An Objective Assessment of Orthognathic Surgery Patients

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Objectives: To retrospectively assess malocclusions, skeletal relationships and the functional needs of orthognathic patients treated in a University teaching hospital.

Subjects and methods: This study used clinical records of 100 consecutive patients [51 female, 49 males, mean (SD) age =21.5 (2.71) years] who had orthognathic surgery in a Shahid Beheshti University of Medical Sciences affiliated hospital (9/2014–7/2017). Malocclusion type (incisor classification), sagittal skeletal pattern (ANB angle), index of orthognathic functional treatment need (IOFTN) score, and osteotomy type were recorded.

Results: Overall, 66%, 31%, and 3% had Class III, II, and Class I malocclusions, respectively. Similarly, 68% and 32% had Class III and II sagittal skeletal relationships, respectively. Overall, 95% of patients scored IOFTN 4 or 5. The most prevalent IOFTN score were 4.3 (37%), 5.3 (16%), 5.4 (16%), and 4.2 (10%). There were no gender differences ($P > 0.05$) for the distribution of malocclusions, sagittal skeletal relationships, different IOFTN scores, or when IOFTN scores were re-grouped (5, 4, and ≤ 3). When IOFTN scores were re-grouped (5, 4, and ≤ 3), they were equally distributed among patients with Class II or III skeletal relationships ($P > 0.05$), but when the authors looked at different malocclusions, there were significant differences in IOFTN score distribution ($P = 0.006$). The use of genioplasty (4%) or distraction osteogenesis (2%) was limited. Single jaw surgery of either maxilla or mandible was used in 15% and 22% of patients, respectively. About 63% had undergone double-jaw surgery.

Conclusion: Retrospective assessment using IOFTN identified 95% of patients as having great and very great functional needs, but prospective studies using IOFTN is needed to assess the need for orthognathic surgery. Class III malocclusions and Class III sagittal skeletal relationships were more common in this sample.

Key Words: Dentofacial deformity, IOFTN, orthognathic surgery

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Individuals with dentofacial deformities maybe affected by stereotyping or have altered social interactions.[1–5] Within this context, orthognathic surgery can benefit these individuals by gaining better psychological well-being and quality-of-life, as well as improvement in functional aspects such as speech articulation, chewing ability, swallowing mechanism, and breathing.[5–13] A combination of orthodontics and orthognathic surgery can be successfully used to improve the occlusion, facial skeletal appearance, and jaw function.[14,15] An increase in the number of older patients seeking orthognathic surgery has been reported.[16–18] One study suggested that Indications for men to have orthognathic surgery were more frequently functional problems, whereas women sought esthetic improvements.[18]

Prevalence of dentofacial deformities in Iran is not well documented and records on the type of previous orthognathic surgeries are scarce.[19,20] This figure in the UK or USA appears to be about 5% of the general population.[21] A retrospective review of patients with dentofacial deformities who had undergone orthognathic surgery allows some insights into the spectrum and management of dentofacial deformities in Iran, and we therefore reviewed and reported on 100 consecutive patients in a University teaching hospital. Recently, Index of Orthognathic Functional Treatment Need (IOFTN) has been introduced to identify patent in need of orthognathic surgery. The IOFTN has 5 categories ranging from "Very Great Need for Treatment" (grade 5) and "Great Need for Treatment" (grade 4) to "No Need for Treatment" (grade 1). It is applied in combination to other variables, such as psychological and other clinical indicators[22] to identify patients with skeletal deformity who completed facial growth and have malocclusions that are not amenable to orthodontic treatment alone. We also used the IOFTN[22] to see if its use can help identify patient who is in definite need of orthognathic surgery according to the index.

METHODS

The present research was approved by Shahid Beheshti University of Medical Sciences institutional review board (ethical approval committee) and complies with the World Medical Association Declaration of Helsinki on medical research protocols and ethics. A retrospective study was conducted using clinical records of 100 consecutive orthognathic patients (51 female, 49 males, mean [SD] age = 21.5 [2.71] years) who had orthognathic surgery from September 2014 to July 2017 in University teaching hospital (Taleghani Hospital).

