Subjective facial analysis and its correlation with dental relationships

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Introduction: Subjective facial analysis is a diagnostic method that provides morphological analysis of the face. Thus, the aim of the present study was to compare the facial and dental diagnoses and investigate their relationship. **Methods:** This sample consisted of 151 children (7 to 13 years old), without previous orthodontic treatment, analyzed by an orthodontist. Standardized extraoral and intraoral photographs were taken for the subjective facial classification according to Facial Pattern classification and occlusal analyses. It has been researched the occurrence of different Facial Patterns, the relationship between Facial Pattern classification in frontal and profile views, the relationship between Facial Patterns and Angle classification, and between anterior open bite and Long Face Pattern. **Results:** Facial Pattern I was verified in 64.24% of the children, Pattern II in 21.29%, Pattern III in 6.62%, Long Face Pattern in 5.96% and Short Face Pattern in 1.99%. A substantial strength of agreement of approximately 84% between frontal and profile classification of Facial Pattern was observed (Kappa = 0.69). Agreement between the Angle classification and the Facial Pattern was seen in approximately 63% of the cases (Kappa = 0.27). Long Face Pattern did not present more open bite prevalence. **Conclusion:** Facial Patterns I and II were the most prevalent in children and the less prevalent was the Short Face Pattern. A significant concordance was observed between profile and frontal subjective facial analysis. There was slight concordance between the Facial Pattern and the sagittal dental relationships. The anterior open bite (AOB) was not significantly prevalent in any Facial Pattern.

Keywords: Malocclusion. Diagnosis. Orthodontics.

Introdução: a análise facial subjetiva é um método diagnóstico que privilegia a avaliação morfológica da face; assim, o principal objetivo do presente trabalho foi comparar os diagnósticos faciais e dentários e investigar a correlação entre eles. **Métodos:** a amostra consistiu de 151 crianças (7 a 13 anos de idade), sem nenhum tratamento ortodôntico prévio, analisadas por um ortodontista. Foram realizadas fotografias padronizadas extrabucais e intrabucais, para a classificação subjetiva dos Padrões Faciais e das relações dentárias segundo a classificação de Angle. Investigou-se a ocorrência de diferentes tipos de Padrões Faciais, em vistas frontal e de perfil; a relação entre os Padrões Faciais e as relações dentárias de Classe e, também, entre a má oclusão de mordida aberta anterior e o Padrão Face Longa. **Resultados:** o Padrão Facial I (PF I) esteve presente em 64,24% das crianças; o PF II, em 21,29%; o PF III, em 6,62%; o PF Face Longa, em 5,96% e o PF Face Curta, em 1,99%. Observou-se concordância substancial entre a avaliação do PF na vista frontal e na de perfil, igual a 84% (Kappa = 0,69). Houve concordância entre a avaliação da relação dentária de Classe e do PF em 63% da amostra (Kappa = 0,27). O PF Face Longa não demonstrou maior prevalência da má oclusão de mordida aberta. **Conclusão:** os Padrões Faciais I e II foram os mais prevalentes em crianças, enquanto o menos prevalente foi o Padrão Face Curta. Verificou-se concordância significativa entre as análises faciais frontal e de perfil. Existe uma ligeira concordância entre o Padrão Facial e a relação sagital dentária. A mordida aberta anterior não se apresentou mais prevalente em nenhum tipo de Padrão Facial.

Palavras-chave: Má oclusão. Diagnóstico. Ortodontia.

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

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INTRODUCTION

According to the classification of malocclusion proposed by Angle[1] in 1885, occlusal problems could be grouped regarding their similar origin and treatment, which would be very clinically useful. However, limitations were recognized with their routine use, especially because it is based only on dental relations without incorporating skeletal or facial features. The advent of cephalometric radiographs solved some shortcomings of Angle classification, incorporating information on hard tissue relationships, but still, little attention was placed on the soft tissues and facial analysis. Cephalometric analysis of soft profile was the most influential method in building awareness of the soft tissue as a diagnostic instrument.[2,3,4] Although it was emphasized long time ago that the soft-tissue facial profile may be of equal importance to the craniofacial skeleton in the assessment of orthodontic patients,[5,6] only more recently did orthodontists recognize the functional and esthetic aspects of the soft tissue as determinants in diagnosis and treatment planning.[7]

