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Cephalometric Analysis for Evaluating the Profile Nasal Morphology in Egyptian Adults

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ABSTRACT

Aesthetic features are different from race to another, and this should be considered during the preoperative planning of an aesthetic procedure. Anthropometric measurements of the Caucasian nose have been set by many authors. We aimed with this study to establish similar measurements for adult Egyptian males and females. Also, the results are compared to that of the Caucasian nose.

In current study, lateral cephalometry is done for thirty males and thirty females aged from 16-35 years, of normal face with Angle class I occlusion. Cephalograms are traced manually; then vertical, horizontal, and angular measurements are taken. Results are analyzed to set up the normative Egyptian standards for the nose of this age group. By comparing the results to that of the Caucasian, some differences are noticed.

Cephalometry is proved to be a good tool for nasal shape analysis. Further study is needed to compare such results with that come from the digital tracing and analysis to see how we could correlate both techniques.

INTRODUCTION

Beauty is an ill-defined concept that is obvious to observer and recognized cross-culturally. However, it is difficult to quantify and it may vary in its perception across different ethnic groups **[1]**. To achieve high levels of patient satisfaction consistently after rhinoplasty, the surgeon must have an idea of the appropriate aesthetic norm. This has yet to be satisfactory defined for all racial groups. Again, surgeons undertaking rhinoplasty for non-Caucasian individuals require a broad understanding of ethnically specific nasal features **[2]**. Hence, understanding of the aesthetic norms of Caucasians alone should not be considered sufficient **[1]**.

Many authors have stated that the analysis of the soft tissue should be taken into consideration for the proper evaluation of an underlying skeletal discrepancy because of the individual differences in soft tissue thickness **[3-6]**. Cephalometric technique dates back to Broadbent's investigation of orthodontic patients in 1931 and has been applied to various cranio-maxillofacial conditions **[7]**. It is performed by measuring lengths and angles defined by craniofacial reference points; traditional cephalometry is based on the use of radiograms to determine these measurements **[8]**. Investigators have developed numerous analyses to interpret the diagnostic information that the lateral cephalogram provides **[9]**.

Guyron used a simple technique of full-scale life-size photography for planning rhinoplasty cases. He also used cephalometry as an adjuvant tool for his planning but without the use of computer software **[10]**. Ferraio conducted a study where he found that the nasal profiles of men and women were virtually identical **[11]**. Stark and Epker performed a study on American men and women in which they did measurements of the nasal profile on a traditional traced cephalogram **[12]**. Leong, in his study to compare Oriental and Caucasian nose, emphasized on the many aesthetic differences between both groups **[13]**.

In our study, we evaluated the normal anthropometric measurements of the nasal profile of Egyptian adult males and females. Results are then compared to the similar studies done for the Caucasian nose. We used the standard lateral cephalogram.

MATERIAL AND METHODS

Our study was conducted in Plastic, Reconstructive and Burn Surgery Unit of Mansoura University. In this study, lateral cephalometric radiographs were done for thirty Egyptian males and thirty Egyptian females. All of them were selected between the age of 16 and 35 years within the period from January to September 2006. Our volunteers included University students, hospital staff and normal population. Each of them fulfilled certain entry criteria of: 1- Angle's class I occlusion with pleasant and balanced facial profile, 2- Competent lip, 3- Normal overjet and overbite, 4- No cranio-facial deformities, and 5- No history of orthodontic treatment, nor rhinoplasty.

Each volunteer underwent history taking and thorough clinical examination to exclude any abnormalities or malformation. The patients were categorized into males and females. Standard cephalogram, hard and soft tissue, was done (Fig. 1) with fixed radiation level; distances between radiation source, head and X-ray film; and head position for all participates. The cephalometric films were obtained using the same X-ray unit (Panoura Ultra, Uoshida dental Mfg CoLtd) at natural head position, with teeth in maximum interdigitation and lips in a relaxed posture.

Cephalometric analysis:

For the lateral cephalometry, anthropometric landmarks were traced on an acetate paper using radiograph light source in a horizontal position. Any X-ray coordinate was constructed for all tracings with a line parallel to Frankfort horizontal (FH) line and a line perpendicular to it at the level of Sella. To overcome the magnification error that could happen due to changing the distance between the X-ray anode and the film we put a ruler lead marker in the nasal fixation piece to be able to measure the magnification factor. This factor is then multiplied by the resulted measurements to get the actual ones. The tracing was done and repeated after a week by the same investigator and the results were subjected to statistical analysis.

