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Does age influence self-perception of the soft-tissue profile in children?

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Introduction: Appreciation of the soft-tissue profile is important in orthodontic diagnosis and treatment. However, are the patients themselves aware of their profile appearance? We aimed to evaluate if age influences self-perception of the soft-tissue profile in children. **Methods:** The study population for this prospective cross-sectional investigation consisted of 3 groups of 60 patients, classified according to age (<12 years; 12-15 years; >15 years). Each subject's right-sided facial profile was photographed to obtain a silhouette. Facial profile silhouette templates were created to represent the local population. Each subject's photograph was inserted into the corresponding template, and the subjects were asked to identify themselves. Facial profile self-recognition was recorded as a binary variable (yes or no). Other recorded variables included age, sex, and sexual maturity rating (using Tanner staging). Chi-square tests were used to analyze facial profile self-recognition between different subgroups, and stepwise multiple regression was used to predict the probabilities of facial profile self-recognition, with age, sexual maturity rating, and other recorded variables as independent variables. **Results:** Eighty percent of subjects aged >15 years recognized their own profile, compared with only 55% and 50% of subjects aged 12-15 years and <12 years, respectively. Subjects aged >15 years were significantly more likely to recognize their profile than younger subjects ($P = 0.001$). Similarly, subjects with the most advanced sexual maturity rating (stage V) were significantly more likely to recognize their profile (85% self-recognition) than those in groups I-IV ($P < 0.001$). Girls were more likely to recognize their profiles than boys ($P = 0.028$). When using multiple regression analysis, sexual maturity rating appears to be the only significant predictor for facial profile self-recognition ($R^2 = 0.25$; $P < 0.001$). **Conclusions:** Facial profile self-recognition seems to improve with age and sexual maturity (sexual maturity rating stage V). Because orthodontic treatment planning takes possible soft-tissue changes into account, it is important to evaluate the degree of self-perception of the patients to adapt our goals and treatment discussions. (Am J Orthod Dentofacial Orthop 2021;159:e207-e215)

Soft-tissue esthetics is of major concern in orthodontic treatment planning. Orthodontists tend to focus on findings from the soft-tissue profile examination, which constitutes part of their diagnostic workup, using these findings for treatment planning. This approach is evident when looking at the number of recent meta-analyses that focus on profile changes after treatment, such as comparing treatment with or without extractions,[1] comparing space closure with en masse retraction vs 2-step retraction,[2] comparing outcomes with orthodontic camouflage vs orthognathic surgery in Class II malocclusion,[3] or looking at the treatment of dentoalveolar protrusion using maximum anchorage.[4]

After the taking of initial orthodontic records, the effect of the soft-tissue profile on treatment choice and the effect that orthodontic treatment can have on the soft-tissue profile is discussed with patients and their families before the beginning of treatment. Depending on the objectives of treatment, the soft-tissue profile can be improved or worsened. Thus, it is important to inform the patient about the potential changes on their soft-tissue profile, based on the best available evidence. However, the relevance this may have for the patient is not always clear, and this may also be age-dependent, differing between adolescent and younger patients. Although using objective outcomes to quantify soft-tissue profile characteristics may help the treatment planning process, patients' perceptions may differ.

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In our search for perfection, our definition of normality may be influenced by what we consider ideal, which may not be consistent with the patient's perception of normal. Studies have pointed out that laypersons are less critical when evaluating soft-tissue profiles than orthodontists.[5]

Fleming et al[6] ask a pertinent question: "Are dental researchers asking the right questions?". It has been shown that most outcomes used in orthodontic research do not reflect patient perspectives.[7] Another relevant question may be, to what extent do we as orthodontists essentially ignore the perception of the patient and their family on their profile and its influence on the motivation for orthodontic treatment? Interestingly, Øland et al[8] found that in a group of patients undergoing orthognathic surgery, the preoperative facial profile type did not have any influence on the motives to seek and undertake treatment.

