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IS CUTANEOUS PROFILE PERCEPTION AN INDICATOR OF SKELETAL CLASS III MALFORMATION TREATMENT PLAN? A CROSS SECTIONAL STUDY.

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Background: The treatment choice in adults with skeletal class III malocclusion represents a challenging task for orthodontists, especially in borderline cases. With the growth spurt being surpassed, the clinician is left between two treatment options: orthodontic camouflage or orthognathic surgery. Around the years, many studies tried to uncover a guide model which enables practitioners to distinguish between skeletal class III that can be appropriately treated by orthodontics alone and those needing surgical intervention.

Aim: The aim of this study is to demonstrate the importance of cutaneous profile perception as a subjective decisive parameter in the treatment of borderline skeletal class III adult patients and, as a secondary objective, to compare it with the most decisive cephalometric parameters found in previous studies.

Material and methods: Among 28 skeletal class III patients found in the Saint Joseph university orthodontics department's data base, 10 different adult patients: 4 males and 6 females have met the inclusion criteria. Three types of data have been gathered from each patient: lateral cephalograms, profile photographs and the treatment that the patient underwent. To understand the significance of profile perception in the treatment plan for these patients, all of the 10 patients› profile photographs were put in a survey that was sent to 3 groups of people: orthodontists, dentists, and laypersons. Each participant should evaluate based only on his/her perception of the photo if the patient should be treated by orthodontic-surgical treatment or if an orthodontic camouflage alone is enough. In addition, the efficiency of profile perception will be compared with the efficiency of the most decisive cephalometric parameters found in literature: ANB angle=-4°, Witts appraisal =-5.8mm.

Results: A total of 158 participants were included in this study. When we compare what participants chose based on profile perception with real treatment, 75% of orthodontists have correctly classified the patients. Lower rates were noted for dentists and laypeople, respectively 65% and 64.5%. If we also consider the cephalometric values found in literature (ANB=-4°, Witts appraisal=-5.8mm) as the correct treatment that should have been done, 70% of the patients were correctly treated in our faculty.

Conclusion: There are no cephalometric or clinical golden standards to decide between surgical intervention or orthodontic camouflage in adult patients presenting skeletal class III malformation. Cephalometric values are very useful but insufficient tools even when many parameters are combined. Both objective and subjective criteria should be taken into consideration to individualize each treatment plan according to each patient.

Key words: Skeletal class III malocclusion, Adult, Orthodontic camouflage, Orthognathic surgery, Cutaneous profile perception.

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Conflicts of interest:
The authors declare no conflicts of interest.

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***ORIGINAL ARTICLE** / ARTICLE ORIGINAL*

***Orthodontics** / Orthodontie*

LA PERCEPTION DU PROFIL CUTANÉ EST-ELLE UN INDICATEUR DU PLAN DE TRAITEMENT DES CLASSE III SQUELETTIQUES ? UNE ÉTUDE TRANSVERSALE.

Contexte : Le choix du traitement chez les adultes présentant une malocclusion de classe III représente un défi pour les orthodontistes, en particulier dans les cas limites. Le pic de croissance étant dépassé, le clinicien se retrouve face à deux options de traitement : le camouflage orthodontique ou la chirurgie orthognatique. Au fil des ans, de nombreuses études ont tenté de découvrir un guide permettant aux praticiens de faire la distinction entre les classes III squelettiques qui peuvent être traitées de manière appropriée par l›orthodontie seule et celles qui nécessitent une intervention chirurgicale.

Objectif : L›objectif de cette étude est de démontrer l›importance de la perception du profil cutané en tant que paramètre subjectif décisif dans le traitement des patients adultes présentant une classe III squelettique limite et, en tant qu›objectif secondaire, de la comparer aux paramètres céphalométriques les plus décisifs trouvés dans des études antérieures.

