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Research Article

TREATMENT OF SKELETAL CLASS II BORDERLINE: A RETROSPECTIVE STUDY

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Abstract

Class II malocclusions are an important part of the chief complaints in orthodontics because of their significant prevalence among the anteroposterior discrepancies, and because of the esthetic and functional discomfort pushing a large number of patients to seek medical intervention. The treatment challenges encountered by orthodontists focus on the "borderline" skeletal Class II malocclusions, presenting moderate dysmorphism that can be treated by orthodontic camouflage treatment as well as orthodontic-surgical approach. The objective of this study was to propose a formula that could guide the orthodontist towards a compromise or a treatment combining orthodontics and surgery for these "borderline" class II cases. We, therefore, conducted a retrospective study involving 77 patients. Anteroposterior cephalograms, photographs, as well as information and medical examination documents were the equipment needed for this study.

Following the multi-varied analysis by binary logistic regression, we were able to determine the significant parameters leading to the following 6-variable equation (28.095+ (0.126 * Z) - (0.718 * SNA) + (1.425 * SNB) - (0.955 * SNPog) - (0.250 * MLSN) - (0.782 * CLII)). This equation allowed us to obtain a score likely to help practitioners decide on whether to treat Class II patients with or without orthognathic surgery. This formula could be used by orthodontists as an additional tool in the therapeutic decision, which should, above all, be based on clinical observation and radiological examination.

Keywords: Class II malocclusions, borderline cases ,retrospective study,orthognathic surgery, orthodontic treatment

I.Introduction

Class II malocclusions is an important part of our daily practice in orthodontics. Indeed their prevalence is one of the most important anomalies of the antero-posterior sense (1-2). For young and growing patients, reorienting the growth of the bone bases is the orthodontist's therapeutic priority. However, for patients who have already exhausted their growth potential, the therapeutic approach varies between three options, namely: abstention, camouflage or orthosurgical treatment (3).

The choice of therapy for these patients depends mainly on the severity of the malocclusion. For so-called moderate class II cases, camouflage treatment is most often proposed and for so-called severe class II cases, a combination of orthodontic treatment and orthognathic surgery is the best therapeutic option.

However, doubts persist for the so-called class II of the limits where the two options can be offered. We are faced with a real decision-making challenge because for each of these treatments the mechanics used, the direction of dental movements, and their effects are quite different (5).

The objective of this work is to study the main decision factors influencing our therapeutic attitude to establish an orthodontic treatment or ortho-surgical treatment for class II "borderline" case.

We propose, through a clinical study carried out on an orthodontic population, a simplified therapeutic scheme that would facilitate decision-making regarding of these ambiguous clinical situations.

II. Material and Methods

The retrospective study involved a sample of 77 adult patients in good general health, treated in the dentofacial orthopedics department of the dental clinic in Monastir (Tunisia). This sample was divided into two groups according to the treatment decision: a first group having benefited from camouflage treatment consisting of 46 patients, and a second group having received orthodontic-surgical treatment consisting of 31 patients.

Regarding surgical cases, the operations were performed in the maxillofacial surgery department of Sahloul hospital (Sousse, Tunisia).

The patient inclusion criteria were as follows:

- Angle $\widehat{ANB}$greater than or equal to 6°;

- Absence of craniofacial syndromes and severe facial asymmetries;

- Absence of agenesis and multiple dental inclusions;

- Patients at the end of growth who have not received orthopedic treatment.

The studied material includes lateral occlusal teleradiographs with a scale of 1/1, panoramic radiographs as well as exo-oral and endo-oral photographs of skeletal Class II patients successfully treated with both methods.

A clinical information sheet was then developed for this purpose, including information on the patient's condition and a set of parameters as follows.

Facial parameters:

-Angle$\hat{Z}$ (1);

-Angle $\hat{H}$ (2);

-Nasolabial angle ($\widehat{ANL}$) (3);

-Skin profile (N'$\widehat{SnPog}$')(4);

- Face profile (N'$\widehat{PnPog}$')(5);

- Other parameters: UL-E (6), LL and E (7) (fig 1).