Anthropometric landmarks (Fig. 1):

1- *Bony land marks:*

N (nasion): The most anterior point of the frontonasal suture.

A point: The deepest point on the anterior contour of the upper alveolar arch.

B point: The deepest point on the anterior contour of the lower alveolar arch.

O (orbitale): The most inferior point of the orbit rim.

Po (porion): The upper most point of the external auditory canal.

FH (Frankfort horizontal): A horizontal line from the superior border of the Po to the O points.

2- *Soft tissue landmarks:*

Gb (glabella): The most prominent point in the mid-sagittal plane of the forehead.

R (radix): The most concave point in the tissue overlying the area of the frontonasal suture.

T (nasal tip): The most prominent or anterior point of the nose.

Col (columella): The most anterior soft tissue point on the columella of the nose.

Sn (subnasale): The point at which the columella merges with the upper lip in the mid-sagittal plane.

Ls (labral superioris): The most anterior point on the upper lip.

Li (labral inferioris): The most anterior point on the lower lip.

Pg' (soft tissue pogonion): The most anterior point on the soft tissue profile of the chin.

St (stomion): The most inferior point of the upper lip.

Me' (menton): The lowest point on the soft tissue profile of the chin in mid-sagittal plane.

G' (gnathion): The point formed by the intersection distance between Pg' and Me'.

Anthropometric measurements:

I- *Vertical measurements (Fig. 2):*

Upper facial height (UFH): The vertical distance between Gb and Sn.

Lower facial height (LFH): The vertical distance between Sn and Me'.

Total nasal height (TNH): The vertical distance between R and Sn.

Upper nasal height (UNH): The vertical distance between R and T.

Lower nasal height (LNH): The vertical distance between T and Sn.

Stomion to menton distance (St-Me): The vertical distance between St and Me'.

II- *Horizontal measurements (Fig. 2):*

Columellar length (CL): The distance between Sn and Col.

Nasal tip projection (TP): The linear horizontal distance between mid-facial vertical line and T.

Radix projection (RP): The linear horizontal distance between N and the overlying soft tissue.

Nasal length (RT): The linear horizontal distance between R and T.

III- *Angular measurements (Fig. 3):*

Nasofrontal (<NFr): The angle between a line form radix tangent to the soft tissue glabella and another tangent line to nasal dorsum.

Columellar rotation (<CR): The angle between a line from Sn tangent to the columella and the mid-facial line.

Nasolabial (<NL): The angle between two lines from Sn; one tangent to the upper lip and the other one tangent to the columella.

Bony nasal angle (<BN): The angle between mid-facial vertical line and a tangent line from N to the upper nasal bone line.

Three aspects of profile nasal aesthetics in Egyptians were evaluated. The first is quantifying profile nasal aesthetics from a standard lateral cephalometric radiograph. The second one is reporting the normative data for these measurements in males and females. Finally, our results were compared with other studies done for American Caucasian population and a study done for Egyptian sample by Hussien et al. **[14]**.

Statistical design:

Statistical analysis of the data is done by using Excel program 2003 and SPSS (Statistical Package of Social Science) version 10. The first part of the data was descriptive in the form of mean ± SD (standard deviation), frequency, and proportion. The second part was analytic to test statistical significant difference between groups. For qualitative data (frequency and proportion) Ki-square test was used. For quantitative data (mean ± SD) student *t*-test was used to compare groups.

RESULTS

Tables (1,2,3) show the normative anthropometric measurements of the nose for Egyptian males as obtained from the lateral cephalogram.

Tables (4,5,6) show the normative anthropometric measurements of the nose for Egyptian females as obtained from the lateral cephalogram.

Egyptian male and female were compared to their corresponding American Caucasians using "*t*" test and "*p*" value. Analysis of the results for the vertical measurements of Egyptian males (Table 7) revealed insignificant difference for UFH, LFH, TNH, UNH and LNH. Whereas, S-Me was longer in American males.

As regard the horizontal measurements (Table 8), insignificant difference for RT and RP was noticed. While for TP and CL, American males were longer.

For the angular measurements (Table 9), insignificant difference was noticed for <CR, <CL, and <BN. In the mean time, <NFr was more acute in American males than Egyptian males.

The only positive finding in comparing Egyptian and American females for the vertical measurement was the S-Me length (Table 10). It was more in American females.