Matériel et méthodes : Parmi les 28 patients de classe III squelettique trouvés dans la base de données du service d'orthodontie de la faculté de médecine dentaire de l'université Saint Joseph de Beirut, 10 patients adultes différents : 4 hommes et 6 femmes ont satisfait les critères d›inclusion. Trois types de données ont été recueillis pour chaque patient : des téléradiographies de profil, des photographies de profil et le traitement subi par le patient. Pour comprendre l›importance de la perception du profil dans le plan de traitement de ces patients, les photographies de profil des 10 patients ont été incluses dans une enquête envoyée à trois groupes de personnes : orthodontistes, dentistes et profanes. Chaque participant devait évaluer, basé uniquement sur sa perception de la photo, si le patient devait être traité par un traitement orthodontico-chirurgical ou si une un camouflage orthodontique était suffisant. En outre, l›efficacité de la perception du profil sera comparée à l›efficacité des paramètres céphalométriques les plus décisifs trouvés dans la littérature : ANB angle=-4°, évaluation de Witts =-5.8mm.

Résultats : Au total, 158 participants ont été inclus dans cette étude. Lorsque nous comparons ce que les participants ont choisi basé sur leur perception du profil avec le traitement réel, 75 % des orthodontistes ont correctement classé les patients. Des taux plus faibles ont été notés pour les dentistes et les profanes, respectivement 65% et 64,5%. Si nous considérons également les valeurs céphalométriques trouvées dans la littérature (ANB=-4°, évaluation de Witts=-5.8mm) comme le traitement correct qui aurait dû être fait, 70% des patients ont été correctement traités dans notre faculté.

Conclusion : Il n›existe pas de «golden standard» céphalométrique ou clinique pour décider entre une intervention chirurgicale ou un camouflage orthodontique chez les patients adultes présentant une malformation squelettique de classe III. Les valeurs céphalométriques sont des outils très utiles mais insuffisants, même lorsque de nombreux paramètres sont combinés. Les critères objectifs et subjectifs doivent être pris en considération pour individualiser chaque plan de traitement en fonction de chaque patient.

Mots clés : Malocclusion de classe III, adulte, camouflage orthodontique, chirurgie orthognatique, perception du profil cutané.

Introduction

In the 1800s, Edward H.Angle developed the concept of normal occlusion in natural dentition. A normal occlusion occurs when "the mesiobuccal cusp of the upper first molar occludes in the buccal groove of the lower first molar while all teeth are aligned on a smoothly curved line of occlusion". Based on this particular relationship, Angle described three different types of malocclusion, from which, we will only focus on class III malocclusion [1,2]

According to Angle, dentoalveolar class III is characterized by a relative mesial occlusion in both lateral halves of lower dental arches to the extent of at least one half the width of single cusp on each side [3].

Skeletal class III is a cranio-facial disharmony affecting either the cranial base, the maxilla and/or the mandible [4,5]. More precisely, it corresponds to a discrepancy of the skeletal relation between both jaws characterized by a relatively anterior position of the mandible compared to the maxilla [6].

Class III has the lowest global prevalence of all of Angle's malocclusion classes. Skeletal Class III incidence varies from 5.92% for Caucasians, 3.8% for Africans and 9.63% East Asians [7].

Even though skeletal class III is relatively rare, it is considered one of the most difficult pathologies to treat for an orthodontist. Nowadays, interception treatments of skeletal class III development in predisposed young patients has shown to be very efficient in preventing the development of skeletal class III in adult age. Such interception treatments consist of extra-oral orthopedic devices. These devices will no longer be efficient to use once the patient has reached skeletal maturity. When skeletal growth peak is surpassed, orthodontists are put in front of two treatment options: orthodontic camouflage or orthognathic surgery [7,8].

Deciding which treatment strategy is best for individuals with skeletal Class III malocclusion is a challenging task since not all of them are eligible for orthodontic treatment alone due to the variety of clinical forms.

Treatment decisions for young patients are heavily influenced by skeletal age and the etiology, which defines the possibility of growth modification treatment. However, for adult patients, the severity of this malocclusion, as determined by several clinical and cephalometric parameters, is the most essential element in treatment planning.