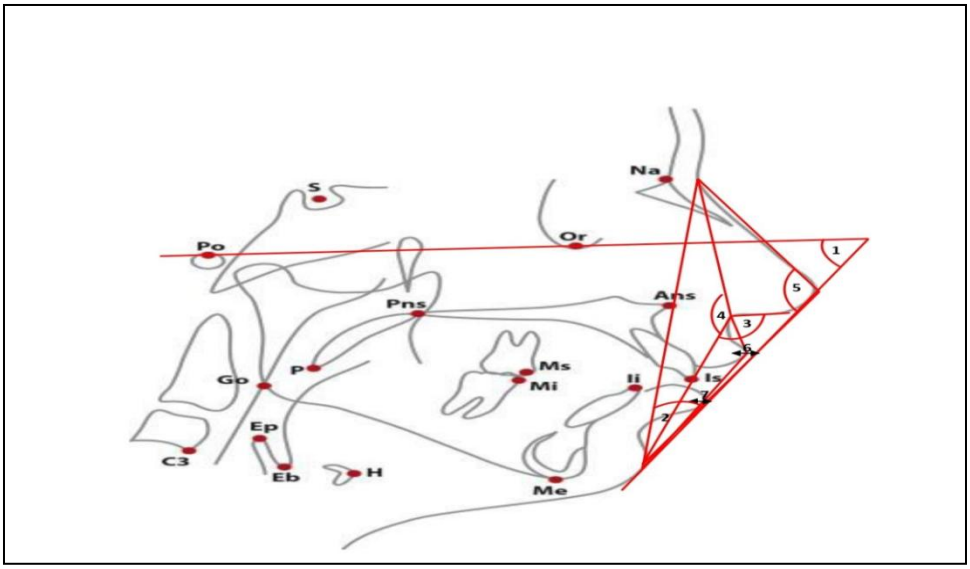

Figure 1: Cephalometric diagram of facial parameters

Skeletal parameters:

These are inherent in the Tweed and Steiner analysis, the most important of which are the angles ($\widehat{SNA}$) , ($\widehat{SNB}$) , ($\widehat{ANB}$)ˆ, the AoBo distance for the maxillo-mandibular shift as well as the angles($\widehat{ML/SN}$)and ($\widehat{SNPog}$) (Fig 2).

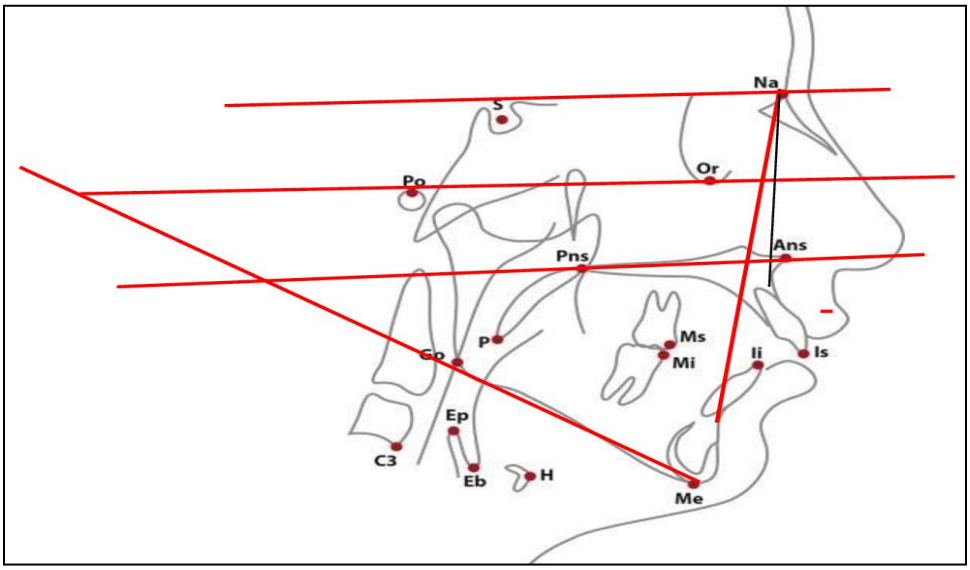

Figure 2. Cephalometric diagram of skeletal parameters

Occlusal parameters

These parameters are inherent in the two analyzes cited above, which are the angles $\widehat{I/NA}$, $\widehat{\imath/NB}$ and the inter-incisal angle.