Analysis of the results for the horizontal measurements (Table 11) revealed insignificant difference for PR and CL. But, RT and TP have been proved to be longer in American females than Egyptian females.

Analysis of the results for the angular measurements (Table 12) revealed insignificant difference for <CR and <CL. Whereas, significant difference for <NFr and <BN were found; with <NFr more in Egyptian females, while <BN is more in Americans.

Table (1): Descriptive statistics of anthropometric measurements of the Egyptian male sample for vertical measurements.

	No.	Mean	Std. Deviation	Minimum	Maximum
UFH	30	73.44	2.22	68.8	77.3
LFH	30	73.33	4.09	68.0	79.0
TNH	30	57.21	2.50	51.0	60.2
UNH	30	45.21	2.27	40.0	49.0
LNH	30	12.00	1.05	10.0	14.0
S-ME	30	52.54	1.59	50.0	55.0

UFH = Upper facial height. UNH = Upper nasal height.
LFH = Lower facial height. LNH = Lower nasal height.
TNH = Total nasal height. S-Me = Stomion to menton distance.

Table (2): Descriptive statistics of anthropometric measurements of the Egyptian male sample for horizontal measurements.

	No.	Mean	Std. Deviation	Minimum	Maximum
RT	30	51.05	3.66	47.0	57.0
RP	30	7.73	0.81	06.4	09.0
TP	30	35.66	2.35	31.8	39.0
CL	30	7.65	0.91	06.3	09.0

RT = Nasal length. TP = Nasal tip projection.
RP = Radix projection. CL = Columellar length.

Table (3): Descriptive statistics of anthropometric measurements of the Egyptian male sample for angular measurements.

	No.	Mean	Std. Deviation	Minimum	Maximum
<CR	30	64.20	4.13	63	72
<NFr	30	135.20	5.10	125	143
<NL	30	110.40	3.71	105	116
<BN	30	30.53	3.03	24	35

<CR = Columellar rotation. <NL = Nasolabial angle.
<NFr = Nasofrontal angle. <BN = Bony nasal angle.

Table (4): Descriptive statistics of anthropometric measurements of the Egyptian female sample for vertical measurements.

	No.	Mean	Std. Deviation	Minimum	Maximum
UFH	30	69.39	4.78	63.0	76.5
LFH	30	67.26	11.71	66.0	72.0
TNH	30	52.24	3.37	48.0	57.0
UNH	30	40.34	2.64	37.0	44.0
LNH	30	11.90	0.98	11.0	14.0
S-ME	30	48.05	2.43	45.0	49.2

UFH = Upper facial height. UNH = Upper nasal height.
LFH = Lower facial height. LNH = Lower nasal height.
TNH = Total nasal height. S-Me = Stomion to menton distance.

Table (5): Descriptive statistics of anthropometric measurements of the Egyptian female sample for horizontal measurements.

	No.	Mean	Std. Deviation	Minimum	Maximum
RT	30	47.0500	3.42	43.0	52.0
RP	30	6.5600	0.61	06.0	07.7
TP	30	32.6000	1.46	30.0	35.0
CL	30	6.6433	0.85	06.1	09.0

RT = Nasal length. TP = Nasal tip projection.
RP = Radix projection. CL = Columellar length.

Table (6): Descriptive statistics of anthropometric measurements of the Egyptian female sample for angular measurements.

	No.	Mean	Std. Deviation	Minimum	Maximum
<CR	30	64.00	5.28	59	73
<NFr	30	139.00	1.98	136	142
<NL	30	111.30	2.01	110	114
<BN	30	29.90	3.41	24	35

<CR = Columellar rotation. <NL = Nasolabial.
<NFr = Nasofrontal. <BN = Bony nasal angle.

Table (7): *t*-test for comparing between Egyptian male and American male for vertical measurements.

	Egyptian Male		American Male		*p* Sig.
	Mean	S.D.	Mean	S.D.	
UFH	73.44	2.22	73.60	4.70	0.825
LFH	73.33	4.09	73.40	4.50	0.926
TNH	57.21	2.50	56.40	4.60	0.054
UNH	45.01	2.27	44.30	2.70	0.050
LNH	12.00	1.05	11.70	3.30	0.129
S-ME	52.54	1.59	53.60	4.50	0.001*

UFH = Upper facial height. UNH = Upper nasal height.
LFH = Lower facial height. LNH = Lower nasal height.
TNH = Total nasal height. S-Me = Stomion to menton distance.
*$p<0.05$ = Significant.