In order to make treatment decisions more objective, many authors attempted to develop cephalometric and clinical yardsticks related to facial appearance as well as to dentoalveolar and skeletal compensations by conducting different studies discussing the following parameters:

- The antero-posterior skeletal discrepancy: The ANB angle is one a cephalometric measurement of inter-maxillary sagittal skeletal relationship. Kerr and al have set up a cut off value of ANB=-4° below which each adult patient should undergo an orthognathic surgery. On another note, Eslami et al.in 2018 assumed that Wits appraisal greater than – 5.8 mm would be effectively corrected by camouflage and less than – 5.8 mm must be treated by orthognathic surgery. According to a 2022 study, from a functional standpoint, a cutoff value of -6mm has been found, below which orthodontic treatment alone will not correct any present masticatory disorder [12].
- Vertical skeletal discrepancy: Studies support the relevance of the vertical component in Class III patients' treatment decisions [9]. A hyperdivergent facial configuration is considered as a unfavorable factor for orthodontic camouflage treatment.
- Incisors inclination: Mandibular incisor inclination: According to Proffit and Ackermann, orthodontic teeth movement is restricted to maxillary incisor protrusion of 2 mm and/or a mandibular retrusion of 3 mm therefore making any negative overjet exceeding 5 mm inefficiently treated by orthodontics methods alone. Other studies have showed that mandibular incisive inclination of less than 83° leads to orthodontic camouflage failure [9].
- Facial esthetic: One indicator of facial esthetic is the Holdaway angle formed by soft tissue nasion – soft tissue pogonion – tangent to upper lip. This angle measures the protrusion of the upper lip in relation to the soft-tissue profile and is unaffected by the skeletal discrepancy between the bases (ANB angle). As a result, it is ideal for defining the profile of borderline surgical skeletal Class IIIs, in whom esthetics and facial look may be more important than occlusion or skeletal disparity. Rabie et al. 2008 affirmed the importance of Holdaway angle in treatment planning for skeletal class III patients. A Holdaway angle greater than 12° can be successfully treated by camouflage orthodontics alone. In the same logic, a Holdaway angle less than 12° indicates the necessity orthodontic-surgical treatment [10]. In a similar study Benyahia et al. 2011 found a borderline value of 7.2°[10]. The big difference between the findings of these 2 studies has brought Eslami et al. 2018 to conduct another study: He found a borderline value of 10.3°[11].

The aim of this study is to demonstrate the importance of cutaneous profile perception as a subjective

decisive parameter in the treatment of borderline skeletal class III adult patients and, as a secondary objective, to compare it with the most decisive cephalometric parameters found in previous studies.

Materials and methods

The ethical approval for this study was obtained by the ethics committee of the Saint Joseph University of Beirut (Tfemd/2023/27) and the study was conducted in accordance with the declaration of Helsinki and Good Clinical Practice guidelines. This study took place at the department of orthodontics in the faculty of dental medicine at Saint Joseph University of Beirut. The following protocol was followed:

Inclusion and exclusion criteria

The study included adult caucasian patients only (>18 years old) with a confirmed skeletal class III (ANB angle < 0° and Witts appraisal <-1mm) and a normodivergent skeletal pattern (FMA angle= 24±4° or Go-Gn-Sn= 32±5°). Patients who underwent orthopedic treatment when they were young, patients presenting other skeletal malformation (facial asymmetry, malformation syndromes) and, patients with missing teeth (agenesis, extracted teeth except for wisdom teeth) have been excluded from this study.

Population and study design

Among 28 skeletal class III patients found in the department's data base, 10 different adult patients: 4 males and 6 females have met the inclusion criteria. Three types of data have been gathered from each patient:

1. Lateral cephalograms from which Wits appraisal, ANB angle, and Z angle values will be used. The lateral cephalograms have been taken in a standardized manner. Subjects were seated, with ear rods and frontal support. The head has been fixed by orienting the Frankfort horizontal plane parallel to the floor. The cephalometric values used in this study are taken from the analysis which was already done in the past to treat the patient using Dolphin Imaging Software.
2. Profile photographs have been used to measure the perception of these patients by sharing them through a survey. We used the photographs that were taken previously for the patient treatment. Profile photographs were taken in a standardized manner: patients were standing with the head positioned naturally next to a white backgroud. To understand the significance of profile perception in the treatment plan for these patients, all of the 10 patients' profile photographs were put in a survey (Google forms) that was sent to 3 groups of people: orthodontists, dentists, and laypersons (Figure 1). Each participant should evaluate based only on his/her perception of the photo if the patient should be treated by orthodontic-surgical treatment or if an orthodontic camouflage alone is enough. It should be noted that patients appearing in the photo are unrecognizable. Also, one of the photos was put twice in the survey to evaluate the intra-participant agreement and photos were put in aleatory order. The answers were displayed in pie charts then downloaded and analyzed on Excel Sheet.
3. The real treatment that the patient underwent: orthodontic camouflage or orthognathic surgery.

Figure 1: The 10 profile photographs used in this study.

Statistical tests have been done to find the following significant relations:

- The intra-evaluator agreement.
- The agreement between the 3 different categories of evaluators.
- Relation between profile perception and cephalometric values (ANB angle: -4°, Witts appraisal: -5,8mm, Z angle).
- Relation between cephalometric values and the treatment that the patient underwent to see if it matches with the findings in the literature.
- Relation between profile perception and the treatment that the patient underwent.

Statistical analysis:

The intra-rater agreement was calculated using Cohen's Kappa coefficient with a Kappa value between 0.61 and 0.8 considered substantial agreement and greater than 0.81 considered perfect agreement. A p-value less than 0.05 was considered statistically significant.

Statistical analysis was carried out using IBM SPSS Statistics 25. First, a descriptive analysis was carried out: the qualitative variables were presented in the form of frequencies and percentages. The independent samples T-test was used to assess the presence of potential statistically significant differences between mean ANB, WITS, and Angle Z measures separately from one side and the decisions made by the different categories of participants from the other side to measure the effect of each these values on profile perception.

Results

A total of 158 participants were included in this study, distributed as follows:

Table 1: Participants characteristics (n=158)

Variable	N (%)
Age	
<18	2 (1.3)
18-25	85 (53.8)
25-40	31 (19.6)
>40	40 (25.3)
Gender	
Male	63 (39.9)
Female	95 (60.1)
Category	
Orthodontists	47 (29.7)
Dentists	54 (34.2)
Other	57 (36.1)

Intra-evaluator agreement:

The Cohen's Kappa coefficient for the total of participants was equal to 0.58 indicating a low level of agreement, with a p-value of less than 0.001 indicating that the agreement is not due to chance alone.

Table 2: Cohen's Kappa coefficient based on category (n=158)

Category	Cohen's Kappa	P-value
Orthodontists	0.804	<0.001**
Dentists	0.445	0.001*
Others	0.532	<0.001**

A nearly perfect agreement has been found among orthodontists. However, a low level of agreement has been found for dentists and laypeople.

Agreement between the 3 different categories

Table 3: Participants treatment choice for the different photos (n=158)

	Category						P-value*
	Orthodontist		Dentist		Other		
	Jaw Surgery	Orthodontic camouflage	Jaw Surgery	Orthodontic camouflage	Jaw Surgery	Orthodontic camouflage	
Photo 1 ANB=-3.7 Wits=-6.7 Angle Z=85.4	2 (4.3)	45 (95.7)	4 (7.4)	50 (92.6)	7 (12.3)	50 (87.7)	0.360
Photo 2 ANB=-0.7 Wits=-3.8 Angle Z= 92.1	15 (31.9)	32 (68.1)	19 (35.2)	35 (64.8)	22 (38.6)	35 (61.4)	0.797
Photo 3 ANB=-1.1 Wits=-4.5 Angle Z=92.3	6 (12.8)	41 (87.2)	10 (18.5)	44 (81.5)	17 (29.8)	40 (70.2)	0.090