Also, we measured on models and radiographs the amount of Class II which is defined by the distance between the mesio-vestibular cusp tip of the maxillary first molar and the vestibular groove of the mandibular first molar (CLII) (Fig 3).

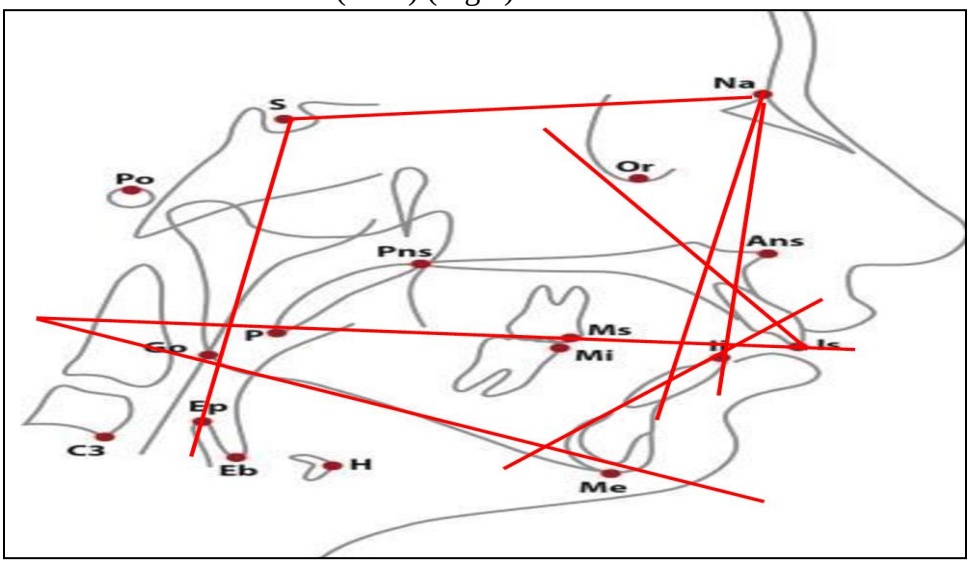

Figure 3: Representative occlusal parameters

Parameters of the upper and middle airways:

These are a series of measurements taken at the level of upper respiratory airways between the posterior edge of the tongue as well as the soft palate and the posterior wall of pharynx (Fig4).

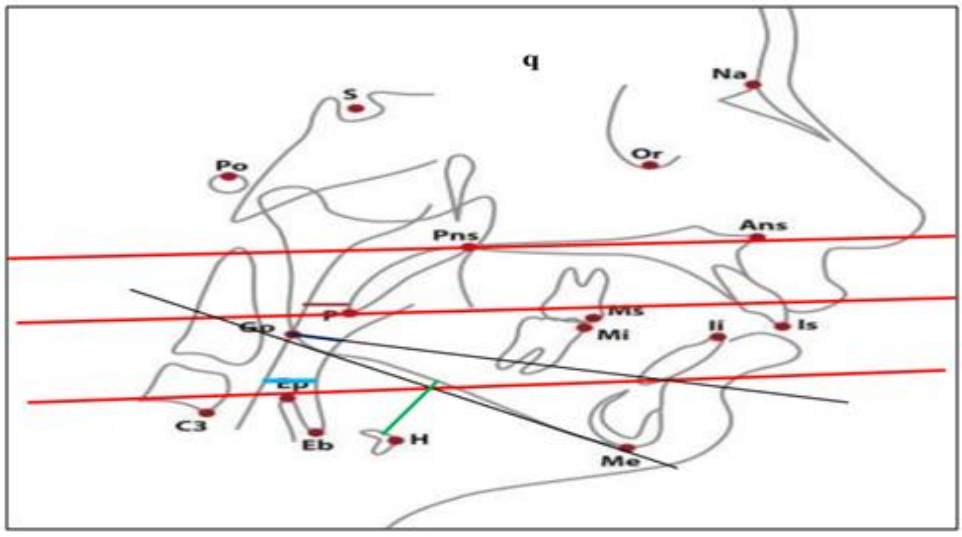

Figure 4: Cephalometric diagram of respiratory parameters

In order to reduce the margin of error, all the measurements were due to the same operator and then subjected to the Dahlberg formula$EM = \sqrt{\sum d^2/2n}$.Data analysis was performed using SPSS software for Windows, version 20.0.

