

# Do orthodontic extractions have an impact on the cutaneous profile?

Dallel<sup>1</sup>, A. Megdiche<sup>2</sup>, Y. Ghedira<sup>2</sup>, S. Tobji<sup>2</sup>, A. Ben Amor<sup>2</sup>

<sup>1</sup> Associate Professor of Orthodontics, Laboratory of Oral Health Research and Orofacial Rehabilitation LR12ES11 - ODF Department - University of Monastir (Tunisia)

<sup>2</sup> Faculty of Dentistry Avenue Avicenne - 5000 Monastir (Tunisia)

## ABSTRACT

Orthodontic treatments can have an impact on the soft tissues and more particularly on the cutaneous profile. The aim of this work was to evaluate profile changes following orthodontic treatment.

**Material and methods:** This study concerned 90 patients randomly selected in the orthodontic department of Monastir (Tunisia). Profile headfilms at the start and at the end of orthodontic treatment were compared using, as reference lines, the SN-7° plane and the orthogonal to SN-7° plane going through the S-point (POSN- 7°). The Student test was applied to evaluate the variations in the cephalometric measurements. The Pearson test was used to study the correlation between the horizontal tooth movements and facial profile changes.

**Results:** We noted a significant decrease in the upper labral (Ls) ( $p=0.049$ ) and lower labral ( $p=0.048$ ) as well as a significant increase in the labio-mental angle ( $p=0.025$ ) in patients treated with extractions of premolars. A positive correlation between the incisor movements and the reduction of the labial protrusion was observed.

**Conclusion:** The results of this study have shown that the movements of the incisors consecutive to extractions can have tangible effects on the cutaneous profile. Further investigations should be carried out to highlight the relationship between tooth movement and soft tissue.

## KEYWORDS

*Esthetic, profile, extraction, orthodontics.*

## INTRODUCTION

There has always been a preoccupation with beauty in human societies, even if it could sometimes be considered as futile or only reserved for women. However, in reality, it is a subject that has been a part of the political, economic, and cultural history of people around the world, concerning both men and women. Over time, beauty

has become a real power of expression and seduction, as well as a sign of social status<sup>2,9,10</sup>.

Over time, humankind has sought to represent the features of their species through the most harmonious images. Therefore, over the centuries, esthetic rules have been established. Whether architectural,

Address for correspondence:

Ines Dallel - Faculty of Dentistry - Avicenna Avenue - 5000 Monastir (Tunisia)  
E-mail: dr.ines.dalel@gmail.com

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pictorial, or otherwise, our notion of beauty is constantly evolving.

Therefore, today, beauty is more of a harmonious whole rather than respect for these rules<sup>19</sup>. In today's society, every single person is becoming more and more concerned about their own appearance<sup>8</sup>.

In orthodontics, the search for facial beauty and esthetics takes precedence among patients' requests and is often the only reason for their consultation.

The cutaneous profile, being an important factor in the determination of facial attraction, does not diverge from these rules<sup>8</sup>.

The literature tells us that soft tissue profiles are taken into account in cephalometric analyses and in the treatment plan because very diverse cutaneous profiles can be associated with the same skeletal and/or dental pattern<sup>5</sup>.

The most common goal of orthodontic treatment is to achieve long-term functional occlusion. However, the main motivation of patients often concerns the correction of esthetic disharmonies associated with malocclusions<sup>6</sup>.

Faced with increasingly demanding adult patients, dental leveling and stable occlusion are no longer adequate<sup>11</sup>.

Therefore, the treatment goals of the orthodontist will not be limited to finding a functional occlusion, but will also include finding harmonious facial proportions and a balance between the various facial projections (forehead, nose, lips, and chin) and depressions (labiomental grooves and nasolabial fold) constituting the facial profile. It is now accepted that harmony and balance of the cutaneous profile result from the interplay between various factors: skeletal characteristics, soft tissue quality, and the position and angulation of the patient's teeth. During the treatment process, the orthodontist is often confronted with situations where the indication to extract premolars can itself risk altering a harmonious and balanced profile. In fact, several studies have shown that the impact of an orthodontic treatment has little effect at the nasal level and a debatable and discussed effect on the chin and can radically transform the position as well as the morphology of the lips<sup>14</sup>.

