Original Article

Short-term and long-term psychological impact and quality of life of patients undergoing orthognathic surgery

Cheng-Hui Lin a,1, Wei-Chih Chin b,e,1, Yu-Shu Huang a,b,e,*
Yu-Ray Chen a,**, Pearlie W.W. Tan c, Jonathan Y.J. Chen b,e,
Nan-Wen Yu b,e, Chih-Huan Wang b,d,e, Pang-Yun Chou a

a Department of Craniofacial Research Center, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan
b Department of Child Psychiatry and Sleep Center, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan
c Plastic, Reconstructive & Aesthetic Surgery, Sengkang General Hospital, Singapore
d Department of Psychology, Zhejiang Normal University, Zhejiang, China
e College of Medicine, Chang Gung University, Taoyuan, Taiwan

ABSTRACT

Background: Orthognathic Surgery (OGS) is a surgery for patients with dento-facial deformity but not all patients are satisfied with its outcome. The purpose of this study is to find out the short-term and long-term psychological impact and quality-of-life of OGS.

Methods: 77 participants receiving OGS and 32 age and gender-matched controls were enrolled. The data of questionnaires were collected before OGS, one month and 9 months after OGS, including short form of the Derriford-Appearance-Scale (DAS-24), Big-Five-Inventory (BFI), Hospital-Anxiety-and-Depression-Scale (HADS), Pittsburgh-sleep-quality-index (PSQI), and 36-Item Short-Form-Health-Survey (SF-36). Variables were presented as mean ± standard deviation or frequency. Paired t-test, ANOVA and MANOVA were used to evaluate the pre-and post-surgery data.

Results: Short-term and long-term satisfaction of OGS was high. Before OGS, BFI showed the extraversion had significant difference between the male and female OGS subgroups. Several domains of DAS-24 were significantly different between the OGS and the control groups. Both groups had no significant difference in PSQI, HADS and SF-36, except sleep-efficiency. After OGS, many domains of DAS-24 were significantly improved and the improvement persisted to 9 months later. Sleep-latency, physical-function, role-limitations-due-to-physical-health and social-functioning exacerbated after OGS. Sleep-latency, physical-function, and social-functioning were improved 9 months after OGS, but sleep-efficiency and role-limitations-due-to-physical-health were still significantly worse than controls.

* Corresponding author. Department of Child Psychiatry and Sleep Center, Chang Gung Memorial Hospital, 5, Fusing, Gueishan, Taoyuan 333, Taiwan.
** Corresponding author. Department of Child Psychiatry and Sleep Center, Chang Gung Memorial Hospital at Linkou, 5, Fusing St., Gueishan, Taoyuan 333, Taiwan.
E-mail addresses: yushuhuang1212@gmail.com (Y.-S. Huang), uraychen@cgmh.org.tw (Y.-R. Chen).
Peer review under responsibility of Chang Gung University.
1 The first authors: Cheng-Hui Lin and Wei-Chih Chin contributed equally to this article.
https://doi.org/10.1016/j.bj.2021.06.002
2319-4170/© 2021 Chang Gung University. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Most patients with dentofacial deformity are usually less confident and suffer from the negative impact of the deformity. Not only their physical health such as oral function but also social function and other psychosocial condition can be affected. Low self-esteem and poorer oral health-related quality of life were reported [1], as well as emotion problems including depression and anxiety. Several studies have shown those with dentofacial deformity report more distress and insecurity compared to the control group, regarding their facial appearance [2–4]. Patients tend to exhibit more psychological stress in social situations than those with other jaw deformities [3]. Thus, most people would try to find a way to fix their problem. Among the reasons to receive orthognathic surgery, the aesthetic desire is frequently and mostly reported, and there are other reasons such as functional improvement [5–9].

Dentofacial deformity includes Class II and III malocclusion, poor dental and jaw relation. It can be noted since very young age and influence development in different life stages. Because current medicine pursues both physical and mental health of human beings, more and more people receive Orthognathic surgery (OGS). OGS is a functional and aesthetic treatment with increasing patient population. Orthognathic surgery (OGS) is a functional and aesthetic treatment. After receiving OGS, patients can have improved bite, better sleep quality for those with obstructive sleep apnea (OSA), and a more pleasing appearance and subsequently better confidence. Moreover, the benefits of OGS with regard to quality of life [10] have been reviewed and the improvement in quality of life after surgery is confirmed [1,11]. Other positive effects of OGS on psychosocial status have also been well reported [3,12,13].