The quantitative variables were subjected to two statistical tests depending on whether they correspond to a normal distribution or not. These tests are respectively that of student or mannwhitney.

The qualitative variables were analyzed by the chi-square test.

III. Results

The study population was 77 patients with skeletal class II ($6 \leq \widehat{ANB} \leq 10$).The average age of samples was 20.4, with a value of 20.33 ± 3.406 for the camouflage group against 20.52 ± 6.324 for the surgical group.

The distribution according to the sex of population was 59 females (76.6%) and 18 males (23.38%) individuals, with a sex ratio of 3.28.

The reason for consultation was either aesthetic: 47 patients (61%), functional: 3 patients (3.9%), or aesthetic and functional: 27 patients (35.1%).

Several parameters were analyzed to apprehend their influence on the choice of camouflage or surgical treatments. The calculation of significance value is objectified by p. All p-values greater than 5% were considered insignificant, so the parameter does not show a significant intergroup difference.

Therapeutic decision and associated factors

The present study showed that there is a significant difference in the angle Zˆ between the two groups of patients. The only facial parameter that has a significant p.
We also found that the angles $\widehat{SNB}$, $\widehat{ANB}$, $\widehat{NAPog}$, $\widehat{SNPog}$, $\widehat{ML/SN}$and the AoBo distance present a difference with a significance rate of less than 0.05 between the two groups of patients.
For the occlusal parameters, only the class II quantity was significantly different and none of the respiratory parameters showed a significant intergroup difference.
Finally after analysis, the patient's sex did not have a significant influence on the treatment decision (Table 2).

Multivariate analysis

Based on the p-value, only parameters with 0.2 or less were selected for the multivariate study.
The selection of variables in stages resulted in a meaningful model of six variables. The selected variables were $\hat{Z}$,$\widehat{SNA}$,$\widehat{SNB}$,$\widehat{ANPog}$,$\widehat{ML/SN}$ and Class II.
These parameters in addition to a calculated constant led to the following equation. This provides the practitioner with a score allowing the case to be classified in one of the patient groups (Table 3).

Score = 28,095 + (0,126$\hat{Z}$) - (0,718*$\widehat{SNA}$) + (1,425*$\widehat{SNB}$) - (0,955*$\widehat{SNPog}$)- (0,250*$\widehat{MLSN}$) - (0,782*CLII)*

The critical score was -0.74 obtained from the ROC curve (Fig.5). Each case with a score above the critical score will likely be treated with cover-up, while a lower score will point towards surgical treatment instead.

As given in the following table, 41 cases of the camouflage group were well classified according to the formula (i.e. 89.1%); while for the surgical group 23 were well classified (i.e. a percentage of 74.2%).

Table 1: Studied skeletal parameters

$\widehat{SNA}$	Angle between the center of turcic seal, the bony nasion and the most declining part of the anterior concavity of maxilla.
$\widehat{SNB}$	Angle between the center of turcic seal, the osseous nasion and the most declining part of the anterior concavity of the mandible.
$\widehat{ANB}$	Maxillo-mandibular sagittal shift (ANB = SNB-SNA).
AoBo	Sagittal shift between Ao and Bo which are the orthogonal projection of A and B on the occlusal plane.
$\widehat{ML/S}$	Angle formed by the intersection of the mandibular plane and the SN line.
$\widehat{SNPo}$	Angle between the center of turcic seal, the Nasion and the anterior point of mandibular symphysis.