When considering the soft-tissue profile, one question that arises is, how much are patients aware of their own profile? Johnston et al[9] asked a group of adult laypersons and potential orthognathic patients whether they had seen their profile, and approximately two thirds stated that they had. It was also found that Class III orthognathic surgical patients, women, and older subjects were more likely to have seen their profile. It has also been claimed that laypersons are not generally aware of their facial profiles unless exposed to photographs.[10] A small number of studies have investigated self-perception of the soft-tissue profile, using methods in which the participant is asked to choose a profile from constructed images that most resembles their own,[11-15] and found that the self-perception of the profile is generally poor. Only 1 study using the participants' own profile photographs to evaluate self-perception[16] found that self-perception is rather accurate. It is important to detect early enough any misperception a patient could have of their own profile.[14] Orthodontists, together with patients, need to align their perceptions of the patient's profile to ensure good communication and avoid misunderstandings.

Logically, it is more likely that adult patients are conscious of the appearance of their profile, whereas children and teenagers, who constitute the majority of our orthodontic population, may be less so. To guarantee a good age-appropriate communication between the practitioner and the patient, practitioners need to know whether the patient understands what the soft-tissue profile is and if they are aware of their own profile. The present study aimed to evaluate if age influences self-perception of the soft-tissue profile in children.

MATERIAL AND METHODS

The present prospective cross-sectional study was given authorization after a written request to the local ethics committee (CCER_Req-2017-00963). Before participation, written informed consent was obtained from each patient and their parent or legal guardian if aged <18 years.

All subjects were recruited from the Department of Pediatrics at the University Hospitals of Geneva from April 2018 to September 2019, including patients coming to different outpatient clinics or the adolescent medicine clinic.

The participants were divided into 3 groups according to their age, with the intent of having 3 equally sized groups. The 3 age groups were as follows: <12 years, 12-15 years, and >15 years. The separation between these 3 age groups was suggested by an experienced pediatrician (M.C.) based on pubertal development. It was decided to divide patients on the basis of age because this information is easily available to every clinical orthodontist. To calculate the desired sample size, we conducted an initial pilot study on 35 students within the dental school, and 89% of this group demonstrated soft-tissue profile self-recognition. Based on these results, and the findings from a study by Tufekci et al[13] looking at profile perception, the sample size for the present study was calculated to be able to find a 21% difference (based on the difference between groups in the aforementioned study) in profile recognition between the different age groups, with the oldest age group presenting 89% recognition (as per our pilot study), with an alpha P value of 0.05, and a power of 80%. The calculated required sample size was 59 patients per group, and we thus decided to include a total of 60 patients per group.

To recruit an appropriate number of patients within each age group, we previously reviewed the lists of pediatric consultations to identify patients with ages matching the desired study groups. Then patient recruitment was carried out in the waiting area. While waiting for their appointment with the pediatrician, all patients were asked by a single orthodontist (V.V.) if they were willing to participate in the study, with sufficient explanations being given. Inclusion criteria were patients aged from 9 to 20 years, without any apparent craniofacial abnormalities or deformities. Once the required number of patients were included for 1 group, no more patients were approached within that age range, and recruitment was continued for the remaining groups.

Each individual's soft-tissue profile was photographed with a Nikon Digital SLR Camera D70 (Nikon

Fig 1. Example of a profile silhouette obtained.

Photo Products, Tokyo, Japan) set up with a 105-mm objective at 2 m from the subject. Pictures were taken with the patient at rest and in a way that only the silhouette was visible. Any details of the face were imperceptible because only the shadow of the profile was photographed with a small aperture opening and light coming from behind the participant. The picture was then modified with PowerPoint (Microsoft, Redmond, Wash) by cropping so that details of the hair could not be seen and transforming it to full black and white (Fig 1), similar to what has been used in previous studies.[17] All photographs were taken by the same orthodontist (V.V.) under the same conditions.

