Facial soft tissue profile after Orthognatic Surgery at a Referral Hospital in Tehran, Iran

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Original Article

Abstract

Introduction: Recently, orthognathic surgery is widely used in reconstruction and aesthetics over the world and has found its place in plastic surgery, especially in moderate to severe skeletal deformities. The relationship between facial hard and soft tissues consequently has been raised in planning the surgery and assessment of postoperative changes. Photogrammetry is the reasonable and simple technique to assess the surgeries in this regard which was applied through the current research to evaluate pre- and postoperative facial parameters.

Methods: Between 2012 and 2014, 29 patients including 13 females and 16 males enrolled the study. The mean±SD of age was 27.3±4.65 years in men and 25.71±2.41 years in women. Patients who referred to a hospital in Tehran, Iran, were reviewed using their charts and enrolled the study regarding inclusion and exclusion criteria before being invited to get postoperative 6-24 months after their surgery for photogrammetry in this cross-sectional performance.

Results: 29 patients including 13 females and 16 males enrolled the study. The mean±SD of age was 27.3±4.65 years in men and 25.71±2.41 years in women. The facial convexity and the total facial contour had the most changes after the cervicomental and mentolabial angles which was about 5 degrees. In terms of longitudinal parameters, the bigonial breadth showed the most changes followed by the lower lip height and the central lower lip height. The surgery was effective to change physiognomic and morphologic face parameters with much more changes in women ($P<0.001$).

Conclusion: It seems that orthognatic surgery, disregarding the standards of the face, and the criteria of beauty between men and women in different races, help people to have better face besides malocclusion correction. The present study showed that the facial parameters changed towards more normal measures following the surgeries done in the surveyed referral center in Iran.

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Introduction:

Orthognatic surgery has owned a growing body of acceptance in recent decades over the world to be success in the field of aesthetic and reconstructive surgery, especially in moderate to severe skeletal deformities (1-3). One of the prominent concerns in the field of orthognatic surgery has been always the correlation between hard and soft tissue changes due to the surgery (4-6) which has attracted many studies and techniques to assess the relationship. Three dimensional techniques such as CT scan, videography, laser scan, morph-analysis and 3D ultrasonography have been raised, for instance; and nowadays, due to simplicity, low costs, and fast process, 2D and 3D photogrammetry is more used one in a vast number of aesthetic and face reconstruction centers (7-13).

Orthognatic surgery is addressed as the procedures to correct common maxillary and mandibular problems, generally (14). Malocclusion is a developmental defect in face which disturbs the anterior-posterior harmony of the teeth to involve individual appearance and function in that area. The surgery helps patients regain their beauty and normal occlusion through upper and lower jaws relocation.

Many authors tried to introduce normal and/or beautiful faces in different races and measure facial landmarks to be used in normal face definition in order to firstly, select people who need correction and then, assess the procedure accuracy in providing hard and soft tissue seeming and functional harmony. Figure 1 is trying to show normal facial soft tissue landmarks in an Iranian woman at full face and lateral views. Asghari et al., likely, attempted to find normal measures of face in the Iranian population in 2014 and showed high similarity between the studied people and other Asian population in addition to the fact that the face is most different body area between men and women, at least in appearance (15). The soft tissue profile was also studied in Spanish people by Riveiro et al. (16) to determine the mean values of the parameters among normal Caucasian race using 2D photogrammetry. They recruited 275 male and female participants who showed the most varieties in nasolabial and mentolabial angles.

In 1958, Burstone (17) introduced an angle named "total facial contour" that is defined the angle between the upper face and the anterior lower face. Later, Arnett, Bergman, Hiranaka, Yuen and Riveiro found that this angle was correlated to the facial profile classification. Rustemeyer, during a study, found that the facial convexity, the lower lip height and the labiomental angle obviously differed after the LeFort surgery in class and of facial profile, respectively; while the upper lip height and the nasolabial angle were the same as before the surgery (1). Facial symmetry was the other concern focused by Wermker et al. (18), recently. They acknowledged that computer assisted orthognatic surgery planning is not reliable to predict the outcomes, especially in middle face.

The present study headed to assess the photogrammetry results of orthognatic surgery comparing pre- and postoperative 2D pictures of the patients who underwent the procedure because their malocclusion.

Methods:

Through a cross-sectional study, this work attempted to assess the changes of the facial soft tissue profiles in candidates for orthognatic surgery by comparing pre - and postoperative 2D photogrammetry.