The aim of this work is to study the impact of different orthodontic treatments on the soft tissues of the face to deduce guidelines to preserve the facial esthetics of our patients.

## PATIENTS AND METHODS

### Patients

To evaluate and compare the impact of orthodontic treatments on the facial profile, we conducted a retrospective study on a sample of 90 Tunisian adult patients who had been orthodontically treated in the

dentofacial orthopedics department of the Monastir dental clinic, without taking into account the initial malocclusion of these patients.

The inclusion criteria were completed orthodontic treatment, treatment using fixed multi-attachment devices, minimum age 15 years for girls

and 17 years for boys at the beginning of treatment, and the presence of complete and good quality clinical documents.

Excluded from our study were patients who received orthopedic or functional treatment or orthognathic surgery, patients who were still growing, and patients with obvious soft tissue disorders and severe asymmetries.

## Methods

For the purpose of analysis, pre- and post-treatment profile teleradiographies were performed, at a scale of 1/1 (real size), patient standing with a horizontal Frankfurt plane and the teeth in occlusion. The cutaneous profile was evaluated before and after treatment from linear and angular measurements used as reference axes (Fig. 1):

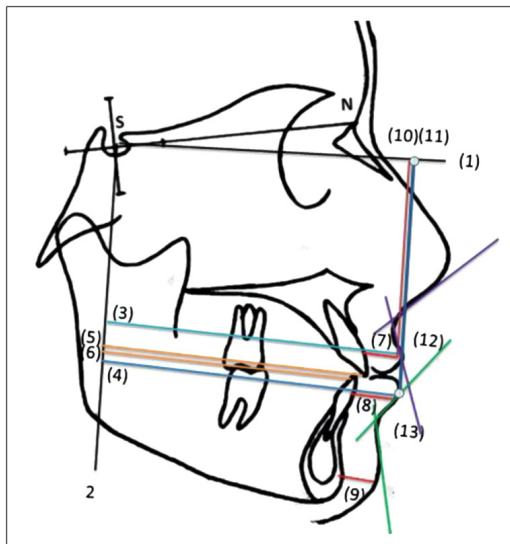


Figure 1  
Reference axes and linear and angular measurements.

1. **The horizontal axis:** This is line SN-7°, which is substantially parallel to the Frankfurt plane.
2. **The vertical axis:** This is the orthogonal plane at SN-7° passing through the point S (POSN-7°), whose posterior position with respect to the points to be studied makes it possible to reduce the risk of error when taking measures (23).

The horizontal linear measurements recorded are as follows:

3. **Upper lip protrusion:** Distance between the most anterior point of the upper lip (Ls) and the edge of the vermilion of the vertical plane POSN-7°.
4. **Lower lip protrusion:** Distance between the most anterior point of the lower lip (Li) and the edge of the vermilion of the vertical plane POSN-7°.
5. **The horizontal position of the free edge of the upper incisor (Is):** Distance between Is and POSN-7°.
6. **The horizontal position of the free edge of the lower incisor (Ii):** Distance between Ii and POSN-7°.
7. **The thickness of the upper lip (Ep Ls):** Distance between Ls and the vestibular surface of the upper incisor according to SN-7°.
8. **The thickness of the lower lip (Ep Li):** Distance between Li and the vestibular surface at the lower incisor according to SN-7°.
9. **The thickness of the cutaneous pogonion (EpPogcut):** Distance between the most anterior point of the cutaneous pogonion (Pogcut) and the bone tissues of the chin according to SN-7°.