Photo 4 ANB=-0.3 Wits=-2.2 Angle Z=76.4	9 (19.1)	38 (80.9)	22 (40.7)	32 (59.3)	25 (43.9)	32 (56.1)	**0.016***
Photo 5 ANB=-0.3 Wits=-3.4 Angle Z=83.1	24 (51.1)	33 (48.9)	27 (50.0)	27 (50.0)	39 (68.4)	18 (31.6)	0.096
Photo 6 ANB=-1.7 Wits=-8.0 Angle Z=73.1	25 (53.2)	22 (46.8)	17 (31.5)	37 (68.5)	29 (50.9)	28 (49.1)	**0.049***
Photo 7 ANB=-0.4 Wits=-2.0 Angle Z=72.2	2 (4.3)	45 (95.7)	9 (16.7)	45 (83.3)	6 (10.5)	51 (89.5)	0.130
Photo 8 ANB=-5.4 Wits=-4.5 Angle Z=84.1	40 (85.1)	7 (14.9)	48 (88.9)	6 (11.1)	41 (71.9)	16 (28.1)	0.060
Photo 9 ANB=-2.0 Wits=-5.3 Angle Z=93.4	25 (53.2)	22 (46.8)	22 (40.7)	32 (59.3)	35 (61.4)	22 (38.6)	0.096
Photo 10 ANB=-0.6 Wits=-5.6 Angle Z=78.6	11 (23.4)	36 (76.6)	23 (42.6)	31 (57.4)	20 (35.1)	37 (64.9)	0.109

*Comparison between the different categories

Statistically significant differences were found between the answers of the different categories of participants for photos 4 and 6 with p-values equal to 0.016 and 0.049, respectively. As a result, no difference has been noted in the perception of different categories of participants for the same case except for 2 out of 10 profile images.

Relation between profile perception and cephalometric values:

- Statistically significant differences were found between the orthodontists' decisions based on ANB measures with $p<0.001$.

Table 4: Decision of orthodontists based on WITS, ANB and Z angle

	Orthodontists		P-value
	Jaw Surgery	Orthodontic camouflage	
	Mean ± SD	Mean ± SD	
WITS	-4.9 ± 1.6	-4.8 ± 1.8	0.479
ANB	-2.2 ± 2.0	-1.4 ± 1.3	**<0.001****
Angle z	83.8 ± 6.9	83.6 ± 7.9	0.763

Table 5: Decision of dentists based on WITS, ANB and Z angle measures

	Dentists		P-value
	Jaw Surgery	Orthodontic camouflage	
	Mean ± SD	Mean ± SD	
WITS	-4.5 ± 1.6	-4.9 ± 1.8	**0.003***
ANB	-1.9 ± 2.1	-1.5 ± 1.3	**0.003***
Angle z	83.2 ± 6.7	83.7 ± 8.0	0.528

- Statistically significant differences were found between the dentists' decisions based on WITS and ANB measures with p=0.003 for both tests.

Table 6: Decision of laypeople based on WITS, ANB and Z angle measures

	Other people		P-value
	Jaw Surgery	Orthodontic camouflage	
	Mean ± SD	Mean ± SD	
WITS	-4.6 ± 1.7	-4.8 ± 1.8	0.261
ANB	-1.8 ± 1.8	-1.6 ±1.5	0.283
Angle z	83.7 ± 7.1	83.2 ± 7.9	0.411

Statistically significant differences were found for ANB angle in orthodontists and for both ANB angle and Wits appraisal for dentists. No significant results were found in laypeople group. No significant results were found for Z angle for any of the categories.

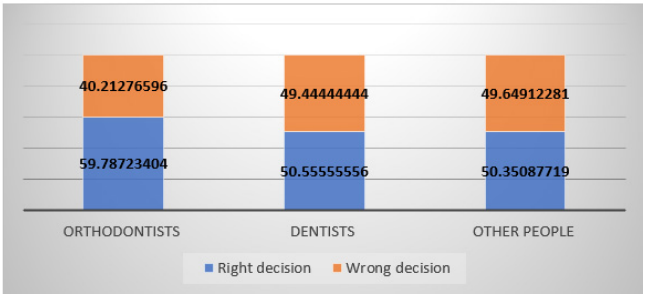

Figure 2: Figure showing the right decision based on WITS for the different categories.

