PHOTOGRAPHIC ANGULAR ANALYSIS OF ADULT SOFT TISSUE FACIAL PROFILE

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ABSTRACT:

Intoduction: The most striking feature, visible on first sight of any human being, is the face. Photographic assessment of facial attributes have been the gem of modern day orthodontics as Orthodontic diagnosis & treatment planning has no been based on profiles rather than Angle`s Concept. The study was aimed at assessing the soft tissue profiles and determining gender dimorphism in a young adult population sample. **Material Methods**: The study included 60 subjects (30 males and 30 females) of age range 18-25 years. The sampling comprised random selection of the subjects. The method involved photographic profile analysis with angular measurements made on standard photographic records taken in natural head position. The standardized photographs were analyzed digitally. A total of 11 variables were used in the study **Results**: Gender dimorphism was found for several angles. Male subjects showed wider Nasofrontal, Nasal, Nasal dorsum, Middle facial third, Inferior facial third angles and the angle of facial convexity. The female subjects had wider values for Mentolabial, Head-posture and Total facial convexity angles, while Nasolabial and Cervicomental angles showed least variation amongst genders.**Conclusion:** The results point to the importance of individualized case planning. Soft tissue profile analysis establishes invaluable details that help treatment planning and predict response to particular treatment modality.

Keywords: Photographic analysis, standardized photographs, natural head position, angular measurements.

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INTRODUCTION:

The most striking feature, visible on first sight of any human being, is the face. The face is not only the most prominent feature, but also the most important structure in defining overall appeal and esthetics of that person. It has been established that self-esteem is strongly dependent on facial appearance. That is why; the human face has been the center of discussion and research for centuries. Features of the human face have been a constant fascination for scientists and artists alike. Ancient Egyptians and Greeks applied mathematical proportions to the human face in 3000B.C[1]. They developed an intricate quantitative system for defining the proportions of the human body known as a canon[2]. The canon consisted of drawing the human head, feet and legs in profile view and the torso in frontal view, and enclosed in a 22 lines square grid. The proportions were measured by an "el" ruler.

The Roman architect Vitruvius described the face by dividing it into 3 equal parts, marked by the distance from hairline to glabella, from glabella to subnasale and from subnasale to menton[3]. This division is still used in facial form analysis today. Similarly Albrecht Durer used geometrical proportional analysis of both the leptoprosopic and euryprosopic faces in a co-ordinate system in 3 dimensions[4]. He also made use of 2 lines, one drawn from the forehead tangent to the nose, and the other tangent to the chin and the upper lip which intersected and formed the facial angle. To date, this angular measurement is a key measurement in cephalometric analysis of the facial form.

Since the late 19th and early 20th century, facial form and soft tissue relations have been in and out of the mainstream orthodontic practice. In early 20th century, Angle, known as the father of modern orthodontics, claimed that the correct dentoskeletal relationships were the only determinants of a successful orthodontic treatment, thus downplaying the importance of the soft tissue and profile. He followed the sculpture of Apollo Belvedere as his canon[5]. According to him and his followers, stability only came in treatment if correct dentoalveolar and skeletal bases were in ideal relationship. However, Case[6], his contemporary, researched in finding the ideal face form for each individual, thus relating and incorporating the soft tissue relationships into orthodontic treatment planning.

In 1931, Broadbent and Hofrath standardized the Radiographic technique, and again soft tissue took a back seat in orthodontic treatment planning as skeletal relationships took center stage. Later, Subtelny[7] in 1959, and Steiner[8] in 1960, used linear measurements of soft tissue profile. Steiner described the tangent to the upper and lower lip as S-Line. Ricketts[9] in 1968 defined the Esthetic E-line as the Nasal tip to pogonion, as the point of reference for determining the relationship of the lip to the rest of the face. In 1996, Canut[10] described the Esthetic analysis relating the nasal, labial and chin prominences to the Subnasale and Supramental point, and the depth of the nasolabial sulcus.