Table (8): *t*-test for comparing between Egyptian males and American males for horizontal measurements.

	Egyptian Male		American Male		*p* Sig.
	Mean	S.D.	Mean	S.D.	
RT	51.00	3.66	51.00	3.60	1.000
RP	07.73	0.815	07.90	4.50	0.263
TP	35.66	2.35	37.20	3.10	0.001*
CL	07.65	0.919	08.70	1.70	0.000**

RT = Nasal length. CL = Columellar length.
RP = Radix projection. *$p<0.05$ = Significant.
TP = Nasal tip projection. **$p<0.001$ = High significance.

Table (9): *t*-test for comparing Egyptian male and American male for angular measurements.

	Egyptian Male		American Male		*p* Sig.
	Mean	S.D.	Mean	S.D.	
<CR	64.20	4.13	64.3	9.20	0.896
<NFr	135.20	5.10	121.4	8.40	0.000**
<NL	110.40	3.71	111.4	14.10	0.152
<BN	30.53	3.03	31.5	2.70	0.092

<CR = Columellar rotation. <BN = Bony nasal angle.
<NFr = Nasofrontal angle. **$p<0.001$ = High significant.
<NL = Nasolabial angle.

Table (10): *t*-test for comparing between Egyptian and American females for vertical measurement.

	Egyptian Female		American Female		*p* Sig.
	Mean	S.D.	Mean	S.D.	
UFH	69.39	4.78	69.1	4.30	0.691
LFH	67.26	11.71	67.3	4.10	0.986
TNH	52.24	3.37	52.4	3.70	0.871
UNH	40.34	2.64	41.2	1.50	0.086
LNH	11.90	0.98	11.2	3.50	0.050
S-ME	48.05	2.43	49.1	4.10	0.025*

UFH = Upper facial height. UNH = Upper nasal height.
LFH = Lower facial height. LNH = Lower nasal height.
TNH = Total nasal height. S-Me = Stomion to menton distance.
*$p<0.05$ = Significant.

Table (11): *t*-test for comparing Egyptian females and American females for horizontal measurements.

	Egyptian Female		American Female		*p* Sig.
	Mean	S.D.	Mean	S.D.	
RT	47.05	3.42	51.49	3.70	0.000*
RP	06.56	0.61	06.50	1.40	0.599
TP	32.60	1.46	37.30	2.10	0.000**
CL	06.64	0.85	6.60	1.90	0.784

RT = Nasal length.
RP = Radix projection.
TP = Nasal tip projection.
CL = Columellar length.
**$p<0.001$ = High significance.

Table (12): *t*-test for comparing Egyptian and American females for angular measurements.

	Egyptian Female		American Female		*p* Sig.
	Mean	S.D.	Mean	S.D.	
<CR	64.00	5.28	64.4	7.50	0.682
<NFr	139.00	1.98	118.6	7.90	0.000**
<NL	111.30	2.01	111.9	11.70	0.600
<BN	29.90	3.41	31.4	2.00	0.023*

<CR = Columellar rotation.
<NFr = Nasofrontal angle.
<NL = Nasolabial angle.
<BN = Bony nasal angle.
*$p<0.05$ = Significant.
**$p<0.001$ = High significant.

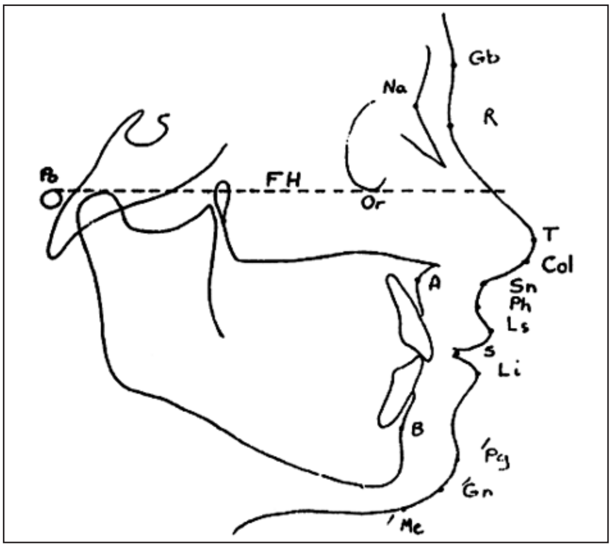

Fig. (1-A): Anthropometric landmarks.