Different templates were generated to standardize the process of recognition by selecting various profile photographs from the pool of orthodontic patients of our University clinic. Efforts were made to include different profile types and patients of different ethnic backgrounds to represent the diversity of the local population. These template profile pictures were then darkened with the same process on PowerPoint. The generation of templates was as follows: two templates were produced with 9 photographs each, for each of the age groups (<12 years, 12-15 years, or >15 years), 1 for female patients and 1 for male patients, making a total of 6 templates. The placement of the photographs in the templates was standardized with 2 rows of 5 profile silhouettes, leaving the ninth position empty (second from the right on the bottom row). This position was left blank to incorporate the profile silhouette of the study subject. An example of a template is shown in Figure 2. Once the study silhouette was added to the corresponding template (according to age group and sex), the individual was asked to identify themselves within the template containing 10 silhouette profiles.

Besides profile recognition, other variables recorded for each participant were sex, age, the reason for the pediatric consultation, history of previous or active orthodontic treatment, and sexual maturity rating (Tanner staging). The included sample was diverse concerning the reason for consultation. Five main categories appeared: eating disorders, chronic diseases, psychosocial issues, psychiatric issues, and somatic complaints.

The sexual maturity rating, which is an objective classification system used to evaluate the development and sequence of secondary sex characteristics of children during puberty,[18] comprising 5 stages with stage I corresponding to no signs of sexual maturity and stage V corresponding to completed sexual development, was evaluated by 2 pediatricians (M.C. and C.S.). The 2 pediatricians had been previously calibrated to each other in the use of this rating. Finally, the participants were also asked, in the form of an open-ended question, which part of the profile they look at to help them recognize their profile.

Statistical analysis

Statistical analysis was performed using SPSS (version 25; SPSS, Chicago, Ill). Initially, chi-square tests were performed to compare the percentage of facial profile self-recognition on the basis of age group, sexual maturity rating, sex, the reason for pediatric consultation, and history of previous or active orthodontic treatment. To compare the proportions of recognition between each group, we performed chi-square tests. Subsequently, stepwise multiple linear regression analysis was performed to evaluate the influence of the studied variables on facial profile self-recognition.

RESULTS

A total of 180 subjects took part in the study, from an initial 182 subjects approached. Two subjects refused to participate. The included subjects were aged from 9 to 20 years, with 117 female and 63 male subjects. Three equally sized groups of 60 subjects, who had been defined *a priori*, were formed on the basis of age: <12 years, 12-15 years, and >15 years,

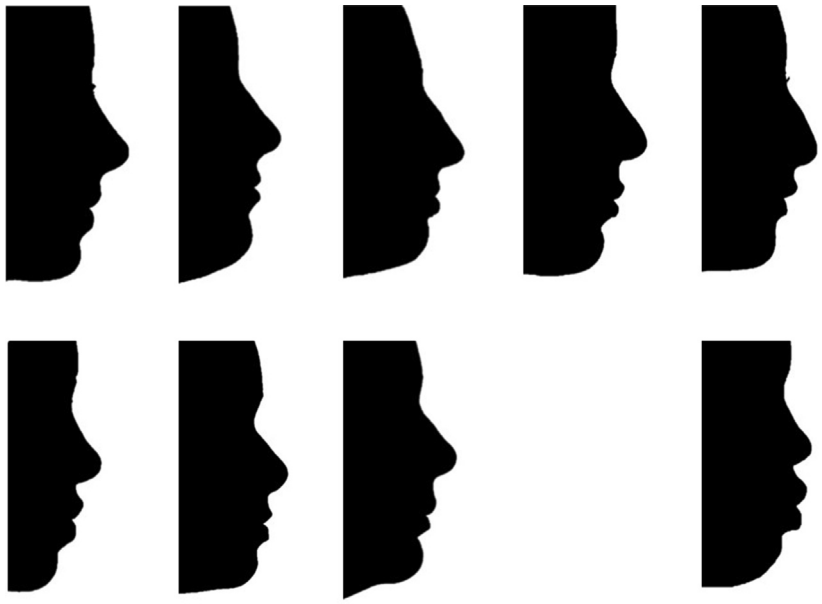

Fig 2. Example of a template of 9 silhouette profiles, in which the photograph of the subject was included in the ninth position. Shown here are female subjects aged 9-12 years.