However, some patients can be unsatisfied with the outcome of OGS, and some studies showed that patients who had increased distress before OGS could also have more distress postoperatively [3,13]. Besides, although most previous studies showed positive and successful psychosocial outcomes after OGS surgery [11,12,14–18], some authors suggested that the results should be interpreted with caution since there was wide variation in study designs, inconsistent measurement methods of the psychosocial outcome, and reporting biases [10,18,19]. There were few prospective long-term follow-up studies and thus it can be difficult to quantify the extent and duration of the psychosocial influences of OGS. Other studies also mentioned that not only the benefit, but also other unfavorable outcomes and the psychological difficulties after OGS should be further investigated [20,21]. Therefore, although most evidences suggest improvement, the impact of OGS on different patient populations can be ambiguous, and it necessitates further investigation of the both short-term and long-term psychological changes in different psychosocial aspects.

Our craniofacial center is one of the world’s best craniofacial centers, receiving at least 600 patients for OGS per year. We pursue the surgical success and also emphasize the importance of physical and mental health. In our experience, some people have disproportionate dissatisfaction with the surgical results, and it brings distress to both the patient and the medical team. Subsequent clinic visits and distressing phone calls can be exhausting and demoralizing, and some patients insist on re-operation, which consumes unnecessary time and treatment costs. Therefore, we developed a comprehensive psychological screening and evaluation assessment for screening and monitoring OGS patients before and after surgery.

By using our psychological assessment, we designed a long-term prospective study to explore possible psychological issues before and after OGS and analyzed the short-term and long-term psychological impact and quality of life in patients receiving OGS.

Materials and methods

Patients who were scheduled for OGS due to class II or III malocclusion or an asymmetrical face were recruited prospectively. Patients with craniofacial syndrome, cleft lip and palate, or facial deformities secondary to trauma and tumor resections were excluded. We also enrolled age and gender matched healthy controls without dentofacial deformity as the control group, and those with major physical disease (such as stroke, epilepsy, heart failure, liver cirrhosis, etc.) and psychiatric disorder (such as bipolar disorder, schizophrenia, and mental retardation, etc.) were excluded. The study was...
Orthognathic surgery (OGS) is a safe and essential procedure to functionally correct malocclusion and esthetically improve facial profile [22,23]. The indication of OGS is for those patients with craniofacial anomaly, acquired dentofacial deformity, and facial asymmetry [24]. OGS mainly consists of two key surgical techniques including Le Fort I osteotomy and bilateral sagittal splitting osteotomy. LFI is used to disjunction the connection of maxilla to pterygoid plate and zygotha to free the upper jaw. BSSO can separate the proximal and distal segments of mandible to free the lower jaw. Then, based on the guided stent, a new maxillomandibular complex could be repositioned for a better facial profile according to intra-operative esthetic checkpoints [25]. In addition, following the two-jaw surgery, genioplasty is usually performed to optimize the facial harmony at last.

**Psychological screening and evaluation assessment**

At present, there is no structured tool available to evaluate the psychological status and mental health of patients receiving OGS. Thus, we developed a comprehensive psychological screening and evaluation assessment, exploring 6 domains: (1) Demographic data, (2) Personality, (3) Distress and dysfunction to problems of appearance, (4) Sleep, (5) Emotion, and (6) Quality of life. We also assessed the Satisfaction of the surgery details were shown as follows:

(a) Participants were diagnosed as having class II or III malocclusion or an asymmetrical face and scheduled for OGS at the Craniofacial Center of Chang Gung Memorial Hospital. Investigators explained the purpose and process of the study to patients and their families and invited them to join as participants. All participants signed an informed consent.

(b) After they signed the informed consent, they filled questionnaires before they received OGS (the preoperative phase).

(c) After OGS, we followed our participants and they completed the same questionnaires 1 month and 9 months after the surgery, evaluating the short-term and long term impact of OGS and the change of quality of life.

### The surgical technique of OGS

Orthognathic surgery (OGS) is a safe and essential procedure to functionally correct malocclusion and esthetically improve facial profile [22,23]. The indication of OGS is for those patients with craniofacial anomaly, acquired dentofacial deformity, and facial asymmetry [24]. OGS mainly consists of two key surgical techniques including Le Fort I osteotomy and bilateral sagittal splitting osteotomy. LFI is used to disjunction the connection of maxilla to pterygoid plate and zygoma to free the upper jaw. BSSO can separate the proximal and distal segments of mandible to free the lower jaw. Then, based on the guided stent, a new maxillomandibular complex could be repositioned for a better facial profile according to intra-operative esthetic checkpoints [25]. In addition, following the two-jaw surgery, genioplasty is usually performed to optimize the facial harmony at last.

### Psychological screening and evaluation assessment

At present, there is no structured tool available to evaluate the psychological status and mental health of patients receiving OGS. Thus, we developed a comprehensive psychological screening and evaluation assessment, exploring 6 domains: (1) Demographic data, (2) Personality, (3) Distress and dysfunction to problems of appearance, (4) Sleep, (5) Emotion, and (6) Quality of life. We also assessed the Satisfaction of the surgery details were shown as follows:

(a) Participants were diagnosed as having class II or III malocclusion or an asymmetrical face and scheduled for OGS at the Craniofacial Center of Chang Gung Memorial Hospital. Investigators explained the purpose and process of the study to patients and their families and invited them to join as participants. All participants signed an informed consent.