Participants and Records:

Patients who had referred to one of the main centers of plastic surgery in Tehran, Iran, between 2012 and 2014 were participated this retrospective work. The patients' charts were selected if their informed consents were seen in records to be reported in researches without addressing their private information. The patients suffered from classes or of malocclusion and were between 18 and 40 years of age. In the case of skull deformities, BMI $<$ 35, previous orthognatic surgeries needing revisions, gigantism or acromegaly as well as micrognathia and other similar problems, the patients were excluded the performance. There was no randomized case selection and all the referrals enrolled the research work during the studied time period.

Facial parameters and landmarks:

We focused on 37 facial parameters among which 26 longitudinal parameters and 11 angles

were assessed immediately before and 6-24 months after orthognatic surgery. The measures were recorded in the charts using 2D photogrammetry before the surgery. At the time of chart review, the patients were called to ask them to return to get 2D control photograms to be compared with preoperative ones at full-face and lateral views.

Statistics:

The character of the study justifies using paired t-test in order to compare the data before and after the surgery. To prevent a huge data for all the patients in terms of all parameters, we sum up the individual data into their means and standard deviations as can be seen in results. The comparisons were reported considering the significance of < 0.05 regarding 95% confidence interval and type 1 error of 0.05. The frequencies and distributions in qualitative data were reported by chi-square test or Fisher's exact test.

Ethics:

This analytic study was conducted retrospectively with no intervention for the participants. Though, all the participants who were called were informed about the aims and process of this study before expressing their agreement to get postoperative photograms. All the participants had the chance to leave the study at any stage they wished. The private information was secured by the principal investigator. No excessive costs were suffered by the participants due to enrolling the study. Furthermore, no facilitations were given to them who decided to enroll this research work compared to the others.

Results:

Totally, 40 patients experienced orthognatic surgery in the studied section of time by the current research. Two patients had segmental osteotomy in their records. Four other patients suffered from congenital anomalies like cleft lip or had a recent history of trauma. Five subjects did not refer to get postoperative pictures. Finally, 29 patients including 13 females and 16 males enrolled the study. The mean$\pm$SD of age was 27.3$\pm$4.65 years in men and 25.71$\pm$2.41 years in women as presented in table1.

The table also shows the frequency of disease classification. Class of malocclusion was seen in 8 (27.59%) whilst class in 21 (72.41%). The most applied surgery was bimaxillary orthognatic surgery in 14 subjects (48.3%) before LeFort in 10(34.5%) and bilateral sagittal split ramus osteotomy (BSSRO) in 5 (17%) of cases. The assessed parameters were recorded for the two time-sections before and after the surgery and their means of changes were compared statistically to be reported by table 2 and 3. As showed in table 2, upper face parameters such as the supraorbital breadth, the minimum face breadth, the forehead height, the upper face height, the upper vermilion, the upper lip height and some parameters in the lowest parts of the face like the chin height, and the lower vermilion did not differ comparing before and after the procedures. Likely, the nasofrontal, the medfacial and the nasal dorsum angles had no different changes. On the contrary, the vertical nasal, despite its little changes in women, was significantly changed in men ($P=0.003$). This was while the nasal angle changes were also prominent in men but not in women. The facial convexity and the total facial contour had the most changes after the cervicomental and mentolabial angles which was about 5 degrees.

In terms of longitudinal parameters, the bigonial breadth showed the most changes followed by the lower lip height and the central lower lip height.

The surgery was effective to change physiognomic and morphologic face parameters with much more changes in women ($P<0.001$).

Concerning surgical complications, 2 patients reported hypoesthesia in lower lip after 7-10 months of surgery when visited. Upper lip hypoesthesia was also reported by one 8 months later. These patients determined that the complications were improving as time goes by. A patient complained from increased interalar interval. Some patients' photograms are illustrated in figure 2.

Table 1. Demographics and disease and surgery information

Total	Sex		Age Mean±SD		Class		Surgery		
	M	F	M	F	II	III	Bimax	LeFortI	BSSRO
29	16 (55%)	13 (45%)	27.3±4.65	25.7±2.41	8 (27.6%)	21 (72.4%)	14 (48.3%)	10 (34.5%)	5 (17.2%)

Table 2. The changes in the means of facial soft tissue profile after the surgeries (longitudinal)