Table I. Baseline data for 3 age groups

Age group	*Age (mean ± SD)*	*Sex*	*History of orthodontic treatment*
<12 y	10.3 ± 0.8	34 females/26 males	14 yes/46 no
12-15 y	13.1 ± 0.8	40 females/20 males	19 yes/41 no
>15 y	16.3 ± 1.2	43 females/17 males	28 yes/32 no

SD, standard deviation.

respectively. Baseline data concerning the 3 age groups are presented in Table I.

Looking at the 3 age categories, although 80% of subjects above 15 years recognized their profile, only 50% of those younger than 12 years and 55% of those from 12 to 15 years succeeded in doing so. Facial profile self-recognition in the oldest age category was significantly higher than the 2 other groups ($P = 0.001$ and $P = 0.003$, respectively).

With regard to sex, female subjects were more likely to recognize their facial profile than male subjects, with a percentage of self-recognition of 68% vs 51% ($P = 0.028$). Profile recognition based on age and sex is shown in Figure 3.

Distribution of sexual maturity rating scores was as follows: 33 subjects in stage I, 31 in stage II, 33 in stage III, 30 in stage IV, and 53 in stage V. Sexual maturity rating was found to have an influence on facial profile self-recognition, with 45% of subjects with maturity rating I, 42% of those with maturity rating II, 61% with maturity rating III, 60% with maturity rating IV, and 85% with maturity rating V recognizing their own profile (Fig 4). The most advanced sexual maturity (stage V) showed a statistically significant difference to the other maturity ratings (stages I-IV) ($P <0.001$). There was a correlation between age and sexual maturity rating in the present sample ($R^2 = 0.79$; $P <0.001$), despite variation in age seen for different sexual maturity ratings (Fig 5).

Concerning the other variables (history of orthodontic treatment; reason for pediatric consultation), no significant differences were found for facial profile self-recognition between the different subgroups.

Stepwise multiple linear regression analysis (including sex, age, history of orthodontic treatment, and reason for pediatric consultation as independent variables) revealed a statistically significant model ($R^2 = 0.206$; $P <0.001$), age being the only significant variable within the model predicting facial profile self-recognition ($P <0.001$). However, this was without including sexual maturity rating as an independent variable. When also including sexual maturity rating as an independent variable, along with the variables

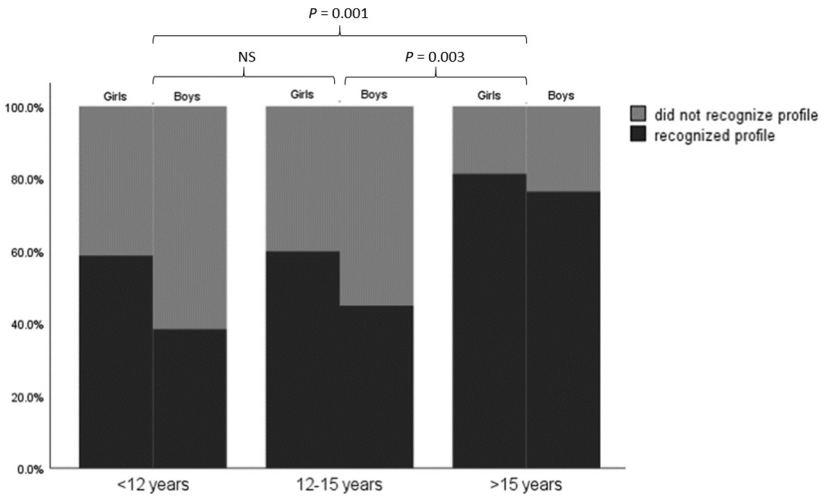

Fig 3. Profile recognition based on age group and sex. *P* values are shown for differences between different age groups. *NS*, nonsignificant.