(b) After they signed the informed consent, they filled questionnaires before they received OGS (the preoperative phase).

(c) After OGS, we followed our participants and they completed the same questionnaires 1 month and 9 months after the surgery, evaluating the short-term and long term impact of OGS and the change of quality of life.

### The surgical technique of OGS

Orthognathic surgery (OGS) is a safe and essential procedure to functionally correct malocclusion and esthetically improve facial profile [22,23]. The indication of OGS is for those patients with craniofacial anomaly, acquired dentofacial deformity, and facial asymmetry [24]. OGS mainly consists of two key surgical techniques including Le Fort I osteotomy and bilateral sagittal splitting osteotomy. LFI is used to disjunction the connection of maxilla to pterygoid plate and zygoma to free the upper jaw. BSSO can separate the proximal and distal segments of mandible to free the lower jaw. Then, based on the guided stent, a new maxillomandibular complex could be repositioned for a better facial profile according to intra-operative esthetic checkpoints [25]. In addition, following the two-jaw surgery, genioplasty is usually performed to optimize the facial harmony at last.

### Psychological screening and evaluation assessment

At present, there is no structured tool available to evaluate the psychological status and mental health of patients receiving OGS. Thus, we developed a comprehensive psychological screening and evaluation assessment, exploring 6 domains: (1) Demographic data, (2) Personality, (3) Distress and dysfunction to problems of appearance, (4) Sleep, (5) Emotion, and (6) Quality of life. We also assessed the Satisfaction of the surgery details were shown as follows:

(a) Participants were diagnosed as having class II or III malocclusion or an asymmetrical face and scheduled for OGS at the Craniofacial Center of Chang Gung Memorial Hospital. Investigators explained the purpose and process of the study to patients and their families and invited them to join as participants. All participants signed an informed consent.

(b) After they signed the informed consent, they filled questionnaires before they received OGS (the preoperative phase).

(c) After OGS, we followed our participants and they completed the same questionnaires 1 month and 9 months after the surgery, evaluating the short-term and long term impact of OGS and the change of quality of life.

### The surgical technique of OGS

Orthognathic surgery (OGS) is a safe and essential procedure to functionally correct malocclusion and esthetically improve facial profile [22,23]. The indication of OGS is for those patients with craniofacial anomaly, acquired dentofacial deformity, and facial asymmetry [24]. OGS mainly consists of two key surgical techniques including Le Fort I osteotomy and bilateral sagittal splitting osteotomy. LFI is used to disjunction the connection of maxilla to pterygoid plate and zygoma to free the upper jaw. BSSO can separate the proximal and distal segments of mandible to free the lower jaw. Then, based on the guided stent, a new maxillomandibular complex could be repositioned for a better facial profile according to intra-operative esthetic checkpoints [25]. In addition, following the two-jaw surgery, genioplasty is usually performed to optimize the facial harmony at last.

### Psychological screening and evaluation assessment

At present, there is no structured tool available to evaluate the psychological status and mental health of patients receiving OGS. Thus, we developed a comprehensive psychological screening and evaluation assessment, exploring 6 domains: (1) Demographic data, (2) Personality, (3) Distress and dysfunction to problems of appearance, (4) Sleep, (5) Emotion, and (6) Quality of life. We also assessed the Satisfaction of the surgery details were shown as follows:

### The surgical technique of OGS

Orthognathic surgery (OGS) is a safe and essential procedure to functionally correct malocclusion and esthetically improve facial profile [22,23]. The indication of OGS is for those patients with craniofacial anomaly, acquired dentofacial deformity, and facial asymmetry [24]. OGS mainly consists of two key surgical techniques including Le Fort I osteotomy and bilateral sagittal splitting osteotomy. LFI is used to disjunction the connection of maxilla to pterygoid plate and zygoma to free the upper jaw. BSSO can separate the proximal and distal segments of mandible to free the lower jaw. Then, based on the guided stent, a new maxillomandibular complex could be repositioned for a better facial profile according to intra-operative esthetic checkpoints [25]. In addition, following the two-jaw surgery, genioplasty is usually performed to optimize the facial harmony at last.
components include extraversion, agreeableness, conscientiousness, neuroticism, and openness. Higher scores of a particular component mean more tendency of the specific personality trait [28].

(3) Distress and dysfunction to problems of appearance: we used Derriford Appearance Score (DAS-24) to measure distress and dysfunction to problems of appearance. It could evaluate the distress of patients with different appearance-altering conditions, e.g. burns, cleft lip and palate, etc. [29,30].