Longitudinal pharameters	Males		Females		Changes (absolute)		Sig		t		SE	
	Before	After	Before	After	M	F	M	F	M	F	M	F
Minimum frontal breadth	103.2±0.8	103.5±0.9	95.1±0.6	95.3±0.5	0.3	0.2	0.1851	0.173	1.34	1.38	0.224	0.145
Supraorbital breadth	122.2±0.7	122.4±0.7	112.3±0.9	112.1±1.2	0.2	0.2	0.281	0.476	1.09	0.718	0.184	0.279
Forehead height I	52.4±0.4	52.5±0.3	51.6±0.5	51.4±0.3	0.1	0.2	0.286	0.07	1.077	1.847	0.93	0.108
Forehead height II	62.2±0.8	62.3±0.6	62.1±0.7	61.9±0.7	0.1	0.2	0.592	0.281	0.538	1.088	0.186	0.184
Facial Middle face height	67.5±1	66.2±0.9	64.3±0.8	63.1±0.8	1.3	1.2	<0.001	<0.001	5.204	5.712	0.250	0.210
Maximum facial breadth	135.4±0.4	135.2±0.4	124.4±0.4	124.7±0.4	0.2	0.3	0.062	0.006	1.904	2.856	0.105	0.105
Bigonial breadth	117.3±0.7	112.5±0.4	108.6±0.7	104.4±0.3	4.8	4.2	<0.001	<0.001	32.06	29.70	0.150	0.141
Physiognomic face height	198.4±1.2	196.1±1	188±0.9	184.4±0.8	2.3	3.6	<0.001	<0.001	7.93	16.10	0.290	0.224
Morphologic face height	136.2±0.7	133.8±0.7	125.9±0.6	122.5±o.6	2.4	3.4	<0.001	<0.001	13.06	21.58	0.184	0.158
Upper face height	83±0.6	82.8±0.6	76.5±0.5	76.3±0.5	0.2	0.2	0.21	0.133	1.27	1.52	0.158	0.131
Anterior mandibular height	56.2±0.8	53.8±0.7	50.7±0.7	47.4±0.4	3.1	3.3	<0.001	<0.001	16.86	22.04	0.184	0.150
Chin height	32±4.1	31±3.7	28.2±3.1	27.9±2.8	1	0.3	0.334	0.700	0.98	0.387	1.026	0.776
Lower face height	78.5±2.4	77.1±2.5	72.1±3	69.9±2.8	1.4	2.2	0.034	0.006	2.176	2.887	0.644	0.762
Nasal Nose height	60.7±4.2	59.4±4.1	55.1±3	53.8±3.1	1.3	1.3	0.238	0.110	1.193	1.623	1.09	0.801
Nasal bridge length	48.8±2.6	46.6±2.1	43.3±2	42.5±1.8	2.2	0.8	<0.001	0.115	3.54	1.6	0.621	0.5
Nose width	40.6±2	42±2.1	36.3±1.7	37.7±1.5	1.4	1.4	0.012	0.002	2.6	3.32	0.54	0.42
Nasal root width	20.7±1.7	20.8±1.8	20.3±1.5	20.1±1	0.1	0.2	0.83	0.55	0.22	0.6	0.46	0.34
Nostril floor width	14.3±1	14.8±1	12.7±0.7	13.1±0.9	0.5	0.4	0.62	0.64	1.9	1.9	0.26	0.21
Oral-labial Philtrum width	15.6±1.3	16±1.7	14.7±1	14.9±1.3	0.4	0.2	0.32	0.51	1	0.66	0.4	0.3
Labial fissure width	55.6±2.5	54.7±2.6	52.7±2.3	51.8±2	0.9	0.9	0.18	0.17	1.34	1.4	0.67	0.65
Philtrum length	16.6±2.3	17.8±2.6	14.7±1.9	14.9±1.8	1.2	0.2	0.068	0.682	1.862	0.412	0.65	0.49
Upper vermilion height	5.7±1.1	5.8±1	6.2±1.7	6.4±1.8	0.1	0.2	0.72	0.57	0.36	0.44	0.28	0.46
Upper lip height	22.3±3.5	23.6±3	21.4±2.7	22.5±2.7	1.3	1.1	0.13	0.13	1.52	1.55	0.86	0.71
Lower lip height	24.2±2.9	21.8±3	22.7±2.9	19.5±2.1	2.4	3.2	0.003	<0.001	3.1	4.9	0.78	0.66
Cutaneous lower lip height	13.9±2	11.9±1.5	12.9±1.7	10±1.7	2	2.9	<0.001	<0.001	4.31	6.5	0.46	0.45
Lower vermilion height	10.3±1.5	9.9±1.3	9.8±1.3	9.5±1	0.4	0.3	0.28	0.33	1.1	1	0.37	0.30

Table 3. The changes in the means of facial soft tissue profile after the surgeries (angles)