Several studies have shown the relationship between facial features and the skeletal and occlusal changes in malocclusions, concluding that information about skeletal and dental abnormalities can be derived from soft tissue analysis. Therefore, facial analysis should be used as a diagnostic tool. Significant correlations have been observed between skeletal and soft tissues in the anteroposterior discrepancy.[8-11] A recent study has demonstrated that sagittal and vertical occlusal deviations can be related to soft tissue morphology in children at the age of 4-6.[12] With this new concept about orthodontic facial diagnosis, variation is accepted as natural, and the average cephalometric measurements do not usually reflect the facial features of the patient. The orthodontist's task is to achieve the occlusal and facial outcomes that would mostly benefit an individual. Since the soft tissues largely determine the limitations of orthodontic treatment, from the perspectives of function and stability, as well as esthetics, the orthodontist must plan treatment within the patient's limits of soft tissue adaptation and soft tissue contours.[7] Driven by the same concern, and aiming to organize a diagnostic method supported by protocols and capable of providing specific predictions, in 2004, Capelozza Filho[13] developed a classification system for orthodontic problems based on facial morphology. According to this classification, the morphological analysis of the face is the main diagnostic tool for Facial Pattern determination[14] and the face is classified into five clinically subjective Patterns regardless of numerical averages: Facial Patterns I, II, III; Long and Short Face Patterns. This analysis has been frequently used with acceptable level of reproducibility.[13,15]

As described, previous studies have analyzed the relationship between the facial features and skeletal and occlusal characteristics. Such studies typically used facial measurements taken in photographs. Evaluations of the relationship between Angle classification and subjective facial analysis, which were the aim of this study, are scarce. Yet, it has been researched the occurrence of different Facial Patterns, the relationship between Facial Pattern classification in frontal and profile views, and between anterior open bite and Long Face Pattern.

MATERIAL AND METHODS

Subjects

The sample included a total of 151 students (82 male; 69 female; 7 to 13 years old) from two primary schools from the city of Bauru, São Paulo, Brazil. These students were at different stages of dentition, including mixed and permanent dentitions, and could not be or have undergone orthodontic treatment. The ethical approval was obtained from Bauru School of Dentistry, *Universidade de São Paulo* (University of São Paulo, Bauru/SP, Brazil).

Facial photographs

Standardized extraoral and intraoral photographs were taken for the subjective facial and occlusal analysis. The extraoral photographs consisted in the frontal and profile views, and the intraoral set consisted of a frontal, right and left side views (Figs 1 and 2).

The photographic camera used was a Maxxium 5D (Konica Minolta), with 28-80mm Sigma Macro lens and a 59MI Phoenix circular flash. For the extraoral photographs, a tripod was used for stabilization, the circular flash was turned on and the camera was set in manual mode, with an exposition time of 1/30 seconds, 0.22 of aperture, and ISO 100. Subject-camera distance was standardized at 65 cm. The subjects should be in natural head position, looking into a mirror, installed in front of them. Once these photos were taken, they were assembled in a slide show using Microsoft PowerPoint with a sequence of two slides per subject.

Figure 1 - Illustrative extraoral photographs.

Figure 2 - Illustrative intraoral photographs.

Facial and occlusal classifications

The subjective facial evaluation was performed by a calibrated evaluator who classified the subjects into five groups according to their facial features: Pattern I, II, III; Long or Short Face facial patterns. This classification is subjective and based on the analysis of various facial features, which are described in detail in related works.[13,15,16,17] In brief, Facial Pattern I has harmonious facial growth in the sagittal and vertical direction, good relationship between maxilla and mandible and proportionality between the facial thirds. This Pattern show as particularities: facial symmetry, good zygomatic projection, pleasant nasolabial angle, passive lip sealing or discrete interlabial space, well defined chin-neck line and angle. Facial Pattern II has a convex profile with either maxillary excess or mandibular deficiency, or even a combination of both. Facial Pattern III presents a flat to concave facial profile, resulting from maxillary deficiency, mandibular excess or a combination of both. Vertically, the Long Face Pattern shows a vertical excess of the lower facial third combined or not with a decreased middle third and an active lip contact. Contrarily, the Short Face Pattern shows a decreased lower facial third, with lip compression at rest. In this classification, the vertical Pattern (Long or Short Face) is always leading on the sagittal. For example, if the patient has features of Pattern III and also Long or Short Face, it is classified as a Long or Short Face. The Facial Pattern classification was separately performed on the frontal and profile views, which ensures characteristics of different severity.[13,14,15] An Asymmetry Pattern was also incorporated in the classification, qualitatively and subjectively evaluated on frontal view, for the presence of visible mandibular laterognathism.