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PRE-TREATMENT VARIABLES MEASURED AND RECORDED

Skeletal Sagittal Relationship

The pre-treatment cephalometric radiographs used for extraction of the cephalometric variable of ANB angle (A point-Nasion-B point), indicating the relative position of the maxilla to mandible. The ANB angle can be also calculated from the formula: ANB = SNA-SNB. The sagittal skeletal relationship was classified as follows; Class I ($1 < ANB < 4$), Class II ($ANB > 4$), Class III ($ANB < 1$).

Malocclusion and Selected Occlusal Traits

Malocclusion type was assessed on pre-treatment study casts and orthodontic records; this was classified based on the British standard incisor classification as follows:[23]

Class I, The lower incisal edges occlude with or lie immediately below the cingulum of the upper incisors.

Class II division I, The lower incisal edge occludes behind the cingulum of the upper central incisors and the upper incisors are proclined.

Class II division II, The lower incisal edge occludes behind the cingulum of the upper central incisors, and the upper incisors are retroclined.

Class III, The lower incisal edge occludes in front of the cingulum of the upper incisors.

Overjet[24] was recorded as the distance from the most labial point of the incisal edge of the maxillary incisors to the most labial surface of the corresponding mandibular incisor and measured to the nearest half millimeter, parallel to the occlusal plane. A reverse OJ (negative) was registered when the lower incisors were in front of the upper incisors.

Overbite[24] was measured as the vertical overlap of the incisors when the posterior teeth were in contact and recorded in mm.

Orthognathic Functional Need Assessment

This was recorded and verified by the second author (ABF) using the IOFTN[22] on pre-treatment study casts and material from the orthodontic records.

Osteotomy Type

This was classified broadly as LeFort I, bilateral sagittal split osteotomy, bimaxillary (double-jaw) osteotomy, and genioplasty. The types of surgical movements such as advancement, setback, and the impaction of maxilla were also recorded.

STATISTICAL ANALYSIS

Statistical analysis was performed with the Statistical Package for Social Sciences version 20.

Descriptive analyses such as Mean and standard deviation were calculated. The frequency of different components of the IOFTN was compared between genders using the Chi-Square test as well as among subjects with different malocclusions and sagittal skeletal patterns. The percentages of cases with IOFTN scores of 4/5 for various malocclusions and sagittal skeletal patterns were also calculated. The $P < 0.05$ was considered statistically significant.

RESULTS

Figure 1 shows the histogram of main occlusal traits (overjet, overbite) as well as the ANB angle that was recorded for the sample. Overall, 95% of patients were identified with IOFTN score of 4 or 5, having great or very great need for treatment. The most