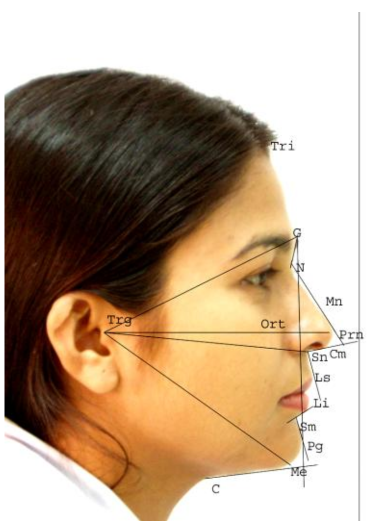
Many authors have suggested utilizing soft tissue analysis as a reliable guide for occlusal treatment and attendant soft tissue changes. Arnett and Bergman[11-12] presented the Facial Keys to Orthodontic Diagnosis and Treatment Planning as a three-dimensional clinical blueprint for soft tissue analysis and treatment planning. In this study, the aim was to determine angular measurements of the facial profile of young adults. A standardized photographic analysis of the profile in natural head position was done to assess the soft tissue profiles and to determine the gender dimorphism in the proposed sample.

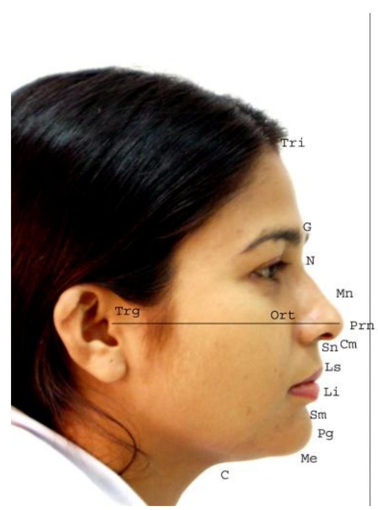
MATERIAL AND METHODS:

This Cross-sectional study was conducted in the Orthodontic section of the Dental Department of Children Hospital and Institute of Child health, Lahore. The sample consisted of 60 subjects of age range 18 – 25 years with an equal number of subjects from both genders. Selected sample consisted of Pakistani subjects, with fully developed adult dentition and facial profile and were skeletally class I, II and III, determined through cephalometric analysis.

The photographic setup consisted of a tripod that held a Digital Camera (Nikon P90, with 26mm-624mm (35mm equiv.) zoom range). Stability and easy adjustment of the tripod enabled the optic axis of the lens to be kept horizontal. All photographs were captured at a standard resolution of 10 Mega pixels, without flash, at standardized settings, with a distance of 5 feet from the subject in a well illuminated room in candescent light. The subjects were positioned on a line marked on the floor, and framed alongside a vertical scale divided in 5-cm segments. The scale allowed measurements at life size (1:1). From the scale hung a plumb line held by a thick black thread that indicated the True Vertical (TV). The photographs were shot with a white background and an even distribution of light to minimize shadows and to reduce noise

All photographs were exported in Adobe Photoshop 7 and adjusted according to the actual patient facial size. Anatomical points of reference of the face were digitally marked on photographs of all the subjects. All the required measurements were measured using Adobe Photoshop by single operator to minimize margin of error. The angles were measured in degrees and rounded off to the nearest integer.





LANDMRKS:

The following landmarks were located on the photographs to obtain all the measurements manually.

G, glabella; N, nasion; Mn, mid nasal; Prn, pronasal; Cm, columella; Sn, subnasal; Ls, labial superior; Li, labial inferior; Sm, supramental; Pg, pogonion; Me, menton; C, cervical; Trg, tragus; sTV, superior point of the True Vertical; iTV, inferior point of the True Vertical; Orb , orbitale

REFERENCE LINES:

sTV–iTV, True Vertical;
N–Ort (parallel to TV through nasion),
Trg–Ort (perpendicular to TV through Trg),
True Horizontal.