The subjects' anteroposterior occlusion was also classified into Classes I, II or III according to Angle's classification.[1] One researcher performed this assessment in intraoral photographs, and possible doubts were solved on a clinical examination. If the first permanent molars were absent, the relationship between upper and lower deciduous canines would be evaluated. If the first permanent molars and deciduous canine were absent, the child would not be included in this investigation. There is Class I canine relationship when the maxillary canine occludes between the lower deciduous canine and the deciduous first molar. In Class II malocclusions the maxillary canine occludes mesially and, in Class III malocclusions, distally to this position. Patients with a subdivision Class II or III relationship were classified as Class II or III. Anterior open bite was also investigated

and characterized by the presence of negative overbite observed in intraoral frontal view photograph — except for cases in which permanent incisors were in active eruption process.

Intraexaminer agreement

The examiner was submitted to a Kappa test in two different periods, after a 30-day interval. In the first evaluation, 28 patients were examined in both frontal and profile views, and repeated after 30 days.

Statistical analyses

Concordance between the facial subjective classification in the frontal and profile views, as well as between the facial profile classification and sagittal dental relationship was investigated with Kappa statistics.

Association between anterior open bite and Long Face Pattern was evaluated with Fisher's exact test and the level of statistical significance was set at 5%. All statistical analyses were performed with Statistical Package for Social Sciences (SPSS), version 5.0 (SPSS Inc., Surrey, UK).

RESULTS

The intra-examiner concordance was analyzed by the Kappa test, showing to be moderate and substantial depending on the view (0.60 for the frontal view and 0.74 for the profile view).

Table 1 shows the occurrence of different Facial Patterns according to the frontal and profile analyses, respectively. Pattern I individuals were the majority in both classifications (frontal = 72.85% and profile = 64.24%). In the profile evaluation, although Facial Pattern I was also prevalent, the percentage of Facial Pattern II showed an increase when compared with the frontal view, with a reduction in the percentage of Pattern I. Moreover, Kappa test showed a substantial strength of agreement (0.69) between frontal and profile analyses. When analyzing the relation between the frontal and profile views, there is a tendency of the score between them being the same, i.e., 127 out of 145 patients presented the same Facial Pattern classification. This tendency cannot be determined in the Asymmetry Facial Pattern because it is not possible to be evaluated in the profile view.

In the sagittal analysis, an agreement of 63.31% between the classification of Facial Pattern (I, II and III) and teeth relationship (Class I, II and III) was verified, i.e., agreement occurred in most of the cases, but it was not mandatory (Table 2). Besides, Kappa test showed only a slight strength of agreement (0.27).

Table 3 shows the prevalence of anterior open bite between different Facial Patterns on the frontal analysis, demonstrating that the Long Face Pattern showed no more anterior open bite than the others ($p = 0.501$).

Table 1 - Occurrence percentage of different Facial Patterns according to the frontal and profile analysis (agreement between frontal and profile analysis, Kappa = 0.69).

FRONTAL	PROFILE Pattern I	PROFILE Pattern II	PROFILE Pattern III	PROFILE Long Face	PROFILE Short Face	TOTAL
Pattern I	93 (61.59%)	14 (9.27%)	3 (1.99%)	0	0	110 (72.85%)
Pattern II	0	18 (11.92%)	0	0	0	18 (11.92%)
Pattern III	1 (0.66%)	0	4 (2.65%)	0	0	5 (3.31%)
Long Face	0	0	0	9 (5.96%)	0	9 (5.96%)
Short Face	0	0	0	0	3 (1.99%)	3 (1.99%)
Asymmetry	3 (1.99%)	0	3 (1.99%)	0	0	6 (3.97%)
TOTAL	97 (64.24%)	32 (21.29%)	10 (6.62%)	9 (5.96%)	3 (1.99%)	151 (100%)

Table 2 - Agreement percentage between sagittal dental relationship (Angle classification) and the Facial Pattern.

PROFILE	Class I	Class II	Class III	Total
Pattern I	66 (47.48%)	24 (17.27%)	7 (5.04%)	97 (69.78%)
Pattern II	12 (8.63%)	18 (12.95%)	2 (1.44%)	32 (23.02%)
Pattern III	6 (4.32%)	0	4 (2.88%)	10 (7.19%)
Total	90 (64.75%)	36 (25.9%)	13 (9.35%)	139 (100%)

Table 3 - Prevalence of anterior open bite (AOB) among different Facial Patterns in the frontal analysis.