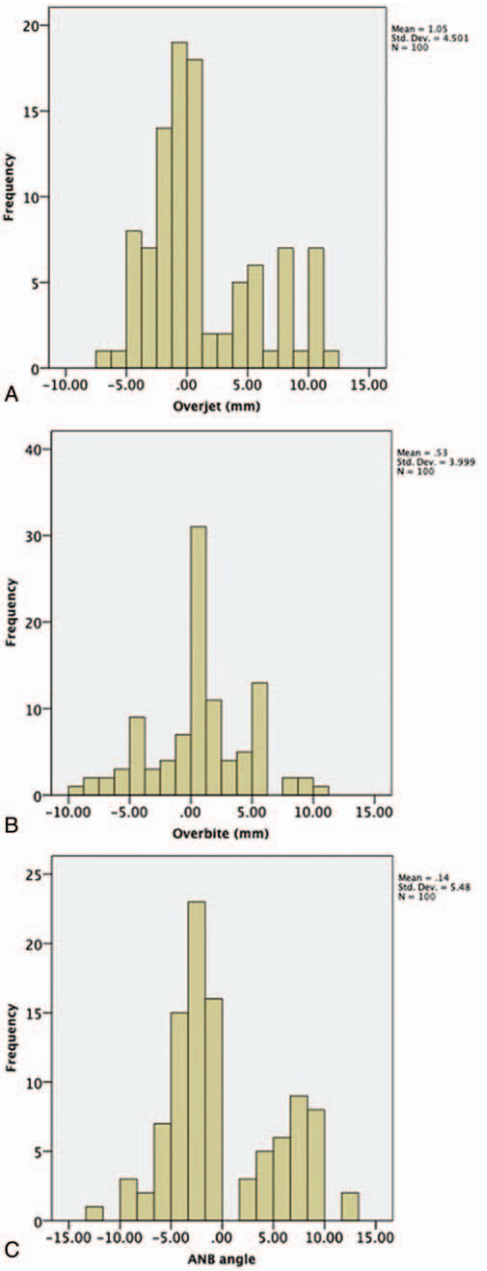

FIGURE 1. a Distribution of the recorded overjet values (mm) for the sample. Figure 1b Distribution of the recorded overbite values (mm) for the sample. Figure 1c Distribution of recorded ANB angles in the study sample.

prevalent IOFTN score in our sample was the 4.3 (37%), followed by 5.3 (16%), 5.4 (16%), and 4.2 (10%) (Supplemental Digital Content, Table 1, http://links.lww.com/SCS/A839). There were no gender differences for different IOFTN scores ($P > 0.05$) or when IOFTN scores were re-grouped to grades 5, 4, and, ≤ 3 (Supplemental Digital Content, Table 2, http://links.lww.com/SCS/A839, $P > 0.05$). When IOFTN scores were re-grouped to grades 5, 4, and, ≤ 3, they were equally distributed among patients with Class II or Class III skeletal relationships (Supplemental Digital Content, Table 3, http://links.lww.com/SCS/A839, $P > 0.05$) but when we looked at different malocclusion there were significant differences (Supplemental Digital Content Table 4, http://links.lww.com/SCS/A839, $P = 0.006$).

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In terms of malocclusion (incisor relationship), 66%, 31%, and 3% presented with Class III, Class II, and Class I malocclusions, respectively. Assessment of sagittal skeletal relationship revealed 68% and 32% of patients being Class III and Class II skeletal relationship, respectively. No gender differences were identified for the distribution of malocclusions or sagittal skeletal relationships in this sample ($P > 0.05$). Genioplasty was used in 4%. Single jaw surgery of either maxilla or mandible was used in 15% and 22% of patients, respectively. Two patients (2%) had distraction osteogenesis as a part of their treatment. Overall, 63% had undergone bimaxillary surgery (Supplemental Digital Content Table 5, http://links.lww.com/SCS/A839).

DISCUSSION

In a nationwide study in the USA,[25] among 101,692 orthognathic surgery patients, 19.6 percent underwent concurrent ancillary procedures (i.e., genioplasty, rhinoplasty, or septoplasty), and 37.6% underwent double-jaw surgery. In the present sample, concurrent genioplasty was used in a minority of patients (4 percent), but 63% underwent double-jaw surgery, which is higher than the USA reported figures.[25] As Iranian government does not fund orthognathic surgery, the high incidence of double-jaw surgery may reflect the greater severity of dentofacial deformities that received treatment. Similar to the study in Malaysia, we only identified 2 patients who underwent distraction osteogenesis as a part of their treatment.[26]

Literatures suggest that patients with severe sagittal Class II deformities are more inclined toward orthodontics rather than surgery,[27,29] however a greater number of severe Class III subjects seek orthognathic surgical treatment compared to those with severe mandibular deficiency.[28,29] We also noted a higher percentage of Class skeletal III subjects in the present sample. Overall, a concave profile has been rated amongst the worst in facial attractiveness.[29–33] A trend for more Class III individuals seeking orthognathic surgery, compared to Class II individuals has been suggested.[33] This is however contrary to the previous findings, where the Class II skeletal pattern was the most prevalent finding, accounting for nearly half of the cases.[19]