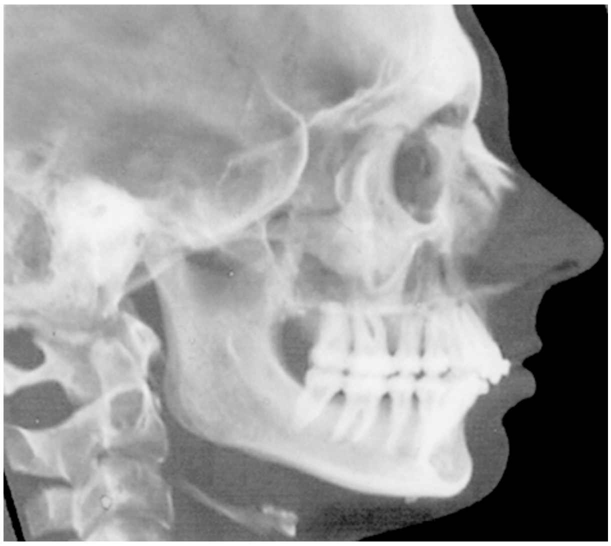

Fig. (1-B): Soft and hard tissue lateral cephalometry X-ray.

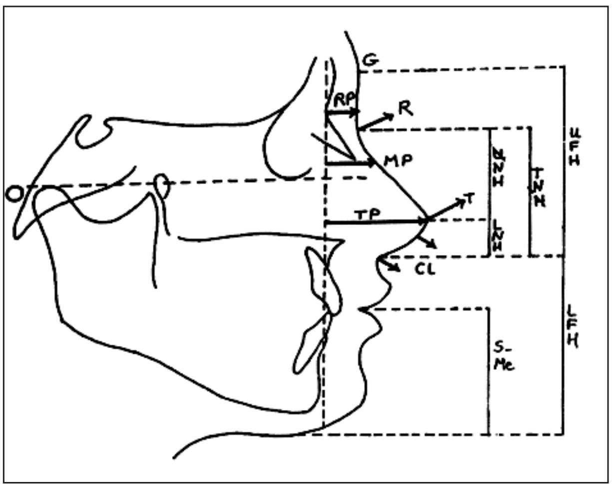

Fig. (2): Vertical and horizontal measurements.

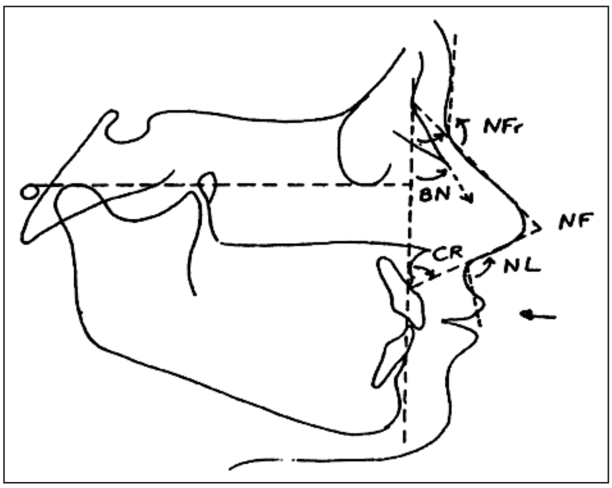

Fig. (3): Angular measurements.

DISCUSSION

Some rhinoplasty surgeons still have the view that; "in rhinoplasty, the Caucasian nose is still predominant as the gold standard of beauty" **[15]**. Others highlighted the concept that the nose must be in harmony with the rest of the race of the individual **[1]**.

In view of the fact that each rhinoplasty case must be individualized, the identification of the normal range of the cephalometric measurements for particular population is necessary, and hence the diagnosis of abnormalities can be possible **[16]**. Stark and Epker defined the nasal profile parameters of American men and women on traced cephalograms without the use of digital program **[12]**. The available norms derived from Caucasians Americans cannot be applied to other races unless they are modified. Alcade and Co-workers developed soft tissue norms for Japanese adults and found that analyses based on causcasians norms cannot applicable as a reference for the diagnosis and treatment of the Japanese patients **[17]**. Comparative studies have been done for other races such as in Saudi Arabia **[18]**, and Korea **[19]**. This encouraged us to carry out the current study on Egyptian nose on similar basis of Stark and Epker.