Angles	Males		Females		Changes (absolute)		Sig		t		SE	
	Before	After	Before	After	M	F	M	F	M	F	M	F
Nasofrontal	142.2±4.2	144±4.6	139.3±5.1	140.7±5.3	1.8	1.4	0.12	0.31	1.56	1.02	1.16	1.37
Vertical nasal	28.1±3.4	31.1±4	31.3±2.1	32.2±2.7	3	0.9	0.003	0.16	3.1	1.4	0.98	0.64
Nasolabial	96.3±1.5	98.1±1.8	102.1±1.9	103.5±1.7	1.8	1.4	<0.001	0.004	4.1	3	0.44	0.47
Mentolabial	136.4±2.1	131.5±2.3	134.3±2	129.7±2.1	4.9	4.6	<0.001	<0.001	8.5	8.5	0.58	0.54
Nasal	76.5±3.1	88.3±3.3	84.6±3	86.2±3.9	11.8	1.6	<0.001	0.085	14	1.8	0.84	0.91
Nasal dorsum	176.3±5.1	177.4±4.7	177.2±4.9	179.1±4.3	1.1	1.9	0.4	0.1	0.85	1.6	1.29	1.21
Cervicomental	90.2±2.7	94.6±2.4	87.7±3.1	93.2±3	4.4	5.5	<0.001	<0.001	6.6	6.9	0.67	0.80
Med facial	30.5±1.3	29.9±1	29.4±1.2	28.9±1.5	0.6	0.5	0.05	0.17	1.97	1.4	0.30	0.36
Inf facial third	35.8±1.7	34.3±1.5	36±1	33.5±1.8	1.5	2.5	<0.001	<0.001	3.56	6.54	0.42	0.38
Facial convexity	175.8±4.3	170.3±3.8	174.4±3.5	169.5±4	5.5	4.9	<0.001	<0.001	5.16	4.97	1.07	0.99
Total facial	146.6±4.2	141.3±3.9	143.6±4	139.4±3.7	5.3	4.2	<0.001	<0.001	4.98	4.15	1.06	1.01

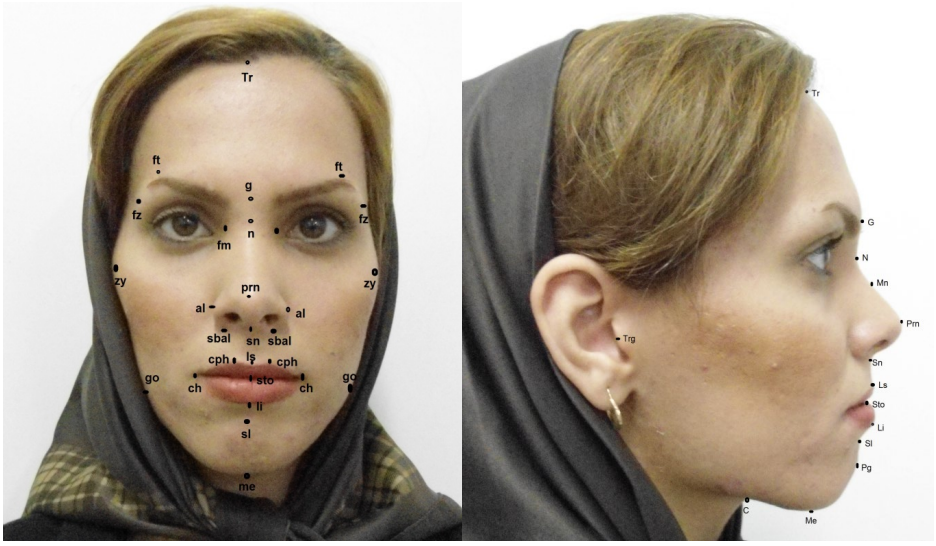

Figure 1. The standard landmarks of the facial soft tissue profile at full face and lateral views in an Iranian normal female face