Table 1:Quantification of studied variables

Quantitative variables analyzed by Student's t test			
Variables	**Camouflage Group (n = 46) Mean (standard deviation)**	**Surgical group (n = 31) Mean (standard deviation)**	**p**
Age (an)	20.33 (3.406)	20.52 (6.324)	0.865
Angle $\hat{Z}$ (°)	65.91 (6.606)	61.32 (7.786)	**0.007 ***
Angle $\hat{H}$ (°)	17.52 (2.248)	17.74 (2.633)	0.695
Skin profile $N\widehat{SnPog}$(°)	165.11 (4.191)	154.58 (5.208)	0.159
Facial profile $N\widehat{PnPog}$(°)	127.87 (3.798)	128.10 (4.956)	0.821
Nasolabial Angle (°)	108.26 (11.381)	108.71 (11.402)	0.866
Skeletal profile $\widehat{NAPog}$ (°)	167.43 (3.436)	165.52 (3.982)	**0.027 ***
$\widehat{SNA}$: Jaw position (°)	81.20 (3.384)	80.16 (3.417)	0.194
$\widehat{SNB}$: Mandible postion (°)	74.41 (3.037)	72.55 (3.722)	**0.018 ***
Skeletal shift $\widehat{ANB}$ (°)	6.78 (0.987)	7.61 (1.230)	**0.002 ***
$\widehat{SNPog}$: Chin position (°)	75.20 (2.023)	73.52 (4.049)	**0.041 ***

$\widehat{ANPog}$: Skeletal shift (°)	6.00 (1.229)	6.65 (1.603)	0.063
AoBoWitts (mm)	4.65 (2.601)	6.06 (3.306)	**0.040 ***
$\widehat{ArGoMe}$: Mandibular angle (°)	125.50 (5.726)	127.48 (7.606)	0.196
$\widehat{ML/SN}$: Mandicular plane^SN (°)	37.26 (5.348)	40.65 (8.301)	**0.033 ***
$\widehat{Y/F}$: Facial pattern (°)	62.11 (3.013)	63.90 (5.224)	0.091
$\widehat{Occ/SN}$: Occlusion plane^SN (°)	17.91 (3.325)	19.45 (4.194)	0.077
$\widehat{ML/PL}$: Mandibular plane^ palatine plane(°)	26.70(4.732)	29.35 (9.555)	0.159
$\widehat{PL/SN}$: palatine plane^SN	10.80 (3.449)	11.29 (4.117)	0.577
Overjet (mm)	6.04 (2.624)	7.19 (4.301)	0.190
Axis of maxillary incisor $\widehat{U1/SN}$ (°)	101.46 (9.354)	102.52 (12.662)	0.674
Mandibular incisor axis $\widehat{L1/ML}$ (°)	100.09 (6.036)	99.29 (8.415)	0.630
Interincisal axis $\widehat{I/\imath}$ (°)	118.91 (9.973)	116.65 (13.613)	0.401
Minimum retrolingual Min-RL (mm)	11.17 (3.629)	11.00 (3.933)	0.842
Posterior pharyngeal space(mm)	12.39 (3.593)	12.35 (3.601)	0.965
Hyo-mandibular height	13.87 (5.841)	14.16 (5.905)	0.831

Quantitative variables analyzed by the Mann-Whitney U test

Variables	**Camouflage group(n=46) Median [Q1.Q3] [Min.Max]**	**Surgical group(n=31) Median [Q1.Q3] [Min.Max]**	**p**
Upper lip position UL.E (mm)	2 [0.4] [-5.6]	0 [-2.1] [-7.8]	0.240
Lower lip positon LL.E (mm)	-0.5 [-3.1] [-7.6]	-2 [-5.1] [-9.9]	0.903
CLII: Quantity class II (mm)	0 [0.3] [0.6]	4 [2.5] [0.7]	0.001
Retro-velar Minimum MinRV (mm)	8 [6.10] [2.14]	8 [5.11] [2.18]	0.200

Qualitative variables analyzed by the chi-square test

Variables	**Camouflage group (n=46)**	**Surgical group (n=31)**	**p**
Sex n(%) male Female	9 (50.0) 37 (62.7)	9 (50.0) 22 (37.3)	0.336

**p significant*

Table 3: Variables emerging from binary logistic regression analysis.