Conventional cephalometric analysis (CCA) is a user-friendly and simple technique that can be used in clinical use plus that the comparison of cephalometric data of individual patients to referent data can only be conducted using CCA. The rational of using the CCA in this study were the ease of use, less digitalization error when applied by one investigator for all cases, and the no need for a sophisticated digital program. We used the tangent line method during tracing of our cases as it is the one used for the American sample to which we compared.

In this study, three aspects of profile nasal aesthetics in Egyptians were evaluated. The first is a proposed detailed method for quantifying profile nasal aesthetics from a standard lateral cephalometric radiograph. The second one reports normative data for these measurements in male and female volunteers with angle class 1 occlusion. Finally our results were compared with another study on Americans Caucasians done by Stark and Epker.

Anthropometric measurements used in this study were categorized into vertical, horizontal, and angular measurements. The comparison between Egyptian males and females showed that males have significant longer vertical and horizontal measurements ($p<0.001$), except for the lower nasal height that was insignificantly different with male more than female ($p=0.539$). This reflects the larger overall body size of males that agreed with the study of Ferraio **[11]**. Upper facial height was found nearly equal to the LFH in males; while it is longer in females. Comparison of the nasal projection revealed that the female to male ratio of nasal tip projection is 91%, while for radix projection it is 84%.

As regard the angular measurements, females nasofrontal angle (139º) is more obtuse than males (135.2º) ($p<0.001$), thus revealing less convex radix in females. Also, the nasolabial angle is more obtuse in female ($p<0.001$) that ensure the more depression of the columella downwards in the males.

By comparing our results to that elaborated by Stark and Epker, no significant differences for vertical measurements are observed. Yet, the S-Me, that represent the length of the lower face, is found longer in Caucasians ($p=0.001$). Hussein and co-workers, in a study in Ain Shams University using a digital program comparing Egyptian sample with American results of Stark and Epker, reported that vertical measurements of Egyptian are more except for UFH and UNH in males in contrast to our study **[14]**. This may be explained by using different methods for tracing.

For the horizontal measurements, nasal tip projection is more in Caucasian for males and females ($p=0.001$). Also, the columella is longer in Caucasian male ($p<0.001$). So, during rhinoplasty we should not increase the tip projection much in Egyptians, yet this should be weighed against the thicker soft tissue that dictates a stronger support. Again, the Egyptian female nose is found shorter ($p<0.001$). Unfortunately, theses results do not go with that of the digital tracing where Egyptian male nose found longer, and radix is more projected in Egyptian females.

Further comparison of the results for the angular measurements showed that the nasofrontal angle is more obtuse in Egyptians ($p<0.001$). Still these results does not go with that of Hussein and colleagues that showed that <CR, <NL, and <NFr are more obtuse in Egyptian females.

The nasal tip is less projected in Egyptians and also in Orientals than the Caucasian noses. Also, the nasolabial angle is more acute in both Egyptians and Orientals, due to the more upper lip protrusion **[13,16]**.

Several investigators have noted the importance of the cephalometric soft tissue analysis in the determination of facial aesthetics on the basis that soft tissue behaves independently from the underlying skeleton **[20,21,22]**.

The results of the soft tissue cephalometric analysis for the Egyptians nose is in line with the findings of previous studies carried out in non Caucasians that confirm the existence of significant soft tissue variables. Hence, the results of the present study will be used as a reference value that may be beneficial in giving a preoperative planning for rhinoplasty in Egyptian people and post operative assessment for the resulting nasal shape.

Subtenly has recommended that the analysis of the soft tissue should be taken into consideration for the proper evaluation of an underlying skeletal discrepancy because of individual differences in soft tissue thickness **[3]**. This was evaluated in this investigation giving the impression that the Egyptians soft tissue thickness of the nose is thicker which encourage overcorrecting work on the cartilage and bone during surgery.

It is well established that the standard cephalometric values provide useful guidelines in rhinoplasty planning. However, it may be incorrect to make rigid applications of these values since they represent population averages that may be inappropriate as individual treatment goals. Furthermore, it has been suggested that it is an analysis misuse if it is applied to a patient of a different age or with a specific facial features. Other studies comparing the traditional cephalogram to the digitalized one are needed to come up with criteria to unify both techniques.

The main advantage of this study is giving a standard lateral cephalometry nasal profile measurements for Egyptians people in both genders helping in rhinoplasty surgical decisions and improving postoperative outcomes. It is hoped that the result of this piece of work will provide more objective database helping in making surgical decisions improving postoperative outcomes. Hopping to for another study comparing the traditional cephalogram to digitalized one.

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