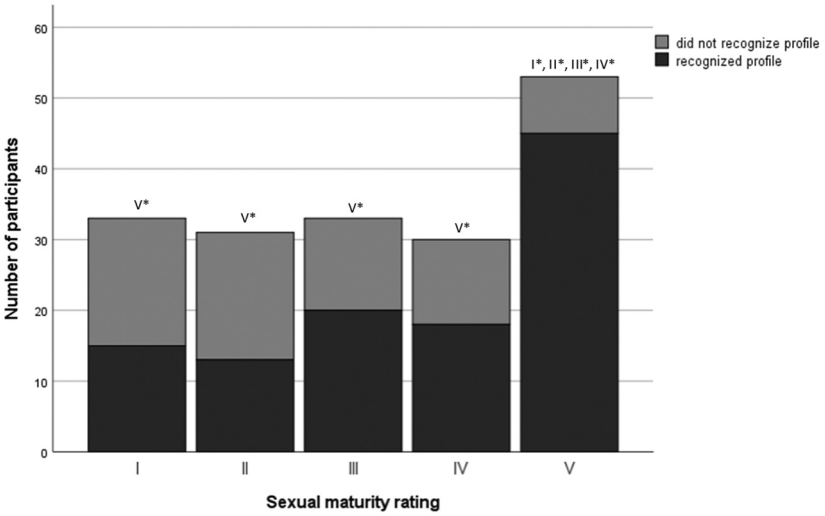

Fig 4. Profile recognition based on sexual maturity rating. *Statistically significant differences between groups ($P < 0.05$).

mentioned above, stepwise multiple linear regression analysis revealed a statistically significant model ($R^2 = 0.251$; $P < 0.001$), with sexual maturity rating being the only significant variable within the model ($P < 0.001$) predicting facial profile self-recognition (Table II).

When looking only at female subjects, stepwise multiple linear regression was performed, revealing that within this subsample, sexual maturity rating was once more the only statistically significant variable predicting facial profile self-recognition ($R^2 = 0.237$; $P < 0.001$) (Table I). A similar result was found for the male subsample ($R^2 = 0.197$; $P = 0.012$) (Table II).

DISCUSSION

It is important to determine to which extent patients are aware of their own profile appearance to ensure good communication. In the present study, subjects with a

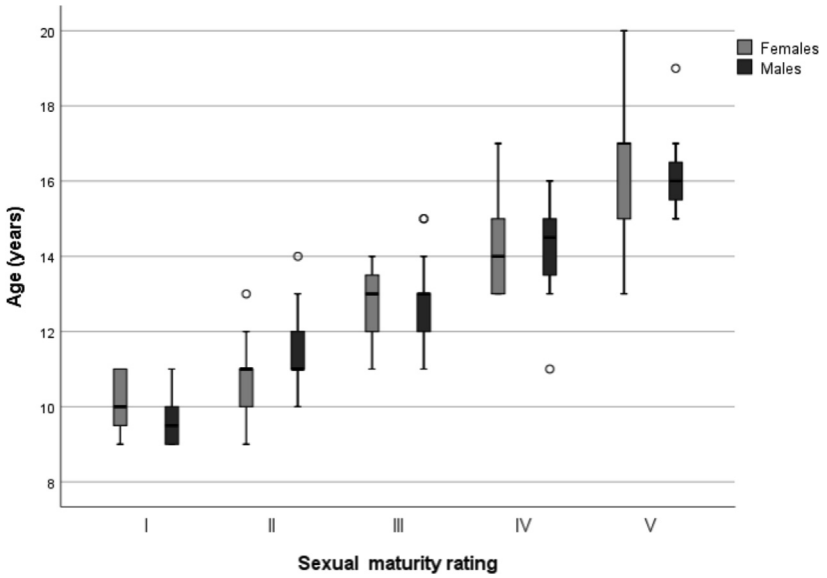

Fig 5. Box plots showing sexual maturity rating in relation to age in the present sample. *Circles* represent outliers.