(4) Sleep: Pittsburgh Sleep Quality Index (PSQI) Scale was used and its 9 questions can assess eight sleep components, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, daytime dysfunction and global PSQI score [31]. Higher scores mean worse sleep quality.

(5) Emotion: The Hospital Anxiety and Depression Scale (HADS) with 14 major questions was used to evaluate depression and anxiety. The internal consistency of the Chinese-Cantonese HADS has been published, with Cronbach’s alpha 0.86 for the full scale, 0.82 for the depression subscale and 0.77 for the anxiety subscale [32]. Higher scores represent more depression or anxiety.

(6) Quality of life: 36-Item Short Form Health Survey (SF-36) is a widely used tool for quality of life, and its 11 questions assess 8 components. The components assessed by SF-36 include physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy/fatigue, emotional well-being, social functioning, pain, and general health. Higher scores mean better physical or mental functions [33].

(7) Satisfaction: a visual analogy scale from 1 to 10 score was designed and used in the study. The higher scores mean more satisfaction. It was scored 1 month and 9 months after OGS.

Statistics

All data were analyzed with SPSS, version-20 (SPSS, Inc., Chicago, IL). Variables were presented as either mean ± standard deviation or frequency. Paired t-test and ANOVA to evaluate the pre-and post-surgery data. Independent t-tests and analysis of variance were used to compare groups according to visibly different/not different, and diagnostic (causal) category within the visibly different group.

To further analyze the changes of DAS-24 in different time points, we grouped the items of DAS-24 into three domains. The first domain is “Subjective distress to appearance,” including Distress at reflection, Irritable at home, Feel hurt, Self-consciousness of appearance, and Feel irritable. The second is “Distress of others’ views to the appearance,” including Distressed at beach, Adopt concealing gestures, Avoid communal changing, Distressed in supermarkets/department, Avoid undressing with partner, Distressed playing sport/games, Distressed at social events, and Distressed at others remarks about appearance. The third domain is “Impact to daily living,” including Self consciousness affects work, Misjudged due to appearance, Distressed by clothing limitation, Feel normal, Affects sex life and Avoid
pubs/restaurants. We used MANOVA to evaluate the 3 domains of DAS-24 in different time points.

A p-value of less than 0.05 was considered significant.

### Results

Total 77 participants (male = 32.5%, mean age = 22.36 ± 7.97 years) were recruited in the OGS group, and the control group consisted of 32 age and gender matched healthy controls (male = 40.6%, mean age = 21.78 ± 6.69 years). Table 1a showed there was no significant difference in demographic data between the OGS group and the control group, except for the physical illness (p = 0.026) and education of mother (p = 0.021). We divided the OGS group and the control group into 4 subgroups by gender and all variables of collected demographic data had no significant difference between the 4 subgroups. Short-term and long-term satisfaction after OGS was high, one month after OGS (8.54 ± 1.79) and 9 months after OGS (8.70 ± 1.25). Table 1b showed the results of BFI before OGS. There was no significant difference between the OGS and control group. The only difference between the 4 subgroups was in the Extraversion (p = 0.044). The male OGS subgroup was more extroverted (mean ± SD = 19.50 ± 4.46) and the female OGS subgroup was more introverted (mean ± SD = 16.53 ± 4.13).

Table 2 showed that at baseline, several domains of DAS-24 had significantly differences between the OGS group and the control group, including distress at reflection (p = 0.000), irritable at home (p = 0.007), feel hurt (p = 0.000), self consciousness affects work (p = 0.013), self-conscious of appearance (p = 0.001), feel irritable (p = 0.000) and distressed at others remarks about appearance (p = 0.015). Many domains were improved significantly after OGS, including distress at reflection (p = 0.015), irritable at home (p = 0.007), feel hurt (p = 0.000), self consciousness affects work (p = 0.013), self-conscious of appearance (p = 0.001), feel irritable (p = 0.000) and distrested at others remarks about appearance (p = 0.015). Persistent improvement 9 month after OGS (PC2 and PC3 ≥ 0.05, indicating no significant difference between the control group and the OGS group 1 month and 9 month after OGS) was noted in distress at reflection, feel hurt, self consciousness affects work, self-conscious of appearance, feel irritable, adopt concealing gestures and feel normal. The improvement of adopt concealing gestures after OGS was even better than the control group, though non-significantly. The results of MANOVA showed that there were significant differences in the first domain (Wilks Lambda = 3.651, p < 0.001) and the third domain (Wilks Lambda = 3.075, p = 0.001), but not the second domain.