According to the IOFTN, 95% of the patients were categorized as having great or very great functional needs. This is similar to previous findings in the UK, reporting 88–98% as having great (grade 4) or very great (grade 5) functional need.[20,34–37] We didn't identify any patient, who had orthognathic surgery purely due to the presence of sleep apnoea (grade 5.6); IOFTN has this unique feature to identify a patient who presents with a well-compensated Class I malocclusion, but symptoms of sleep apnoea. Based on present findings and previous studies,[20,34–37] IOFTN appears to be a valid tool to identify patients in need of orthognathic surgery, helping resource allocation for patients with highest functional needs. Within the context of research, it can also be used to relate the orthognathic need to other health variables.[20] As indicated previously, referring dentists may use the IOFTN for determining whether patients are suitable for orthognathic treatment.[36] Howard-Bowles et al,[35] suggested the acronym "OOSGA (*O*verjet, *O*verbite, *S*cissors bite, *G*ingival exposure, and *A*symmetry)" to improve the efficiency of scoring patients; this is similar to the IOTN's hierarchy allocation system (MOCDO)[38] and would cover the majority of the subcategories within IOFTN, helping to identify the single worst feature of the patient's malocclusion.

As previously suggested, IOFTN index "should be used in combination with psychological and other clinical indicators"[22,35] to identify the patients in need of orthognathic treatment. IOFTN, similar to other occlusal indices,[14,39,40] assesses the occlusal traits, and not the underlying skeletal pattern, ignoring the skeletal component of malocclusion.[20] Therefore, lack of assessment for the vertical, sagittal, and transverse skeletal components of the malocclusion, particularly in well-compensated malocclusions, with low IOFTN score,[35] or following previous orthodontic treatment (camouflage) is a limitation of the index.[20] This is particularly important when assessing patients who had previous orthodontic treatment and scoring low on IOFTN, such as patients with well-compensated malocclusions (with minor occlusal discrepancies), but with severe sagittal, vertical, or transverse skeletal discrepancy.[20,35] Addition of an element to IOFTN to assess the skeletal discrepancy (hard of soft tissue cephalometric variables), or re-assessing malocclusion after orthodontic decompensation, to reveal the true IOFTN grade, can potentially address these issues.[20]

As with previous retrospective studies,[20,26,34,35,37,41,42] there are limitations associated with the present study. The retrospective nature of the presented data, as well as the exclusion of subjects with incomplete data, which resulted in a relatively small sample, may lead to the possible existence of bias. Future studies need to be prospective in nature and assess the performance of the IOFTN in a larger cohort. Obviously, a larger sample with wider spectrum of malocclusions and dentofacial deformities should be used in prospective studies. In planning future studies, addition of patients with well-compensated malocclusions is necessary, such as those with deficient chin or facial asymmetry, but with good occlusion that cannot be identified by IOFTN as having great need for orthognathic surgery. It appears that addition of a measure of skeletal deformity assessment to the index, such as soft tissue facial profile angle,[43] would be helpful in identifying patients with good occlusion and severe underlying skeletal deformity.

CONCLUSION

Retrospective assessment using IOFTN identified 95% of patients as having great and very great functional needs, but prospective studies using IOFTN is needed to assess the need for orthognathic surgery. Class III malocclusions and patients with Class III sagittal skeletal relationships were more common in this sample.