The vertical linear measurements recorded are:

**10. The vertical position of the upper lip:** Distance between the point Ls and the horizontal axis SN-7°.

**11. The vertical position of the lower lip:** Distance between the point Li and the horizontal axis SN-7°.

The angular measurements recorded are as follows:

**12. Nasolabial angle:** This angle allows us to define a harmonious relationship between the lips and the nose.

**13. Labiomental angle:** This angle makes it possible to judge whether the labiomental groove is harmonious.

The data collected were entered on a computer hardware using IBM SPSS software version 24. Student's t-test allowed the averages of the results of the first and second groups to be compared. The Pearson test was used to investigate the correlation between maxillary and mandibular incisor movement and soft tissue change in the cutaneous profile for each group.

## RESULTS

Our sample was divided into two subgroups: (Figs. 2, 3, 4, 5, and 6)

Group 1: It includes 45 patients who received orthodontic treatment with the straight arch technique without premolar extractions. This group consists of 9 men (20%) and 36 women (80%) with an average age of 20.86 years.

Group 2: It includes 45 patients who received orthodontic treatment with

the arch leveling technique with premolar extractions. This group consists of 7 men (15.5%) and 38 women (84.5%) with a mean age of 19.05 years.

The diagrams presented below provide information on our sample distribution according to sex and the initial skeletal or alveolar diagnosis.

The averages of each value studied for groups 1 and 2 are given in tables

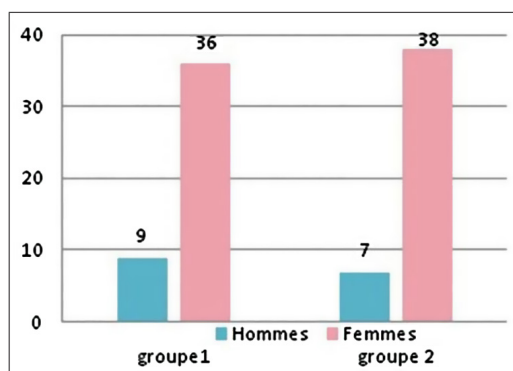


Figure 2:  
Sample distribution by sex.

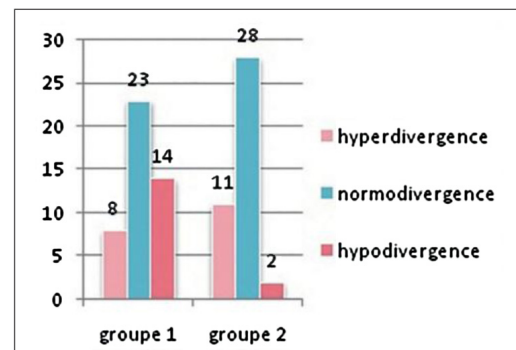


Figure 3:  
Sample distribution according to facial divergence.

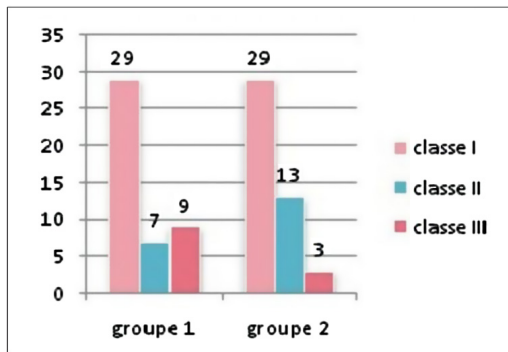


Figure 4:  
Sample distribution according  
to the skeletal class.

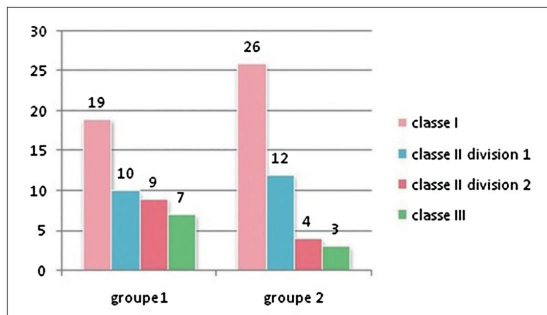


Figure 5:  
Sample distribution according  
to the Angle class.