Tables 3 and 4 showed the results of PSQI, HADS and SF-36 before and after OGS. Before OGS, the OGS and control groups had no significant difference, except the habitual sleep efficiency of PSQI (PC1 = 0.001). However, sleep latency
Table 3 Comparison of PSQI and HADS before OGS and after OGS with the control group.

|                      | Control group | OGS group | P1      | P2      |
|----------------------|---------------|-----------|---------|---------|
|                      | (N = 32)      | (N = 77)  | (N = 77)  | (N = 28)  |
| PSQI-Subjective sleep quality |               | 1.03 ± 0.72 | 1.04 ± 0.70 | 1.00 ± 0.68 | 1.19 ± 0.46 | 0.846 | Pc1: 0.957; Pc2: 0.849; Pc3: 0.277 |
| PSQI-Sleep latency    |               | 1.10 ± 0.70 | 1.21 ± 0.92 | 2.26 ± 0.92 | 1.25 ± 0.87 | 0.001* | Pc1: 0.495; Pc2: 0.001*; Pc3: 0.436 |
| PSQI-Sleep duration   |               | 0.74 ± 0.45 | 0.63 ± 0.76 | 0.66 ± 0.97 | 0.92 ± 0.84 | 0.886 | Pc1: 0.381; Pc2: 0.666; Pc3: 0.297 |
| PSQI-Habitual sleep efficiency |           | 0.17 ± 0.46 | 0.75 ± 1.27 | 0.53 ± 0.70 | 0.61 ± 0.84 | 0.368 | Pc1: 0.001*; Pc2: 0.017*; Pc3: 0.009* |
| PSQI-Sleep disturbances |             | 1.13 ± 0.50 | 0.91 ± 0.63 | 0.86 ± 0.60 | 1.11 ± 0.57 | 0.549 | Pc1: 0.098; Pc2: 0.052; Pc3: 0.893 |
| PSQI-Use of sleeping medication |           | 0.00 ± 0.00 | 0.13 ± 0.56 | 0.11 ± 0.53 | 0.25 ± 0.73 | 0.135 | Pc1: 0.060; Pc2: 0.211; Pc3: 0.051 |
| PSQI-Daytime dysfunction |             | 0.83 ± 0.39 | 0.61 ± 0.64 | 0.51 ± 0.56 | 0.74 ± 0.61 | 0.105 | Pc1: 0.056; Pc2: 0.015*; Pc3: 0.528 |
| PSQI-Score            |               | 5.36 ± 1.90 | 5.35 ± 3.36 | 6.00 ± 3.01 | 6.03 ± 2.83 | 0.459 | Pc1: 0.981; Pc2: 0.326; Pc3: 0.282 |
| HADS Depression       |               | 4.32 ± 1.49 | 4.18 ± 3.12 | 3.47 ± 2.61 | 4.47 ± 3.13 | 0.368 | Pc1: 0.769; Pc2: 0.114; Pc3: 0.801 |
| HADS Anxiety          |               | 5.76 ± 2.35 | 5.89 ± 4.16 | 4.75 ± 4.03 | 5.22 ± 4.48 | 0.799 | Pc1: 0.859; Pc2: 0.277; Pc3: 0.557 |

P1 values were calculated by repeat measure test of OGS groups. P2 values were calculated by Chi-square test or t-test of 2 groups (the OGS and control groups).

Pc1, p value of before OGS and the control group; Pc2, p value of 1 month after OGS and the control group; Pc3, p value of 9 months after OGS and the control group; * = p value < 0.05.

Abbreviations: PSQI: Pittsburgh Sleep Quality Index; HADS: Hospital Anxiety and Depression Scale; OGS: orthognathic surgery; M: mean; SD: standard deviation.

Table 4 Comparison of SF-36 before OGS and after OGS with the control group.

|                      | Control group | OGS group | P1      | P2      |
|----------------------|---------------|-----------|---------|---------|
|                      | (N = 32)      | (N = 77)  | (N = 77)  | (N = 28)  |
| Physical function    |               | 91.29 ± 15.91 | 94.64 ± 13.78 | 89.44 ± 12.46 | 93.75 ± 13.06 | 0.030* | Pc1: 0.287; Pc2: 0.597; Pc3: 0.490 |
| Role limitations due to physical health |       | 95.97 ± 11.36 | 90.71 ± 24.51 | 68.06 ± 39.46 | 82.64 ± 34.23 | 0.008* | Pc1: 0.144; Pc2: 0.001*; Pc3: 0.033* |
| Role limitations due to emotional problems |      | 75.27 ± 35.45 | 84.76 ± 29.86 | 79.63 ± 34.07 | 82.41 ± 35.17 | 0.244 | Pc1: 0.168; Pc2: 0.610; Pc3: 0.412 |
| Energy/Fatigue       |               | 61.83 ± 15.62 | 63.84 ± 19.96 | 63.19 ± 19.50 | 58.61 ± 19.95 | 0.250 | Pc1: 0.626; Pc2: 0.759; Pc3: 0.474 |
| Mental health        |               | 67.87 ± 13.14 | 69.51 ± 19.40 | 68.89 ± 16.78 | 66.11 ± 18.92 | 0.408 | Pc1: 0.674; Pc2: 0.787; Pc3: 0.669 |
| Social functioning   |               | 86.29 ± 16.88 | 82.97 ± 21.43 | 77.43 ± 22.12 | 80.90 ± 22.85 | 0.021* | Pc1: 0.448; Pc2: 0.073; Pc3: 0.273 |
| Body pain            |               | 89.95 ± 12.54 | 92.07 ± 12.52 | 84.86 ± 17.19 | 87.22 ± 16.31 | 0.227 | Pc1: 0.461; Pc2: 0.210; Pc3: 0.489 |
| General health       |               | 71.45 ± 16.08 | 70.29 ± 21.29 | 70.28 ± 20.28 | 68.19 ± 18.86 | 0.819 | Pc1: 0.786; Pc2: 0.796; Pc3: 0.454 |