Variables in equation								
Step 1[a]	A	E.S.	Wald	ddl	Sig.	Exp(B)	IC for Exp(B) 95% Inferior	superior
$\hat{Z}$	-,126	,060	4,515	1	,034	,881	,784	,990
$\widehat{SNA}$	1,673	,589	8,059	1	,005	5,327	1,679	16,909
$\widehat{SNB}$	-1,425	,549	6,728	1	,009	,241	,082	,706
$\widehat{ANPog}$	-,955	,471	4,109	1	,043	,385	,153	,969
$\widehat{MLSN}$	,250	,096	6,803	1	,009	1,285	1,064	1,551
CLII	,782	,214	13,351	1	,000	2,186	1,437	3,324
Constant	-28,095	13,662	4,229	1	,040	,000		

a Variables used in step 1: Z, SNA, ***SNB, ANPog, MLSN, CLII***

Table 4: Sensitivity and specificity of the test applied to the sample.

	Forecasts		
	Therapeutic decision		Percent correct
Observations	Camouflage	Surgery	
Therapeutic decision			
Camouflage	41	5	89,1
Surgery	8	23	74,2
Overall percentage			83,1

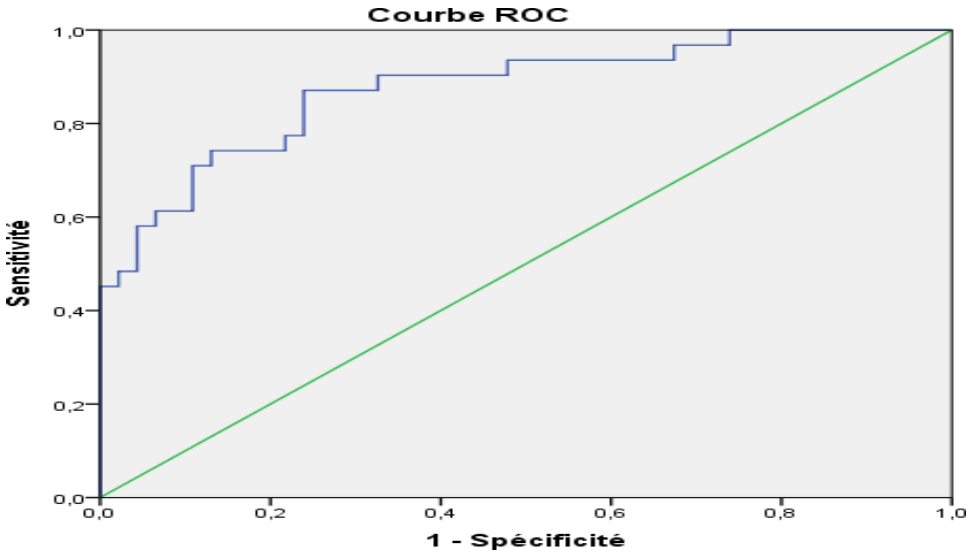

Figure5: Determination of the sensitivity and specificity of the factors according to the ROC curve.

IV Discussion

This study showed that 46 cases (59.7%) were treated with camouflage, against 31 cases (40.2%) which were treated with orthodontic-surgical treatments.

About 61% of the sample had an aesthetic chief complaint, 3% had a functional request, and the rest (35.1%) of patients had a mixed aesthetic and functional complaint.

This confirms the main objective of orthodontics which is the resolution of an essentially aesthetic problem. It should also be noted that the female sex is over-represented in the treatment groups (76.6% of the total number of patients). This can be explained by the increased interest of women in improving their facial and dental aesthetics (6).

The present study had classified borderline skeletal class II cases into two groups: a group treated with orthodontics and a group treated with ortho-surgical therapy.

Regarding the age of groups, the average age of surgical group is slightly higher than that of the camouflage group. This may be linked to the stability of class II surgical protocols which would be strongly linked to the patient's age (7).

As part of the comparison of results, the average age found in this study can be compared to that of Joss's study which is 21.4 years (8) and it is slightly below the average sample age (24) years of the Chaiyongsirisern study (9).

Among the facial parameters, only the difference in angle$\hat{Z}$ was significant between the two groups and was retained for the multivariate analysis. these results were demonstrated in a similar way by the study of Cassidy et al (10) on 108 patients, of which 53 presented a limit of class II. The Z angle is part of the discriminating model, which shows the interest of this parameter in determinating the convexity of the profile, in particularly in skeletal class II patients with mandibular retrognathia.