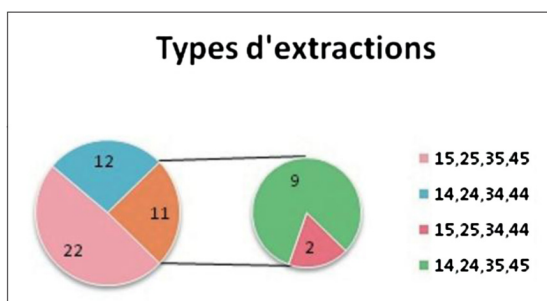


Figure 6:  
Types of extractions performed  
in the group.

as are the comparative values using the SPSS software (Tables I and II).

#### • Analytical study of group 1:

The analysis of group 1 results showed the following:

- An non-significant increase in the protrusion of the upper and lower lips by  $0.53 \pm 2.29$  mm ( $p = 0.845$ ) and  $0.31 \pm 3.55$  mm ( $p = 0.915$ ), respectively.
- A non-significant decrease in labial thickness greater than the Ls point ( $p = 0.35$ ), labial thickness below the Li point ( $p = 0.547$ ), and that of Pogcut ( $p = 0.94$ ).
- The most vestibular maxillary and mandibular incisors advanced in a non-significant manner.
- A non-significant descent of the points Ls and Li by  $1.28 \pm 2.03$  mm and  $0.93 \pm 2.24$  mm, respectively.
- A non-significant closure of the nasolabial angle of  $1.75^\circ \pm 7.5^\circ$ .
- A non-significant opening of the labiomental angle of  $0.88^\circ \pm 8.64^\circ$ . The Pearson test revealed that there was no positive correlation between dental movement and soft tissue changes for this group.

Table I: Group 1 and 2S results: Significant ( $p < 0.05$ ) NS: Not significant.

#### • Analytical study of group 2:

Analysis of the results showed that the following:

- A significant decrease in the upper lip protrusion at the point Ls and in

Table I: Group 1 and 2S results: Significant ( $p < 0.05$ ) NS: Not significant.

Variables	Group 1			Group 2		
	Before treatment	After treatment	P-VALUE Difference	Before treatment	After treatment	P-VALUE Difference
Ls/PoSN-7°	85.55 ± 9.925	86.08 ± 10.36	-0.53 ± 2.29 p = 0.840 NS	77.11 ± 7.08	73.31 ± 7.05	3.80 ± 1.21 <b>p = 0.049 S</b>
Li/PoSN-7°	82.44 ± 10.87	82.75 ± 10.32	-0.31 ± 3.55 p = 0.915 NS	75.20 ± 7.99	70.95 ± 7.60	4.24 ± 1.36 <b>p = 0.048 S</b>
Is/loc-7 °	72.15 ± 9.32	73.06 ± 9.40	-0.91 ± 3.29 p = 0.722 NS	67.71 ± 7.03	63.82 ± 6.92	3.88 ± 1.86 <b>p = 0.046 S</b>
Ii/PoSN-7°	68.15 ± 8.77	69.80 ± 8.96	-1.64 ± 3.29 p = 0.495 NS	63.17 ± 7.46	59.46 ± 7.03	3.71 ± 1.45 <b>p = 0.049 S</b>
Thickness of Ls	12.46 ± 2.18	11.93 ± 2.07	0.53 ± 0.98 p = 0.35 NS	9.91 ± 1.29	10.51 ± 1.01	-0.60 ± 0.87 p = 0.052 NS
Thickness of Li	14 ± 2.13	13.66 ± 1.95	0.33 ± 1.14 p = 0.54 NS	12.68 ± 1.81	12.28 ± 1.65	0.39 ± 1.16 p = 0.37 NS
Thickness of the Pogcut	12.22 ± 2.21	12.17 ± 1.99	0.04 ± 0.72 p = 0.94 NS	10.77 ± 1.46	10.91 ± 1.56	-0.13 ± 0.67 p = 0.75 NS
Vertical position of the Ls	65.08 ± 5.79	66.37 ± 5.85	-1.28 ± 2.03 p = 0.429 NS	77.11 ± 7.08	62.91 ± 5.25	-0.86 ± 2.15 p = 0.544 NS
Vertical position of the Li	80.33 ± 6.63	81.26 ± 6.97	-0.93 ± 2.24 p = 0.60 NS	75.20 ± 7.99	75.82 ± 6.47	0.77 ± 2.49 p = 0.684 NS
Nasolabial angle	102.97 ± 10.20	101.22 ± 9.04	1.75 ± 7.50 p = 0.505 NS	67.71 ± 7.03	107.37 ± 6.68	-3.48 ± 7.78 p = 0.12 NS
Labiomental angle	126.22 ± 13.061	127.11 ± 10.681	-0.88 ± 8.64 p = 0.781 NS	63.17 ± 7.46	131.08 ± 9.16	-5.2 ± 8.40 <b>p = 0.025 S</b>