REFERENCES

1. Willis J, Todorov A. First impressions: making up your mind after a 100-ms exposure to a face. *Psychol Sci* 2006;17:592–598
2. Todorov A, Olivola CY, Dotsch R, et al. Social attributions from faces: determinants, consequences, accuracy, and functional significance. *Annu Rev Psychol* 2015;66:519–545
3. Ramsey JL, Langlois JH, Hoss RA, et al. Origins of stereotype: categorization of facial attractiveness by 6-month-old infants. *Dev Sci* 2004;7:201–211
4. Langlois JH, Kalakanis L, Rubenstein AJ, et al. Maxims or myths of beauty? A meta-analytic and theoretical review. *Psychol Bull* 2000;126:390–423
5. Posnick JC, Kinard BE. Orthognathic surgery has a significant positive effect on perceived personality traits and perceived emotional expressions in long face patients. *J Oral Maxillofac Surg* 2019;77:408.e1–408.e10
6. Lazaridou-Terzoudi T, Kiyak HA, Moore R, et al. Long-term assessment of psychologic outcomes of orthognathic surgery. *J Oral Maxillofac Surg* 2003;61:545–552
7. Nicodemo D, Pereira MD, Ferreira LM. Effect of orthognathic surgery for class III correction on quality of life as measured by SF-36. *Int J Oral Maxillofac Surg* 2008;37:131–134
8. Kim SJ, Kim MR, Shin SW, et al. Evaluation on the psychosocial status of orthognathic surgery patients. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;108:828–832
9. Murphy C, Kearns G, Sleeman D, et al. The clinical relevance of orthognathic surgery on quality of life. *Int J Oral Maxillofac Surg* 2011;40:926–930
10. Rustemeyer J, Gregersen J. Quality of life in orthognathic surgery patients: post-surgical improvements in aesthetics and self-confidence. *J Craniomaxillofac Surg* 2012;40:400–404