FRONTAL	AOB (No)	AOB (Yes)	Total
Pattern I	105 (95.45%)	5 (4.55%)	110
Long Face	8 (88.89%)	1 (11.11%)	9
Pattern II	18 (100%)	0	18
Asymmetry	4 (66.67%)	2 (33.33%)	6
Pattern III	4 (80%)	1 (20%)	5
Short Face	3 (100%)	0	3
Total	142	9	151

DISCUSSION

Facial analysis performed unconsciously and daily by ordinary people, directly influences perception of the characteristics of people we interact with, and is notoriously influenced by the occlusal characteristics and vice versa.[17] It is known that the ratings of attractiveness, intelligence, conscientiousness, pleasantness and acceptance differed significantly depending on the occlusal status depicted. Persons with normal occlusion were rated as most attractive, intelligent, agreeable and extraverted, whereas persons with prognathism were rated as least attractive, intelligent, and extraverted.[18] Furthermore, persons with ideal smiles are considered more intelligent and have a greater chance of finding a job when compared with persons with non-ideal smiles.[19] These points highlight the important of facial appearance in orthodontic diagnosis and planning, showing that obtaining good occlusal outcomes, regardless of the facial damage, is not the best way today. The search for the appropriate diagnosis and treatment for the patient's Facial Pattern seems to be the best choice, specially when the patient's complaint is the face. Therefore, subjective facial analysis is a diagnostic tool which has had its importance increased for being the parameter by which patients and the people they live with will evaluate the treatment results.[17] Besides, organizing orthodontic diagnosis according to the Facial Patterns allows orthodontists to treat malocclusions based on the location of skeletal discrepancies—if they are present—, or the etiology of the malocclusion, establishing treatment protocols that are tailored specifically to each Pattern in each age group, with short-term protocols and predictable long-term prospects by taking into account discrepancy severity.[14]

Facial analysis can be performed in several ways, including the use of angular or linear measurements,[20] but these methods cause significant errors when trying to tailor each individual to population average standards.[7] It is known that diagnoses performed from Angle classification and cephalometric references lead to results which are not always compatible with the patient's esthetic expectations.[21] Combined with the establishment of ideal occlusal relationship, the best esthetic as possible must be pursued.[22] For that, diagnosis must be primarily based on the frontal and profile facial morphology, on the smile assessment and complemented by occlusal evaluation, whose discrepancy commonly is a consequence of skeletal error.[14] Radiographs are also an important tool, however 75% of the orthodontic diagnoses are defined without its evaluation and do not change after its study.[23]

To show that subjective facial analyses are reproducible, a previous publication applied statistical tests to evaluate the agreement, evidencing that agreement between raters and a gold standard was moderate, with raters exhibiting greater agreement between them (Kappa = 0.85) than with the gold standard (0.48). So, with training and experience, the subjective and qualitative facial analysis can be effectively and individually used for each patient.[14] In this research, intra-examiner agreement was also analyzed by the Kappa test, showing to be moderate and substantial depending on the view (0.60 for the frontal view and 0.74 for the profile view), similarly to the literature. It is important to point out that the evaluator that classified Facial Patterns in this research was the same called as gold standard in previous publication, and who was the creator of Facial Pattern classification.[14]

A substantial agreement of approximately 84% between frontal and profile classification of Facial Pattern was observed (Table 1). Among discordant cases, most were considered Pattern I in the frontal analysis and Pattern II in profile assessment. This fact occurs because changes in Pattern II are especially sagittal and essentially viewed in profile view. So, if these changes are subtle, they will probably not be identified in the frontal analysis. This explains the differences between the proportions of Patterns I and II found in the frontal and profile analyses.[13,15] When an individual is classified as Pattern I in the frontal view and as Pattern II or III in the profile view, this means that the discrepancy was not severe enough to compromise the front view, thus, treatment prognosis may be better. If an individual is diagnosed as Pattern II in the profile analysis and Pattern I in the frontal analysis, this individual should be approached as a Pattern II.[13,15]