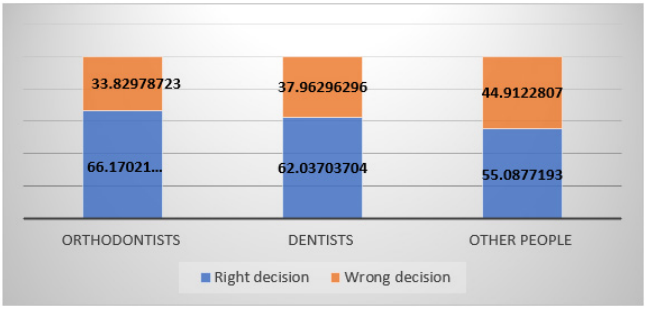

Figure 3: Figure showing the right decision based on ANB for the different categories of participants.

Relation between the cephalometric values and the treatment conducted:

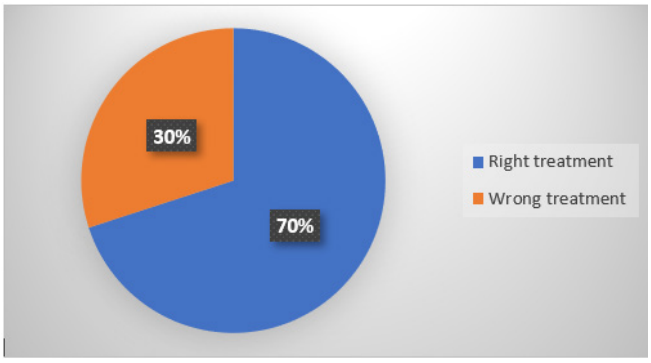

Figure 4: Figure showing when the right treatment was conducted based on WITS (n=10).

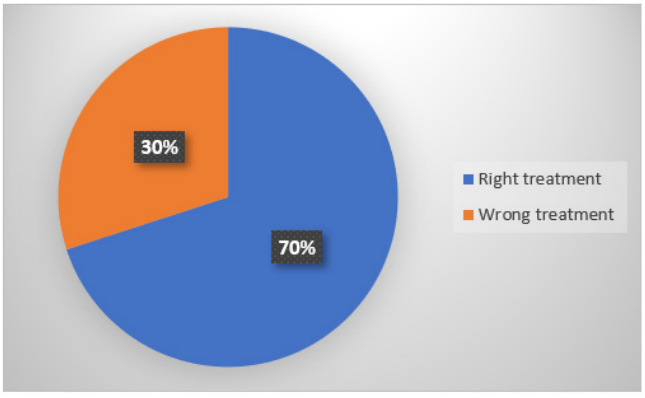

Figure 5: Figure showing when the right treatment was conducted based on ANB (n=10).

Relation between profile perception and the treatment conducted:

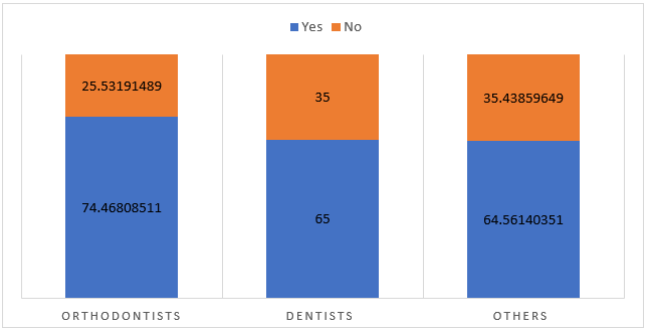

Figure 6: Figure showing when the treatment conducted was the treatment of choice of participants.

75% of orthodontists have correctly classified the patients on basis of the conducted treatment. Lower rates were noted for dentists and laypeople, respectively 65% and 64.5%.