Table II: Correlation between dental movement and soft tissue changes in groups 1 and 2.

Variables	Group 1				Group 2			
	Is/PoSN-7°		Ii/PoSN-7°		Is/loc-7°		Ii/PoSN-7°	
	r	p	r	p	r	p	r	p
Ls/PoSN-7°	0.36	0.14	0.26	0.84	0.505 * <b>S</b>	<0.005	0.54 * <b>S</b>	<0.05
Li/PoSN-7°	0.386	0.132	-0.167	0.273	0.414 * S	<0.05	0.72 * S	<0.005
Thickness of the Ls	-0.214	0.157	-0.271	0.072	-0.126	0.411	-0.128	0.404
Thickness of Li	-0.118	0.44	-0.121	0.43	-0.44	0.776	-0.051	0.74
Thickness of Pogcut	-0.068	0.658	-0.069	0.654	0.31	0.842	-0.035	0.818
Vertical position of Ls	-0.057	0.711	-0.17	0.263	-0.05	0.745	0.146	0.339
Vertical position of Li	0.149	0.329	0.094	0.537	0.064	0.675	-0.114	0.454
Nasolabial angle	-0.261	0.83	-0.021	0.889	-0.099	0.518	0.007	0.965
Labiomental angle	-0.02	0.895	0.215	0.155	-0.126	0.411	-0.057	0.712

S: Significant ( $p < 0.05$ )

- the lower lip protrusion at the point Li by  $3.80 \pm 1.21$  mm ( $p = 0.049$ ) and  $4.24 \pm 1.36$  mm ( $p = 0.048$ ), respectively.
- A slightly significant increase in labial thickness above the Ls point by  $0.6 \pm 0.87$  mm ( $p = 0.052$ ).
  - A non-significant increase in cutaneous pogonion thickness from  $10.77 \pm 1.46$  mm to  $10.91 \pm 1.56$  mm.
  - A non-significant decrease in labial thickness below the Li point of  $0.39 \pm 1.16$  mm. The most vestibular maxillary and mandibular incisors were significantly retracted.
  - Non-significant opening of the nasolabial angle of  $3.48^\circ \pm 7.78^\circ$ .
  - A significant opening of the labiomental angle of  $5.2^\circ \pm 8.408^\circ$  ( $p = 0.025$ ). The bivariate correlation test (the Pearson test) showed that the retraction of the maxillary and mandibular incisors strongly correlates with the reduction of the protrusion of the upper and lower lips at the Ls and Li points.

## DISCUSSION AND RECOMMENDATIONS

In this study, by limiting the sample to adult cases, the influence of growth was minimized.