P1 values were calculated by repeat measure test of OGS groups. P2 values were calculated by Chi-square test or t-test of 2 groups (the OGS and control groups).

Pc1, p value of before OGS and the control group; Pc2, p value of 1 month after OGS and the control group; Pc3, p value of 9 months after OGS and the control group; * = p value < 0.05.

Abbreviations: SF36: 36-Item Short Form Health Survey; OGS: orthognathic surgery; M: mean; SD: standard deviation.

(P1 = 0.001), physical function (P1 = 0.03), role limitations due to physical health (P1 = 0.008) and social functioning (P1 = 0.021) exacerbated after OGS. Sleep latency was improved 9 months after OGS (PC2 = 0.001, PC3 = 0.436), but role limitations due to physical health was still significantly worse than the control group (p = 0.033). Habitual sleep efficiency (p = 0.009) was not significantly changed after OGS, and daytime dysfunction 1 month after OGS was significantly better than the control group (p = 0.015).

Discussion

There are some limitations of this study. First, the sample size is not large. Second, we used questionnaires to evaluate the impact of OGS, and these were all subjective reports rather than objective measurements. No polysomnography (PSG) or actigraphy was used to evaluate sleep. However, to evaluate psychological aspects such as distress or mood, subjective measurements are still the best methods so far. Third, the results of PSQI and HADS of the OGS group were still within normal range, meaning the sleep and mental conditions of the patients were not too different from the controls. These questionnaires possibly are not sensitive enough to detect the differences between the 2 groups and the changes after OGS. Investigation of patients with psychiatric or sleep disorders can help to clarify the impact of OGS in different patient populations. Fourth, our study is not a randomized trial, but we included a healthy control group to increase the trustworthiness. Fifth, because this is a long-term clinical study,
the drop-out rate is high. We followed drop-out subjects through phone calls, but most of them didn’t want to keep participating the study since their problem is fixed, and no further treatment or medication is needed. Last, we didn’t analyze the differences between patients with Class II and III deformity and the correlation with sleep disorders such as OSA in this paper, which will be further analyzed in the future.

The satisfaction of our OGS patients was high, consistent with most previous studies. Besides the satisfaction, in this study, we used several psychometric assessments and statistic methods to evaluate and analyze the short-term and long-term psychological impacts of OGS. At baseline, several domains of DAS-24 had significantly differences between the OGS group and the control group, and many were improved significantly after OGS. Persistent improvements 9 month after OGS were also noted. The results of the three domains of DAS-24 by MANOVA also revealed that the first and the third domains of DAS-24 were significantly improved, indicating self-reported improvement in subjective distress of appearance and decreased impact to daily living. Similar to our results, a systematic review article using MEDLINE and Web of Science showed that orthognathic patients experience benefits as a result of OGS. They had more self-confidence, better body and facial image, and social adjustment. The improvement of adopt concealing gestures was even better than the control group in our study and could represent substantial improvement physically and mentally after OGS.

Another finding is the differences of personality of the OGS group. Males in the OGS group were more extroverted while females in the OGS groups were more introverted. Most previous studies focus on the positive impact of OGS on personality trait, but a previous research reported high percentage of personality disorder in their participants, 14 of 33 were suggestive to have borderline, compulsive, antisocial, or passive-aggressive disorders, although the study didn’t aim at evaluating the prevalence. Dentofacial deformities can impact patients’ growth and development and their personality in adulthood can influence the outcome of OGS and future adjustment. The personality of patients with dentofacial abnormalities is worthy investigating, as well as the gender differences.

The sleep efficiency of the OGS group was significantly worse than the control group. After OGS, sleep latency exacerbated and then was improved 9 months after OGS. Interestingly, daytime dysfunction 1 month after OGS was significantly better than the control group. Craniofacial deformity is a risk factor for OSA, which has huge impact on sleep quality. Besides, postoperative pain can be the acute trigger for prolonged sleep latency. Sleep and pain could be highly correlated with postoperative satisfaction and surgical success and appropriate pain and sleep management is suggested in OGS patients. The utility of OGS in the treatment of obstructive sleep apnea worths further exploring in future research. Objective measurements such as PSG and actigraphy can help us understand the actual impact of OGS on sleep and treat sleep comorbidities such as OSA.