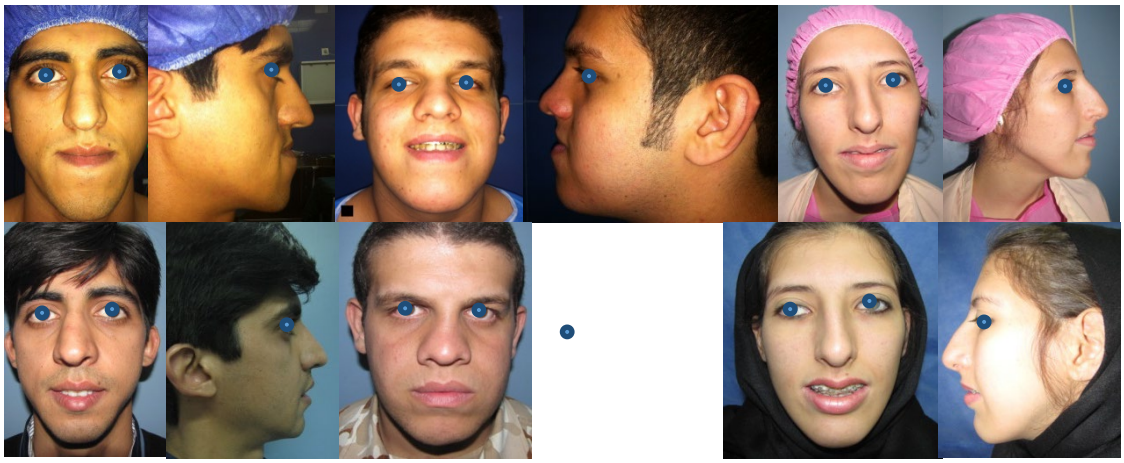

Figure 2. Some pre- and postoperative photograms captured through the present study

Conclusion:

Three kinds of orthognatic surgery were assessed by the present study on class and class of malocclusion. It used 2D-photogrammetry immediately before and 6-24 mo. after surgery. Finally it was showed that facial soft tissue, especially in middle face changed towards normal measures in the majority of the cases due to the procedure. Moreover, the physiognomic and morphologic height decreased, particularly in women.

Subjective use of photograms to assess the surgical procedures has been traditionally helpful in aesthetics for a long time; but recently, objective affairs and landmarks measurement has been raised to evaluate the procedure by facts and figures. In this regards, four kinds of measures are most worthwhile including the angles, lines, ratios and areal assessments (19-31). Human face is one of the most variable and changeable parts of his/her body.

Stoner in 1955, Fernandez in 2003 and Arnett and Bergman in 1993 focused on normal human head position (NHP) to talk about standard profiles in human using cephalofacial photogrammetry which is noninvasive low cost technique in this matter (32).

A successful orthognatic surgery tries to make a balance between hard (skeletal) deformities and soft tissue and aesthetic items. An Iranian study by Momeni Danaei et al. made a survey in terms of soft facial tissue by subcondylar and BSSRO surgeries (33). Momeni and colleagues compared the two surgeries in Iranian patients to evaluate their cephalograms before and 6mo. after the surgery. They showed an increase in the upper lip height by BSSRO which makes this technique suitable for people who have narrow upper lip. The both tried kinds of surgery increased the lower lip height in Momeni's work, like Friede and chunmaneechote's trial in 1999 (34). Men prefer lower lip height but more prominent chin while women like to have more thick lips (35,36). Momeni got an increased lower face height in subcondylar surgery while decreased by BSSRO, like what Jung et al. found in 2009 (37). They also reported reduced facial angle, especially in subcondylar surgery (33).

Aydil et al. (38) concluded good effectiveness for LeFort and BSSRO in vertical and anteroposterior replacement of the maxilla and mandible, respectively. They found changes in middle face that were on the line with our results.

One of our patients complained from increased interalar length which could be normally expected in many bimaxillary surgeries as Edler et al. reported a mean of 0.8 mm for it one year after surgery, although is not too much (19).

Apart from the outcomes of orthognatic surgery, standard measures in different races are the other attractive field in aesthetics. Farahvash et al., in 2010, studied 197 beautiful Iranian women between 13 and 30 years of age to compare them with the European Caucasians (39). They found smaller full and lateral face views by photogrammetry in Iranians. They also showed longer midface, shorter lower face, narrower and more prominent lips, smaller chin and also more facial convexity in Iranians than Caucasians. These kinds of studies help maxillofacial surgeons and orthodontists to make decision to candidate people for surgery and assess the outcomes very simply (40-42). The facial landmarks are also increasing in their numbers (41-43).

In 1980, only 25% of people needed to orthodontic approach with aesthetic motivation, but 75%, nowadays (28). Milutinovic et al. (40) realized in their report in 2014 that outward attraction and beauty is now a challenge between dentists, aesthetic surgeons, and orthodontists when focused on face symmetry, face size and the rates between facial landmarks. This is while the received sense from a face is not perfectly expressed by measures, yet. Jayaratne et al. are the other group who compared three races including Chinese, African-Americans, and white populations in terms of special facial measures (44). They also found close sizes in many landmarks in addition to some different measures between the assessed races.

The present study used no filler, including natural or synthetic, as many surgeries need them to correct any inequality in face following manipulations. However patients and the surgeon were completely satisfied by the outcomes.

To sum up, it seems that orthognatic surgery, disregarding the standards of the face, and the criteria of beauty between men and women in different races, help people to have better face besides malocclusion correction. Finally, the

present study showed that the facial parameters changed towards more normal measures following the surgeries done in the surveyed referral center in Iran.

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