Discussion

Based on Cohen's Kappa coefficient (Table 2), nearly perfect agreement among orthodontists has been found, proving that the answers provided by each orthodontist participant represent accurate statistics. On the other side, the low-level agreement among dentists and laypeople decreases the reliability of their answers. However, their answers remain significant as the agreement between them is not due to chance alone. These results are in concordance with another similar study which concludes that not only orthodontists but also maxillofacial surgeons showed great agreement among them [13]. Such significant agreement may be because orthodontists have a more critical eye on such profile differences as a result of their clinical experience in examining their patients' profiles.

Even if intra-evaluator agreement among specialists is high, it only indicates the degree of reliability of their answers. The real difference in the cutaneous profile perception between various categories is still controversial. Some reports suggest that laymen and professionals perceive facial aesthetics differently (Lines et al., 1978; Prahl-Andersen et al., 1979), with the general public demonstrating the greatest variation in what they consider attractive (Cochrane et al., 1999). On the other hand, Shelly et al. (2000) and Maple et al. (2005) reported agreement between laymen and professionals in their perception of facial aesthetics [14] . In our case dentists, orthodontists and laypeople had the same perception of 8 out of 10 profile images (Table 3). This agreement in the majority of cases may be explained by a study conducted in 1990 in which Kerr and O'Donnell found that both dental professionals and laypeople agreed that subjects with a Class III malocclusion are less attractive than those with a Class I malocclusion [14]. Following the same logic, the more severe the skeletal class III malocclusion was, the less attractive laypeople, dentists and orthodontists perceived the patient's profile and therefore voted for more drastic treatment like orthognathic surgery. However, in the 2 remaining images, the three categories had significant differences in their perception and therefore each category preferred a different treatment option over another. The borderline cutaneous profile of these patients may be responsible for such variations among different categories perception.

With the intra-evaluator agreement coefficient confirming the relevance of our study and a big similarity found between different categories perception of patient's profiles, the remaining results should be discussed to examine how cutaneous profile could possibly affect the treatment decision-making process for these patients.

From a purely cephalometric standpoint, many authors around the years have found cephalometric cutoff values in order to direct clinicians handling skeletal class III patient which treatment decision to take: orthodontic camouflage or orthognathic surgery. In our study, the value of ANB angle was shown to be critical for orthodontists to classify patients in the surgical or the orthodontic group (Table 4). For dentists (Table 5), ANB angle values and Wits appraisal affected their appreciation of the patients' profiles while laypeople answers were not affected by these same cephalometric values (Table 6). In all three categories, Z angle had no significant effect on the participants profile which may be due to the variation of soft tissue thickness and especially the lips. It is true that mentioned cephalometric values may affect the perception of a patient's profile in a dentist's or orthodontist's eyes. However, taking a cut off cephalometric value as the only reference in order to classify patients into surgery or orthodontic group is not enough. All studies found in literature failed to correctly classify 100% of the patients based on cephalometric values only. Based on a Holdaway angle of 10.3° and Wits appraisal of - 5.8 mm as cut off values, Eslami and al properly classified 81.5% of their patients [12]. Another study conducted by Kerr and Al was able to correctly classify 92% of the patients following 4 different parameters: Holdaway angle, ANB value, mandibular incisors inclination and Maxillary/Mandible ratio [9]. This increase in the accuracy of the classification may be due to the inclusion of a bigger number of cephalometric parameters. In our study, we tried to confirm the accuracy of classifying our patients following two of the mentioned cut off values: ANB =-4mm, Wits appraisal = -5,8 and comparing to the treatment that they really underwent. When we took each parameter separately, 70% of the patients were correctly classified (Figure 4 and 5). This decrease in accuracy relatively to results found in literature may be due to the use of only one parameter.

In addition, when we compared the treatment plan that should have been conducted based on these values only with the perception of the participants, orthodontists had the higher accuracy rate where 66.1% of orthodontists classified the patients correctly based on ANB angle and 59.78% based on Wits appraisal. These results confirm that cut off cephalometric values for sagittal face component affect the profile of the patient and as a consequence helps orthodontists in the treatment decision making process.