Most of the studies that have examined the impact of orthodontic treatment on the facial profile have been conducted on Caucasian subjects. Our study has shown that orthodontic treatments without premolar extractions would not affect the soft tissues of the profile. On the other hand, the results of group 2 suggest that extractions modify the facial profile by moving the upper and lower lips into a more posterior position and opening the labiomental angle.

Although patients and methods are not similar, the results of several previous studies are consistent with ours. Indeed, Erdnic, Nanda, and Dandajena<sup>9</sup>, in their study conducted on a sample of 98 patients treated with and without premolar extractions, found significant differences between groups at the end of the orthodontic treatment. However,

they do not report significant changes in the cutaneous profile in subjects in either group, four years after the introduction of a restraint<sup>9</sup>.

In addition, our results suggest that in group 2, premolar extractions would have caused a significant reduction in the protrusion of the upper and lower lips at the Ls and Li points, respectively. This labial retraction results from a significant loss of the underlying bone support, following the significant straightening of the maxillary and mandibular incisors.

Zeirhut et al.<sup>29</sup>, in a sample of 63 adolescents with a class II division 1 malocclusion, 23 of whom were treated with avulsion of premolars and 40 without extraction, found a greater retraction of the incisors and, consequently, in relation to the nose and chin in patients who underwent extractions. Finnoy et al.<sup>10</sup> confirmed that the retrusion of the lips is a consequence of the retraction of the incisors. Hershey<sup>12</sup>, on the other



hand, concluded that the lower lip was less influenced by the corresponding incisors with respect to its profile position.

Kusnotoa's study<sup>16</sup> resulted in a significant positive correlation between the straightening maxillary and mandibular incisors and lip position changes. The author recorded a significant decrease in the upper lip protrusion of 0.4 mm and the lower lip protrusion of 0.6 mm for each millimeter of repositioning of the mandibular incisor.

Oliver<sup>21</sup> found that the correlation coefficients between dental and skin changes were significant only in thin-lipped subjects.

Nevertheless, Rains and Nanda<sup>9</sup> reported a lack of correlation between the displacement of the upper and lower lips and that of the mandibular incisors. In addition, their regression equation revealed that the change in the depth of the upper lip groove was more directly related to the retraction of the upper and lower lips compared with the displacement of the teeth in the same direction<sup>24</sup>. Similarly, Angelle's study showed that changes in dental positions are not systematically followed by changes in soft tissue profiles<sup>1</sup>.

Regarding the thickness of the upper lip at the Ls point, as well as that of the cutaneous pogonion, a different behavior was observed in both groups.

This study revealed that orthodontic treatment without premolar extractions would reduce the soft tissue thickness in these regions in a non-significant manner, whereas treatment without extractions would be responsible for a thickening of these tissues, still without significance. It seems that this increase in

thickness observed would allow Ls and Pogcut not to over-retract following the straightening of the incisors. Moreover, Valentin et al.<sup>28</sup> concluded that the change in the labial thickness tends to mask the change in the position of the teeth following dental movements.

In both groups, a reduction in lower lip thickness associated with significant variability in outcomes was noted. In older studies, Ricketts<sup>25</sup> showed reductions in thickness of 1–3 mm associated with upper lip retrusion, whereas the lower lip experienced retrusion, but no loss of thickness.

The Pearson test revealed a lack of positive correlation between the change in thickness of these regions and dental movement for both groups. This is in agreement with the Singh and Kasai study, in which the authors argued that incisor repositioning has no direct effect on the chin covering tissues, but it would act to promote growth, which explains the increase in recorded thickness improving facial esthetics<sup>14</sup>. Mirabella et al.<sup>20</sup> estimated that a greater initial thickness of the lips would act as a shock absorber or brake as a result of the movement of the incisors.

Kocadereli<sup>15</sup>, on the other hand, believes that the variations in soft tissue thickness of the profile would be highly individualized with a marked reduction in thickness in one patient and flattening in another caused by the same degree of movement of these tissues.