Different from previous studies, our results of SF-36 indicated that after OGS, the quality of life of the OGS group didn’t have improvement in either short-term or long-term follow-up. Physical function, role limitations due to physical health and social functioning even exacerbated after OGS. Only role limitations due to physical health was still significantly worse than the control group 9 months after the surgery. The major concern of patients receiving OGS is still the physical appearance, and relates more with the psychological domains of SF-36. Our findings of worsening of role limitations due to physical health can relate to longer recovery period from the surgery in some patients. Although there were consistent findings in the improvement of the distress of appearance after OGS, other psychosocial outcome such as mood and quality of life can be different. A previous longitudinal study also revealed different outcome trajectory classes, and 15% of the patients exhibited a chronic distress pattern. Our findings pointed out the importance of psychosocial evaluation and intervention before and after OGS.

**Conclusion**

Our study replicated findings of previous studies, showing that patients could have less distress of appearance after OGS and less impact to their daily living. However, not all psychological aspects and quality of life were improved and even some deterioration in sleep and role-limitations due to physical-health was noted after OGS. Proper psychosocial evaluation and intervention before and after OGS can be important in order to promote surgical success and outcome. Further investigation of risk factors for the unfavorable outcome is warranted.

**Conflicts of interest**

The authors declare that they have no competing interests.

**Acknowledgements**

This study was supported by the Chang Gung Memorial Hospital Research Grants (CMRPG3J0131) to Yu-Shu Huang. We want to thank Ms. I Tang to help the statistical analysis.