The Facial Patterns frequencies in children in deciduous dentition has already been demonstrated for Pattern I (63.22%), Pattern II (33.10%) and Pattern III (3.68%).[24] In this investigation, in mixed and initial permanent dentitions, Pattern I has been observed in 64.24%, Pattern II in 21.29%, Pattern III in 6.62%, Long Face Pattern in 5.96% and Short Facial Pattern in 1.99%. The Short and Long Face Patterns have not been evaluated by researchers in the deciduous dentition because, in this phase of craniofacial growth and development, they are not well defined. Comparing the results, only small differences on Facial Patterns distributions between deciduous and mixed/permanent dentitions can be observed. These data reinforce the fact that facial morphology is early defined and kept along the growth.[25] The literature confirms that, by showing that Pattern II is present from deciduous dentition and mandibular growth and does not improve facial skeletal relationship along the evolution of the deciduous, mixed and permanent dentitions.[26-29]

Agreement between Angle classification and Facial Pattern was seen in approximately 63% of cases (Table 2). The percentage of concordance was relevant, however the kappa test showed only slight force. Although less marked, natural dentoalveolar compensation also exists in the sagittal plane, where individuals with facial Patterns II or III may present Class I dental relationships consequent to dental compensations. Moreover, occlusal problems with dentoalveolar origin may lead to Class II or III dental relationships in patients with facial Pattern I. In these, the treatment prognosis is better because there are no skeletal discrepancies.[13]

In general, dental positioning is a consequence of skeletal error which characterizes the malocclusion. This correlation foresees the dental problems which different types of Patterns will tend to present. To make this evaluation precociously, understanding how the growth is going to occur implies in defining real and coherent possibilities of treatment, with a more realistic and stable prognosis. In general, Angle classification tends to reflect sagittal behavior of the facial skeleton in all Facial Patterns. The only available research about this relation reveals a tendency of Class following the Facial Pattern from the deciduous dentition, which was more evident in Pattern II. In Pattern I, Class I prevailed (62.99%), followed by Class II (35.82%) and Class III (1.18%). In Pattern II, Class II prevailed (81.35%) followed by a low incidence of Class I (18.64%). In Pattern III, Class III was present in 50% of the children, followed by Class I in 48.64%, and Class II in 1.35%.[30]

In this research involving children with mixed and permanent dentition, it has been confirmed the tendency of Angle classification to follow the Facial Pattern, especially in Patterns I and II. In Pattern I, 68% showed Class I, 24.8% Class II and 7.2% Class III. In Pattern II, 37.5% were Class I, 56.25% Class II and 6.25% Class III. In Pattern III, 60% were Class I and 40% Class III. Comparing these researches, we can observe just small differences in the distributions of Classes in the Facial Patterns between deciduous and mixed/permanent dentitions. The greatest variation was

observed in Pattern II, where the occurrence of dental relation of Class II decreased in the mixed and permanent dentitions in relation to what was described for the deciduous dentition. Possible explanations for these small differences among the researches are the reference for the Class classification (in deciduous dentition, authors used the deciduous canine and, in mixed and permanent dentition, the permanent molars are used), the adjustment of molar's relation with the major inferior Leeway space and the differential mandibular growth in adolescence.[31] An interesting suggestion for future research is to investigate the Facial Pattern and its relationship with Angle classification separately in the mixed and permanent dentitions, in order to point out possible differences, which cannot be performed in this sample due to the restrict number of participants.

The anterior open bite (AOB) was not significantly prevalent in any Facial Pattern (Table 3). A possible explanation is that the children evaluated in this research were mostly in the mixed dentition, and the main etiological factors of anterior open bite at this stage are the oral habits, causing dentoalveolar changes, regardless of the Facial Pattern. Oral habits have a high frequency in children and deleterious habits most frequently associated are pacifier and thumb sucking, and tongue thrust.[32,33] Other explanation is the high potential for dentoalveolar vertical compensation, evidenced by excessive gingival tissue exposure without anterior open bite, characterizing the gingival smile.[34]

CONCLUSIONS

1. Facial Patterns I (64.24%) and II (21.29%) were the most prevalent in children, followed by Pattern III (6.62%), Long Face Pattern (5.96%) and Short Face Pattern (1.99%).

2. Agreement between profile and frontal subjective facial analysis was substantial. The divergences seem to be related to patients with slight sagittal skeletal error that are preferably identified in profile rather than in frontal analysis.

3. There was slight concordance between Facial Pattern and sagittal dental relationships.

4. The anterior open bite was not significantly prevalent in any Facial Pattern.

Authors contribution

Conception or design of the study: GSS, LCF. Data acquisition, analysis or interpretation: GSS, LCF, DCL, GJ. Writing the article: GSS, DCL, GJ, JFCH. Critical revision of the article: GSS, LCF, DCL, GJ, JFCH. Final approval of the article: GSS, LCF, DCL, GJ, JFCH.

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