Table II. Results of stepwise multiple linear regression models with facial profile self-recognition as the dependent variables. A model for the whole sample is shown, as well as models for males and female subjects separately

Models	R^2	P *value*	*Beta coefficient*	*Constant*
Sexual maturity rating (whole sample)	0.251	<0.001	0.183	−0.046
Sexual maturity rating (female sample)	0.237	<0.001	0.181	−0.007
Sexual maturity rating (male sample)	0.197	0.012	0.163	−0.032

Note. Excluded variables from stepwise multiple regression: age, history of orthodontic treatment, the reason for pediatric consultation, and type of profile.

sexual maturity rating of stage V were more likely to recognize themselves than the others (85% vs 42%-61%). This 85% rate of self-recognition approaches the 89% result in the pilot study on young adult patients in a dental school environment. Looking at our sample, stage V comprises subjects aged from 13 to 20 years. This heterogeneity in age for the same stage suggests that sexual maturity seems to be more important in the ability to recognize one's own profile than simply age. This finding can be confirmed by looking at the results of the stepwise regression analysis.

One hypothesis explaining this change in self-perception may be related to the dynamic nature of the soft-tissue profile, with more profile diversity being noticed because of dramatic changes during pubertal facial growth. Prepubertal subjects may show less diversity of profile, whereas subjects with an advanced sexual maturity rating (stage V) have already undergone important soft-tissue changes during puberty. For example, the nose grows significantly during adolescence,[19] and the lips reach their maximum fullness.[20] Moreover, facial profile convexity decreases with a complete expression of mandibular growth. Greater diversity with sexual maturation would create more distinctive facial profiles that would be easier to recognize by more sexually mature patients.

Sex seems to play a role in the ability to self-recognize one's profile, with female subjects recognizing themselves more often than males. However, in the present study, the total sample comprises more female than male subjects, and those with a sexual maturity rating of V (which may be the decisive factor) are mostly female (79%), which may introduce some bias. This result may be problematic, given that females achieve sexual maturation earlier than males. Therefore, further research is needed with larger and equal numbers of female and male participants to corroborate this observation. Sex differences were also found by Yin et al[15] who asked participants to select the image that most closely represented their facial profile from a series of 5 profile

silhouettes with different levels of convexity and/or concavity, finding that males had greater differences than females for their own perceived facial profiles.

When discussing sample size, a study with a larger sample would help show more subtle differences between the different sexual maturity rating stages. The rate of profile self-recognition in our sample at stage II is 42%, whereas this is 61% at stage III, for example. This observation highlights the changing bodies of the children. At stage III, the traits of sexual maturity become more visible, and the child adapts to these changes. Examples of evident changes are breast development in girls, lengthening of the penis in boys, and the appearance and darkening of pubic hair in both sexes.[21] It is possible that by observing the changes in one's body, the child is also more likely to be attentive to their face and their profile in a mirror. Likewise, factors such as hormonal changes, sexual desire, and behaviors are also changing during this period.[22] Self-awareness of the soft-tissue profile may take place during this particular period of puberty.

No other examined variable was correlated to facial profile self-recognition. The reason for pediatric consultation, at least in the present sample, doesn't seem to influence the ability of profile self-recognition, despite some of the patients exhibiting eating disorders. Body image distortion, dysmorphophobia and low self-esteem can be associated with such disorders,[23,24] and one might assume that the ability of profile self-recognition may be affected as well. However, the present sample was unable to answer this question, which requires research more specifically into the question of body image distortion in this context.