**References**

[1] Soh CL, Narayanan V. Quality of life assessment in patients with dentofacial deformity undergoing orthognathic surgery—a systematic review. Int J Oral Maxillofac Surg 2013;42:974–80.
[2] Hatch JP, Rugh JD, Clark GM, Keeling SD, Tiner BD, Bays RA. Health-related quality of life following orthognathic surgery. Int J Adult Orthodont Orthognath Surg 1998;13:67–77.
[3] Takatsuji H, Kobayashi T, Kojima T, Hasebe D, Izumi N, Saito I, et al. Effects of orthognathic surgery on psychological status of patients with jaw deformities. Int J Oral Maxillofac Surg 2015;44:1125–30.
[4] Vulink NC, Rosenberg A, Plooij JM, Koole R, Bergé SJ, Denys D. Body dysmorphic disorder screening in maxillofacial outpatients presenting for orthognathic surgery. Int J Oral Maxillofac Surg 2008;37:985–91.
[5] Finlay PM, Atkinson JM, Moos KF. Orthognathic surgery: patient expectations; psychological profile and satisfaction with outcome. Br J Oral Maxillofac Surg 1995;33:9–14.
[6] Kiyak HA, Hohl T, Sherrick P, West RA, McNeill RW, Bucher F. Sex differences in motives for and outcomes of orthognathic surgery. J Oral Surg 1981;39:757–64.
[7] Laufer D, Glick D, Gutman D, Sharon A. Patient motivation and response to surgical correction of prognathism. Oral Surg Oral Med Oral Pathol 1976;41:309–13.
[8] McKiernan EX, McKiernan F, Jones ML. Psychological profiles and motives of adults seeking orthodontic treatment. Int J Adult Orthodont Orthognath Surg 1992;7:187–98.
[9] Stirling J, Latchford G, Morris DO, Kindelan J, Spencer RJ, Bekker HL. Elective orthognathic treatment decision making: a survey of patient reasons and experiences. J Orthod 2007;34:113–27. discussion 111.
[10] Silva I, Cardemil C, Kashani H, Bazargani F, Tarnow P, Rasmussen L, et al. Quality of life in patients undergoing orthognathic surgery - a two-centered Swedish study. J Craniomaxillofac Surg 2016;44:973–8.
[11] Hunt OT, Johnston CD, Hepper PG, Burden DJ. The psychosocial impact of orthognathic surgery: a systematic review. Am J Orthod Dentofacial Orthop 2001;120:490–7.
[12] Broers DLM, van der Heijden QMJ, Rozema FR, de Jongh A. Do patients benefit from orthognathic surgery? A systematic review on the effects of elective orthognathic surgery on psychosocial functioning and patient satisfaction. Eur J Oral Sci 2017;125:411–8.
[13] Lee LW, Chen SH, Yu CC, Lo LJ, Lee SR, Chen YR. Stigma, body image, and quality of life in women seeking orthognathic surgery. Plast Reconstr Surg 2007;120:225–31.
[14] Motegi E, Hatch JP, Rugh JD, Yamaguchi H. Health-related quality of life and psychosocial function 5 years after orthognathic surgery. Am J Orthod Dentofacial Orthop 2003;124:138–43.
[15] Murphy C, Kears G, Sleeman D, Cronin M, Allen PF. The clinical relevance of orthognathic surgery on quality of life. Int J Oral Maxillofac Surg 2011;40:926–30.
[16] Brunault P, Battini J, Potard C, Jonas C, Zagualou-Bouquillon B, Chabut A, et al. Orthognathic surgery improves quality of life and depression, but not anxiety, with patients with higher preoperative depression scores improve less. Int J Oral Maxillofac Surg 2016;45:26–34.
[17] Huang CS, Hsu SS, Chen YR. Systematic review of the surgery-first approach in orthognathic surgery. Biomed J 2014;37:184–90.
[18] Peiró-Guijarro MA, Guijarro-Martínez R, Hernández-Alfaro F. Surgery first in orthognathic surgery: a systematic review of the literature. Am J Orthod Dentofacial Orthop 2016;149:448–62.
[19] Naran S, Steinbacher DM, Taylor JA. Current concepts in orthognathic surgery. Plast Reconstr Surg 2018;141:925–36.e.
[20] Bouletreau P. [Unfavorable outcomes in orthognathic surgery]. Orthod Fr 2016;87:111–3. French.
[21] Liddel MJ, Baker SR, Smith KG, Thompson AR. Psychosocial outcomes in orthognathic surgery: a review of the literature. Cleft Palate Craniofac J 2015;52:458–70.
[22] Chou PY, Denadai R, Yao CF, Chen YA, Chang CS, Lin CC, et al. History and evolution of orthognathic surgery at Chang Gung Craniofacial Center: lessons learned from 35-year experience. Ann Plast Surg 2020;84:560–8.
[23] Chou PY, Denadai R, Chen C, Pai BC, Hsu KH, Chang CT, et al. Comparison of orthognathic surgery outcomes between patients with and without underlying high-risk conditions: a multidisciplinary team-based approach and practical guidelines. J Clin Med 2019;8:1760.
[24] Chou PY, Denadai R, Chen SH, Tseng HJ, Hsu CK, Wang SW, et al. Identifying three-dimensional facial fluctuating asymmetry in normal pediatric individuals: a panel assessment outcome study of clinicians and observers. J Clin Med 2019;8:648.
[25] Yu CC, Bergeron L, Lin CH, Chu YM, Chen YR. Single-splint technique in orthognathic surgery: intraoperative checkpoints to control facial symmetry. Plast Reconstr Surg 2009;124:879–86.
[26] Khechoyan DY. Orthognathic surgery: general considerations. Semin Plast Surg 2013;27:133–6.
[27] Cardoso-Moreno MJ, Tomás-Aragones L. The influence of perceived family support on post surgery recovery. Psychol Health Med 2017;22:121–8.
[28] John OP, Srivastava S. The Big-Five trait taxonomy: history, measurement, and theoretical perspectives. In: Pervin LA, John OP, editors. Handbook of personality: theory and research, vol. 2. New York: Guilford Press; 1999. p. 102–38.
[29] Moss TP, Lawson V, Liu CY. The Taiwanese Derriford Appearance Scale: the translation and validation of a scale to measure individual responses to living with problems of appearance. PsyCh J 2015;4:138–45.
[30] Carr T, Moss T, Harris D. The DAS24: a short form of the Derriford Appearance Scale DAS59 to measure individual responses to living with problems of appearance. Br J Health Psychol 2005;10:285–98.
[31] Tsai PS, Wang SY, Wang MY, Su CT, Yang TT, Huang CJ, et al. Psychometric evaluation of the Chinese version of the Pittsburgh Sleep Quality Index (CPSQI) in primary insomnia and control subjects. Qual Life Res 2005;14:1943–52.
[32] Watson R. A psychometric evaluation of the Chinese version of the Hospital Anxiety and Depression Scale in patients with coronary heart disease. J Clin Nurs 2009;18:3068.
[33] Brazier JE, Harper R, Jones NM, O’Cathain A, Thomas KJ, Usherwood T, et al. Validating the SF-36 health survey questionnaire: new outcome measure for primary care. BMJ 1992;305:160–4.
[34] Brucoli M, Zeppetello P, Benech R, Bottano P, Benech A. Psychodynamic features associated with orthognathic surgery: a comparison between conventional orthognathic treatment and “Surgery-First” approach. J Oral Maxillofac Surg 2019;77:157–63.
[35] Widar F. On factors influencing the clinical outcome in orthognathic surgery. https://gupea.ub.gu.se/handle/2077/38462;2015 [accessed 10 February 2019].
[36] Suen KS, Lai Y, Ho SMY, Cheung LK, Choi WS. A longitudinal evaluation of psychosocial changes throughout orthognathic surgery. PLoS One 2018;13:e0203883.