With respect to the nasolabial angle, its variation was not significant for either group. It would be the same when comparing the two groups. However, we noticed that the values recorded before and after the treatment were



and remain within the esthetic range of 90° to 120°.

The treatment would therefore have no unsightly effect on this angle.

Similarly, our results suggest the absence of a correlation between incisor movement and the variation of this angle, regardless of the type of treatment undertaken (with or without premolar extractions). Bourizgui et al.<sup>3</sup>, in their study on a sample of 100 Moroccan patients treated with and without premolar extractions, noted an opening of 10.7° from this angle, but this opening was not significant. However, Thalass et al. and Kusnoto found that retraction of the maxillary incisor led to the retrusion of the upper lip with a significant opening of the nasolabial angle<sup>16,27</sup>. Bravo<sup>4</sup>, meanwhile, recommended avoiding extracting premolars when this angle exceeds 110°.

This study showed that the labio-mental angle does not seem to be influenced by orthodontic treatment without premolar extractions (group 1). On the other hand, a significant opening of this angle of  $5.2^\circ \pm 8.408^\circ$  was observed in the treated group with extractions. These results are consistent with those of Looi and Mills<sup>17</sup>, who reported a significant opening of this angle of 5.3° following premolar extraction in 60 patients with a class II division 1. Caplan<sup>7</sup>, on the other hand, suggests that the labio-mental angle is not significantly affected by our orthodontic treatments.

Similarly, some studies, such as that of Malki<sup>18</sup>, have shown that the modification of this angle during treatment would depend on the vertical pattern of the patient.

In the literature, few studies have examined the analysis of changes in vertical labial positions following incisor movement. Park et al.<sup>23</sup> reported that retraction of the maxillary incisors correlated with an increase in the interlabial vertical dimension.

Jacobs<sup>13</sup> reported that the interlabial gap closes vertically at a ratio of about 1 mm for every 2 mm of upper incisor horizontal retraction.

Margolis<sup>19</sup> stated that the lower lip and chin should be about twice the height of the upper lip.

Therefore, it seems that, from an esthetic point of view, the ability to predict the vertical changes of the upper and lower lips resulting from the retraction of the anterior teeth would be useful in the planning and individualization of orthodontic treatments.

However, factors such as the interlabial distance, height of the lower floor of the face, thickness of the lips, and quality of their musculature should be taken into account and could be evaluated in a more in-depth study.

The orthodontist's action at the level of the nasal region is only indirect insofar as they must take into account the architecture and disposition of this element when choosing the treatment. The existence of significant growth phenomena of the covering tissues and of that of the nose, which occur in parallel with the orthodontic treatment, generally go beyond our intervention. In general, the movement of the nose downward and forward during growth is greater than that of the chin, and this imbalance gives the illusion of labial retraction in the profile. It will therefore be more prudent to retain some labial protrusion when the nose is more prominent. If on the contrary the nose

is small, it will be less embarrassing to institute a treatment that will tend to move the lips back, thus making the nose more visible in the facial profile. The size and position of the nose in the profile should therefore be taken into consideration before deciding whether to retract the upper incisors<sup>22</sup>. In this same context, a study conducted by Ben Amor et al.<sup>2</sup> on a sample of 53 Tunisian patients with a normal orthodontic profile revealed that, morphologically, Tunisian profiles have the

peculiarity of having, very often, a more anterior situation of the nose compared with the norm.

This should lead the orthodontist to be vigilant during treatments with premolar avulsion and incisor retrusion, the latter causing in these cases, a cutaneous imbalance that jeopardizes the entire facial harmony.

## CONCLUSION

Today, current orthodontics is more esthetically orientated and more respectful of the harmony and balance of the various elements constituting the facial profile. It is therefore important to make a thorough assessment of the relationship between these elements before establishing an orthodontic treatment decision.

We therefore call for more multicenter studies to be conducted in larger populations to optimize therapeutic management and to put the patient back at the center of the therapeutic project.

### *Conflict of interest*

*The authors declare that they have no conflict of interest.*

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