The analysis of various bone parameters revealed only 4 of them ($\widehat{ANB}$, $\widehat{SNB}$, $\widehat{SNPog}$, $\widehat{ANPog}$,$\widehat{ML/SN}$.) that present a significant difference between the two groups of patients.

For the angles $\widehat{NAPog}$ and$\widehat{ML/SN}$our results can be compared to those found by Ruf and Pancherz (4). These authors carried out a comparative study between two adults groups, one treated by orthognathic surgery (n = 46), and the other treated by Herbest appliance (n = 23). This total of 69 patients presents a Class II division 1. They observe a greater divergence of the bone bases in the surgical group with a significant facial hyper divergence which is reflected in our study by the angle$\widehat{ML/SN}$.

In addition, they noted a significant anteroposterior displacement of the maxilla in this same group. This is correlated with the angle$\widehat{NAPog}$ which has a p of 0.027 despite its absence of a discriminating model.

Profitt's study (11) demonstrated that the highest failure rate of orthodontic camouflage treatments was that of subjects with a significantly greater mandibular deficit. This imposes a different therapeutic attitude and therefore an ortho-surgical treatment.

This is in adequacy with the results of our analysis because the angle$\widehat{SNB}$ enters the discriminant model and presents an important prognostic interest.

Tulloch revealed the variables involved in the choice of therapy in class II division 1 cases, and obtained, thanks to a discriminant analysis, a 7-variable model. The angle$\widehat{ANB}$is part of the discriminating model both for the choice of the type of treatment and for the prediction of the success of the treatment with a highly significant correlation (12).

Regarding the angle $\widehat{SNA}$, we did not find a significant difference between the two groups according to the univariate analysis. This can be explained by the fact that the population studied mainly presented a skeletal class II by mandibular retrognathia.

About occlusal variables, our study showed that the linear measure of the quantity of class II (of Angle) presents a highly significant difference ($p < 0.001$). These results were invoked by Cassidy (10) in his study on class II borderline and were also found in his discriminating model.

From these correlations the following equation was therefore established:

$28{,}095 + (0{,}126 * \hat{Z}) - (0{,}718 * \widehat{SNA}) + (1{,}425 * \widehat{SNB}) - (0{,}955 * \widehat{SNPog}) - (0{,}250 * \widehat{MLSN}) - (0{,}782 * CLII)$

The critical score was -0.74.

However, additional factors may be taken into account during the management of these borderline cases such as long-term stability, transverse direction variables, periodontal context as well as the psychological profile of the patients.

In fact, skeletal classes II can be associated with transverse direction abnormality such as maxillary brachygnathies or mandibular laterognathies. Although our study was based on lateral teleradiographs showing no duplication of even-numbered structures, a radiographic exploration of the transverse direction would have given more affinity to our statistical model.

It is also imperative to put the emphasis on periodontal support of the teeth and in particular of the lower incisors in the choice of the proposed treatment. The importance of periodontium is such that some authors consider it to be the decisive factor in the choice of therapy to be initiated (13-14).

It therefore seems judicious to establish a precise periodontal diagnosis for each patient presenting a borderline class II in order to propose the most suitable treatment and thus to avoid worsening or creating an underlying periodontal disease.

Furthermore, orthognathic surgery causes changes in the appearance of patients and the orthodontist must be particularly vigilant with regard to patients with fragile personalities who are highly demanding from an aesthetic point of view (15).

It would therefore be convenient to develop a tool capable of qualitatively assessing the patient's initial requirements and thus guiding the practitioner in his decision-making.

V. Conclusion:

The choice of the therapy adapted to each clinical situation in borderline class II cases is a challenge for the orthodontist.

Several variables were included in our therapeutic choice, including the Z angle, the gap between the arches and the skeletal parameters.

The functional factors and the psychological state of our patients must be evaluated by the practitioner before treatment.

The present study had a primarily clinical approach to the decision of orthosurgical or camouflage treatment, therefore expanding the orthodontic population and including these characteristics in a multicenter study would definitely confirm the choice of therapy proposed for a given clinical case.

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