However, these values do not constitute a valid reference to be considered alone while deciding the appropriate treatment for such patients. Here comes the importance of the clinical examination and especially the facial profile perception. In our study, the treatment of choice of participants based on profile perception matched with the treatment conducted in reality for 74.46% of

orthodontists which is more accurate when compared to the treatment of choice matched the treatment suggested by cephalometric values in previous studies [9,12], thus highlighting the importance of the profile perception (Figure 6) which sometimes may have a bigger effect on the treatment decision than cephalometric values. A lower rate was observed for dentists and laypeople of respectively 65% and 64.5% which is still relatively a high accuracy rate seen that they are not specialists.

Conclusion

Within the limitation of this study, we can conclude that there are no cephalometric or clinical golden standards that, when took into consideration alone, the clinician could make his decision between orthognathic surgery and orthodontic camouflage.

Cephalometric values describing the skeletal sagittal discrepancy like ANB angle and Wits appraisal, as well as Holdaway angle which describes the soft tissue profile, are very useful but insufficient tools even when many parameters are combined.

In fact, these objective parameters should be completed by the facial profile perception which remains a subjective matter that depends on the clinician's preference and experience on one side and the patient satisfaction of his or her own looks making it necessary to individualize each treatment plan according to each patient.

References

1. Sarver D. William R. Proffit, 1936-2018. Am J Orthod Dentofacial Orthop. 2019 Jan;155(1):146–7.
2. Ngan P, Moon W. Evolution of Class III treatment in orthodontics. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2015 Jul;148(1):22–36.
3. Rinchuse DJ, Rinchuse DJ. Ambiguities of Angle's classification. Angle Orthod. 1989;59(4):295–8.
4. Ellis E, McNamara JA. Components of adult Class III malocclusion. J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg. 1984 May;42(5):295–305.
5. Al-Mozany SA, Dalci O, Almuzian M, Gonzalez C, Tarraf NE, Ali Darendeliler M. A novel method for treatment of Class III malocclusion in growing patients. Prog Orthod. 2017 Dec 11;18(1):40.
6. Marie Olimpo. Traitement orthopédique des dysmorphoses de classe III : où en est-on en 2015 ?. Médecine humaine et pathologie. 2015. dumas-01306318.
7. Alhammadi MS, Halboub E, Fayed MS, Labib A, El-Saaidi C. Global distribution of malocclusion traits: A systematic review. Dent Press J Orthod. 2018;23(6):40.e1-40.e10.
8. Kapadia RM, Shah AP, Diyora SD, Rathva VJ. Non-surgical treatment of skeletal class III malocclusion. BMJ Case Rep. 2014 Apr 10;2014:bcr2013202326.
9. Stellzig-Eisenhauer A, Lux CJ, Schuster G. Treatment decision in adult patients with Class III malocclusion: orthodontic therapy or orthognathic surgery? Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2002 Jul;122(1):27–37.
10. Benyahia H, Azaroual MF, Garcia C, Hamou E, Abouqal R, Zaoui F. Treatment of skeletal Class III malocclusions: orthognathic surgery or orthodontic camouflage? How to decide. Int Orthod. 2011 Jun;9(2):196–209.
11. Eslami S, Faber J, Fateh A, Sheikholaemmeh F, Grassia V, Jamilian A. Treatment decision in adult patients with class III malocclusion: surgery versus orthodontics. Prog Orthod. 2018 Aug 2;19(1):28.
12. Kawai N, Watanabe M, Shibata M, Horiuchi S, Fushima K, Tanaka E. Treatment decision of camouflage or surgical orthodontic treatment for skeletal Class III patients based on analysis of masticatory function. J Dent Sci. 2022 Apr;17(2):822–30.
13. Sena LMF de, Damasceno E Araújo LAL, Farias ACR, Pereira HSG. The influence of sagittal position of the mandible in facial attractiveness and social perception. Dent Press J Orthod. 2017;22(2):77–86.
14. Fabré M, Mossaz C, Christou P, Kiliaridis S. Orthodontists' and laypersons' aesthetic assessment of Class III subjects referred for orthognathic surgery. Eur J Orthod. 2009 Aug;31(4):443–8.