Interestingly, the history of past or active orthodontic treatment did not influence profile recognition either. This result is in line with a previous study of Kitay et al,[16] who created computer-animated distortions of 5 features of the lower third of participants' own profiles and found that orthodontic and nonorthodontic participants were equally accurate in being able to identify their own profile features. In an older study, Bell et al[12] asked adult patients that had been offered orthognathic surgery to identify profile drawings that most resembled their own profile and found a correlation, albeit weak, with the vertical dimension ($r = 0.38$). The present study did not examine the vertical dimension in this regard, but this would be interesting for further research.

If one looks at the first age category (<12 years) as an example in the present study, 1 in 2 children (50%) was able to recognize their own profiles. The reason why one child may be able to identify their profile while their peer is unable to do so is unclear. Interestingly all the subjects in this age category had a sexual maturity rating of I, indicating that differences in sexual maturity do not play a role in this age category. Therefore, there must be other factors, as of yet unidentified, that may influence profile self-recognition in children. In the present study, the operator asked the children which part of the profile they focused on to help them recognize themselves. Although anecdotal and neither measured objectively nor analyzed statistically as responses were open and varied greatly, it appeared that female teenagers focused more often on their noses and lips. The chin was also often evaluated, both by males and female subjects and throughout all age groups (those aged <12 years and >15 years).

With the emergence of new technologies and easy access to these technologies, children are exposed to smartphones and other digital devices at an early age. This early exposure, along with the frequent taking of *selfies* and other social network tools, could play a role in the age of self-recognition, which may perhaps be lower as society evolves technologically. Older studies may have found results different from what the present study found. One of the earliest studies looking at the self-perception of the facial profile was that of Hershon and Giddon,[11] who asked a group of adults to reproduce their profile using a profile-simulation device which comprised movable parts representing the forehead, nose, upper lip, lower lip, and chin. They found that the subjects were not able to reproduce their own profiles accurately. However, there is probably an important difference between recognizing one's own profile and being able to reproduce it.

Other recent studies also found that patients did not have a good ability to recognize their own profile type. Tufekci et al[13] showed 5 profile silhouettes (representing Classes I, II, and III and straight profiles) to study participants asking them to select the one most resembling their own, with only 43% of laypersons showing consistency between profile self-perception and objective evaluation. Al Taki and Guidoum[25] looked at self-awareness of the facial profile in an adult population by showing participants 3 generic profile silhouettes (concave, straight, and convex) and asking them to choose which image their own profile resembled most. The authors conclude that most of the laypersons were not self-aware of their profile type. In contrast, Bullen et al[14] asked 2 groups of laypersons, 1 aged 15-25 years, and the other aged 26-55 years, to select a facial profile that most resembled their own, and concluded that adolescents and young adults were found to estimate their profile accurately. It is important to point out

that as orthodontic clinicians, we often focus on patients who lie at the extremes of convexity to determine if these patients need morphologic changes to influence whether they are satisfied with treatment. However, the present study did not aim to study extremes but a group of patients with varied facial convexity in the absence of objective dysmorphology.

In an orthodontic practice, practitioners may be reluctant to evaluate the sexual maturity rating. One possibility to overcome this could be to ask the patient to characterize their own sexual maturity by being shown line drawings depicting different stages. Albeit not accurate enough for medical purposes, this self-assessment has been shown to meet the needs of epidemiologic studies[26] and may thus be useful for communication with the orthodontist. Other indices of maturation could be useful to adapt the communication with our patients about their soft-tissue. One such maturation index may be cervical vertebral maturation.[27] To the best of our knowledge, no study to date has compared the sexual maturity rating (Tanner staging) and cervical vertebral maturation staging used by the orthodontists. It would be interesting to examine whether a correlation exists between these 2 parameters, which would subsequently help the orthodontist better evaluate profile awareness and self-recognition of the patients.

CONCLUSIONS

In conclusion, facial profile self-recognition seems to be more predominant in older and more sexually mature children (>15 years; sexual maturity rating stage V). Girls may also be more likely to recognize their own profiles than boys. Because orthodontic treatment planning takes possible soft-tissue changes into account, it is important to evaluate the degree of self-perception of patients to adapt our goals and improve our treatment discussions.

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