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11. de Avila ED, de Molon RS, Loffredo LC, et al. Health-related quality of life and depression in patients with dentofacial deformity. *Oral Maxillofac Surg* 2013;17:187–191
12. Hunt OT, Johnston CD, Hepper PG, et al. The psychosocial impact of orthognathic surgery: a systematic review. *Am J Orthod Dentofacial Orthop* 2001;120:490–497
13. Mendes de Paula Gomes A, Adas Saliba Garbin C, da Silva Ferraz FW, et al. Dentofacial deformities and implications on quality of life: a presurgical multifactorial analysis in patients seeking orthognathic surgical treatment. *J Oral Maxillofac Surg* 2019;77:409.e1–409.e9
14. Cartwright G, Wright NS, Vasuvadev J, et al. Outcome of combined orthodontic-surgical treatment in a United Kingdom university dental institute. *J Orthod* 2016;43:94–101
15. Almutairi FL, Hodges SJ, Hunt NP. Occlusal outcomes in combined orthodontic and orthognathic treatment. *J Orthod* 2017;44:28–33
16. Parton AL, Tong DC, De Silva HL, et al. A nine-year review of orthognathic surgery at the University of Otago. *N Z Dent J* 2011;107:117–120
17. Bailey LJ, Haltiwanger LH, Blakey GH, et al. Who seeks surgical-orthodontic treatment: a current review. *Int J Adult Orthodon Orthognath Surg* 2001;16:280–292
18. Peacock ZS, Lee CC, Klein KP, et al. Orthognathic surgery in patients over 40 years of age: indications and special considerations. *J Oral Maxillofac Surg* 2014;72:1995–2004
19. Eslamipour F, Borzabadi-Farahani A, Le BT, et al. A Retrospective analysis of dentofacial deformities and orthognathic surgeries. *Ann Maxillofac Surg* 2017;7:73–77
20. Borzabadi-Farahani A, Eslamipour F, Shahmoradi M. Functional needs of subjects with dentofacial deformities: a study using the index of orthognathic functional treatment need (IOFTN). *J Plast Reconstr Aesthet Surg* 2016;69:796–801
21. Posnick JC. Definition and prevalence of dentofacial deformities. In: Posnick JC, ed. *Orthognathic surgery: principles and practice.* St Louis, MO: Elsevier; 2014:61–68
22. Ireland AJ, Cunningham SJ, Petrie A, et al. An index of orthognathic functional treatment need (IOFTN). *J Orthod* 2014;41:77–83
23. British Standard Institution. *British standards glossary of dental terms BS- 4492.* London: BSI; 1983
24. Borzabadi-Farahani A, Borzabadi-Farahani A, Eslamipour F. Malocclusion and occlusal traits in an urban Iranian population. An epidemiological study of 11- to 14-year-old children. *Eur J Orthod* 2009;31:477–484
25. Berlin NL, Tuggle CT, Steinbacher DM. Improved short-term outcomes following orthognathic surgery are associated with high-volume centers. *Plast Reconstr Surg* 2016;138:273e–281e
26. Soh CL, Murugesan R, Mohamed Azahar FA, et al. Application of the index of orthognathic functional treatment need(IOFTN) on patients with dentofacial deformity: a retrospective analysis. *J Oral Maxillofac Surg Med Pathol* 2018;30:17–20
27. Phillips C, Border HL, Bennett ME. Dentofacial disharmony: motivations for seeking treatment. *Int J Adult Orthod Orthognath Surg* 1997;12:7–15
28. Wilmot JJ, Barber HD, Chou DG, et al. Associations be- tween severity of dentofacial deformity and motivation for orthodontic-orthognathic surgery treatment. *Angle Orthod* 1993;63:283–288
29. Chew MT. Spectrum and management of dentofacial deformities in a multiethnic Asian population. *Angle Orthod* 2006;76:806–809
30. Maganzini AL, Tseng JYK, Epstein JZ. Perception of facial esthetics by native Chinese participants by using manipulated digital imagery techniques. *Angle Orthod* 2000;70:393–399
31. Lew KK, Soh G, Loh E. Ranking of facial profiles among Asians. *J Esthet Dent* 1992;4:128–130
32. Soh J, Chew MT, Wong HB. A comparative assessment of the perception of Chinese facial profile esthetics. *Am J Orthod Dentofacial Orthop* 2005;127:692–699
33. Proffit WR, Jackson TH, Turvey TA. Changes in the pattern of patients receiving surgical-orthodontic treatment. *Am J Orthod Dentofacial Orthop* 2013;143:793–798
34. Fowler P, King T, Lee M, et al. Retrospective study of eligibility for orthognathic surgery using the Index of Orthognathic Functional Treatment Need (IOFTN). *Br J Oral Maxillofac Surg* 2018;56:416–420
35. Howard-Bowles E, Ho-A-Yun J, Ulhaq A, et al. The application of the Index of Orthognathic Functional Treatment Need (IOFTN): service evaluation and impact. *J Orthod* 2017;44:97–104
36. Barber S, Jawad Z, Hodge T, et al. Would the introduction of the Index of Orthognathic Functional Treatment Need (IOFTN) affect referrals and acceptance of people for orthognathic treatment. *Br Dent J* 2017;222:368–372
37. Harrington C, Gallagher JR, Borzabadi-Farahani A. A retrospective analysis of dentofacial deformities and orthognathic surgeries using the index of orthognathic functional treatment need (IOFTN). *Int J Pediatr Otorhinolaryngol* 2015;79:1063–1066
38. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. *Eur J Orthod* 1989;11:309–320
39. Borzabadi-Farahani A. An insight into four orthodontic treatment need indices. *Prog Orthod* 2011;12:132–142
40. Borzabadi-Farahani A. A review of the oral health-related evidence that supports the orthodontic treatment need indices. *Prog Orthod* 2012;13:314–325
41. Olkun HK, Borzabadi-Farahani A, Uçkan S. Orthognathic surgery treatment need in a Turkish adult population: a retrospective study. *Int J Environ Res Public Health* 2019;16:E1881
42. Hasebe D, Takahashi K, Endo S, et al. A retrospective analysis of orthognathic surgery in Japanese patients with index of orthognathic functional treatment need (IOFTN). *Jpn J Jaw Deform* 2019;29:5–10
43. Bergman RT, Waschak J, Borzabadi-Farahani A, et al. Longitudinal study of cephalometric soft tissue profile traits between the ages of 6 and 18 years. *Angle Orthod* 2014;84:48–55

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