eruption is corrected by gingivectomy with/without ostectomy in the first type, and by apical movement of a flap with/without ostectomy in the second type [12].

Treatment of upper lip levator muscle hyperactivity is generally carried out by means of upper lip surgery, which constitutes a reverse vestibuloplasty, or a more predictable method which involves the amputation of the upper lip levator [9]. The alternative methods to surgical treatment are botulinum toxin Type A (BTX-A) injections. They provide a safe and minimally invasive procedure, yielding very fast but only short-term cosmetic results (improvement for 3–6 months). The preferred injection sites are around the following muscles: the levator muscle of the upper lip and nose wings (levator labii superioris alaeque nasi muscle), the levator muscle of the upper lip (levator labii superioris muscle), the zygomatic minor muscle (zygomaticus minor muscle), the zygomatic major muscle (zygomaticus major muscle), the depressor septi nasi muscle, the risorius muscle [24, 25].

Patients with Class II occlusal abnormalities [26], where due to the lack of abutment of teeth in occlusion, the extrusion of incisors occurred together with the gingival-alveolar complex, are offered orthodontic intrusion and sometimes the lengthening of clinical crowns of teeth with conservative correction and/or prosthetic treatment. Segmental osteotomy may be helpful in correcting the supraeruption of incisors [19].

In clinically simple diagnoses, when the gingival smile is caused by abnormalities in the setting of teeth, the treatment consists of orthodontic procedures. However, if an occlusal defect is a gnathic one, surgical intervention is required. In the case where gingival smile is limited only to the anterior section, a solution may be orthodontic intrusion. If it is also present in the posterior section, it is recommended to carry out further treatment in the field of periodontal surgery [27].

In conclusion it can be stated that the doctor who has taken the challenge to improve gingival smile, using interdisciplinary knowledge of dentistry and existing abilities in manual-art, often in collaboration with the dental technician, can shape the smile perfectly integrated in the facial part of the patient's skull, improving the comfort of his life. Modern techniques in aesthetic periodontics and muco-gingival surgery allow significant increase in attractiveness of the patient's smile.

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