ANGULAR MEASUREMENTS OF THE ANALYSIS

N–G–Prn, nasofrontal angle;
Cm–Sn–Ls, nasolabial angle;
Li–Sm–Pg, mentolabial angle;
Sn–Cm/N–Prn, nasal angle;
N–Mn–Prn, angle of the nasal dorsum;
G–Pg/C–Me, cervicomental angle;
N–Trg–Sn, angle of the medium facial third;
Sn–Trg–Me, angle of the inferior facial third;
Trg–Ort/Sn–Sm, angle of the head position.
G–Sn–Pg, angle of facial convexity;
G–Prn–Pg, angle of total facial convexity

RESULTS:

In this study, 11 variables were used for angular analysis. Descriptive analysis was used for finding the norms, means and standard deviations of both male and female groups.

Table 1 and 2 give the means, standard deviations, and ranges of the variables for males and females. Amongst them, a slightly wider nasofrontal angle was found in males (130.16±5.31 degrees) than in females (133.85±5.57 degrees). Males showed a wider nasal angle (78.23±8.45 degrees) than females (72.51±5.84 degrees). Nasal dorsum angle was also considerably higher in males (167.86±4.51 degrees) than females (150±6.6 degrees). Nasolabial angle showed less gender variation in males (95.83±6.13 degrees) in and females (92.00±7.36 degrees). Mentolabial angle was much higher in females (125.26±7.57 degrees) than in males (110.73±12.78 degrees). Cervicomental angle was almost similar in both males and females, (89.50±8.86 degrees) and (91.85±8.82 degrees) respectively. Angle of the medium facial third was higher in males (30.43±2.16 degrees) and than females (25.4±2.67degrees), as was the angle of inferior facial third with males (32.733±3.32 degrees) showing larger values than females (28.90±3.30 degrees). Females showed a larger angle of the head position (82.06±7.95 degrees) as compared to males (78.13±5.63 degrees). Angle of facial convexity was almost the same in males (163.60±4.65 degrees), as compared to females (163.76±6.36 degrees). Angle of total facial convexity was higher in males (138.66±7.53 degrees) as compared to females (131.83±4.89 degrees).

Table 1:

Descriptive Statistics MALES

N=30	Minimum	Maximum	Mean	Std. Deviation
G-N-Prn	121.00	139.00	130.1667	5.30506
Cm-Sn/N-Prn	65.00	94.00	78.2333	8.45142
N-Mn-Prn	157.00	175.00	167.8667	4.51613
Cm-Sn-Ls	85.00	110.00	95.8333	6.13123
Li-Sm-Pg	84.00	140.00	110.7333	12.78451
C-Me/G-Pg	75.00	104.00	89.5000	8.86197
N-Trg-Sn	26.00	34.00	30.4333	2.16051
Sn-T-Me	27.00	39.00	32.7333	3.32113
Sn-Sm-TH	68.00	90.00	78.1333	5.63079
G-Prn-Pg	125.00	151.00	138.6667	7.53078
G-Sn-Pg	154.00	171.00	163.600	4.36579

Table 2:
N=30

Descriptive Statistics FEMALES

	Minimum	Maximum	Mean	Std. Deviation
G-N-Prn	124.00	143.00	133.8567	5.57356
Cm-Sn/N-Prn	63.00	84.00	72.5167	5.84643
N-Mn-Prn	141.00	163.00	150.5333	6.60059
Cm-Sn-Ls	78.00	105.00	92.0000	7.36722
Li-Sm-Pg	113.00	138.00	125.2667	7.57006
C-Me/G-Pg	81.00	102.00	91.8533	4.82063
N-Trg-Sn	21.00	30.00	25.4000	2.67298
Sn-T-Me	24.00	37.00	28.9000	3.30465
Sn-Sm-TH	69.00	96.00	82.0667	7.95649
G-Prn-Pg	124.00	139.00	131.8333	4.89957
G-Sn-Pg	152.00	175.00	163.7667	6.36631

DISCUSSION:

In this study, the purpose was to determine average values of the soft tissue facial profile of the investigated population. When comparing the present results with other studies, the characteristics of the method and the sample used should be borne in mind. In the results, nasofrontal angle showed little variability between males and females. Females had slightly acute nasolabial angle as compared to males. Burstone[13] reported a nasolabial angle of 74 ± 8 degrees (range 60–90 degrees) in a Caucasian adolescent sample with a normal facial appearance. Yuen and Hiranaka[14] in a study of Asian adolescents on standardized photographic records reported an angle of 102.7 ± 11 degrees for males and 101.6 ± 11 degrees for females. McNamara et al.[15] reported similar results in a study on lateral cephalograms of adult Caucasians (males = 102.2 ± 8 degrees, females = 102.4 ±8 degrees). The nasolabial angle also showed gender dimorphism in a study by Fernández-Riveiro[16], (males = 105 ± 13 degrees, females = 107.6 ± 8.5 degrees), which is higher in contrast to results in our study (males = 95.83±6.13 degrees and females = 92.00±7.36 degrees).

Males also had a bigger nasal angle and more obtuse angle of the nasal dorsum showing gender dimorphism. This is significant in the facial planning during orthodontic treatment of males. Females in general had a wider mentolabial angle. The male mentolabial angle in our study showed a great deal of variance i.e. SD ±12.78. This reading should be taken into account in treatment planning with caution. These findings are similar to those of McNamara et al, Li–Sm–Pg = 133–134±10 degrees. Lines et al found in the silhouettes a mentolabial angle of 120–130 degrees.

Cervicomental angle showed little variance, with a mean value of 89.5 degrees in females and 91.8 degrees in males in this study. Fernández-Riveiro[16], showed this angle to be significantly more acute in males (79.8 ± 5 degrees) than in females (84 ± 6 degrees). Gender dimorphism was seen again in angle of the medium facial third and angle of the inferior facial third which was more in males as compared to females. Angle of the head position was variable in both genders, and presented no gender dimorphism, this was supported by Fernández-Riveiro [16]. Angle of facial convexity (G–Sn–Pg) was similar in males and females (males = 163.60±4.65 degrees and females = 163.76±6.36 degrees). Where as the Angle of total facial convexity (G–Prn–Pg) was higher in males (males (138.66±7.53 degrees) than females

(131.83±4.89 degrees). Yuen and Hiranak[14] reported from their Asian adolescent sample on photographic records a G–Sn–Pg angle of 162 ± 5 degrees in females and 161 ± 6 degrees in males and the G–Prn–Pg angle was 135 ± 4 degrees in males and 135 ±3 degrees in females. No gender dimorphism was found. In the investigation by Fernández-Riveiro[16], the facial convexity and total facial convexity angles obtained were similar. G–Sn–Pg: 168 ± 5 degrees in males and 167 ± 5 degrees in females. The G–Prn–Pg angle: 140 ± 5 degrees in males and 139 ± 4.5 degrees in females.

Special consideration should always be paid while capturing photographs of the subjects for photographic evaluation. It is highly recommended, that with latest technology and advances in digital photography, digital SLRs should be used for taking pictures. It is a long term beneficial investment to incorporate DSLRs in our routine Orthodontic practice and record keeping.

CONCLUSION:

- Facial features of the patient and its comparison with standard soft tissue facial profile measurements are of utmost importance, since even minor orthodontic procedures can alter facial appearance.
- The results showed gender differences in most of the measurements such as nasal angle, nasal dorsum angle, mentolabial angle, angle of the medium facial third, angle of facial convexity, and total facial convexity.
- Nasal angle and mentolabial angle showed maximum variance among subjects in both sexes and thus should be cautiously evaluated in orthodontic planning for either member of the gender.
- The photographic technique showed clinically acceptable validity and reproducibility. This method would be appropriate for multicenter trials as it is non-invasive and reliable.

It is suggested that further studies in this area be made involving different centers on community basis to establish norms of the adult soft tissue profile based on photographic analysis for the Pakistani population.

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