



Changes in the quality of life in patients undergoing orthognathic therapy – A systematic review

G. Schaefer^{a,*}, C. Jacobs^b, K. Sagheb^a, B. Al-Nawas^a, R.K. Rahimi-Nedjat^a

^a Department of Oral and Maxillofacial Surgery – Facial Plastic Surgery, Medical Center of the Johannes Gutenberg-University of Mainz, Mainz, Germany

^b Policlinic for Orthodontics, University Medical Center Jena, Germany

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ABSTRACT

The aim of this study was to investigate the impact of orthognathic therapy on patients' quality of life. Therefore, a systematic review was conducted including all prospective studies that compared pretherapeutic and post-therapeutic Oral Health Impact Profile (OHIP) or Overall Quality of Life (OQOL) questionnaire scores. Studies in patients with congenital deformities, clefts, or posttraumatic or cancer-associated deformities were excluded. Overall, 23 prospective studies were included; 8 used OHIP, 9 used OQOL and 6 used both questionnaires. A total of 1039 patients were identified (60.29% women, 39.71% men), with a mean age of 45.17 years. All analyzed studies showed in both OHIP and OQLQ an improvement of the quality of life in patients after orthognathic therapy. While improved scores could be observed in all investigated criteria, the studies demonstrated that social and aesthetic aspects showed the most prominent impact. Comparison of different Angle Classes showed, furthermore, that Class III patients had an even greater advantage over those with a Class II deformity. The review confirms that the quality of life in patients with orthognathic therapy improves significantly in all observed aspects. With regard to Angle Classes, Class III patients showed an even greater improvement than Class II patients.

1. Introduction

Various reasons have been identified for patients with dysgnathic deformities to seek for treatment. While some patients wish for functional correction, others hope for optimization of their masticatory apparatus or harmonization of their facial profile and aesthetics for psychological reasons (Riviera et al., 2000).

Studies show that in patients with dentofacial deformities, decreased self- and body perception can be observed, which usually results in impaired quality of life. In fact, these deformities can be corrected (Seehra et al., 2011; Frejman et al., 2013; Silva et al., 2021). While in many cases orthodontic treatment is adequate, many patients need a combined orthodontic and surgical correction. Here the surgical procedure in particular is usually perceived as the most important step for correction of the deformity.

However, due to the long duration of the treatment and the necessary surgical procedure with its possible relevant complications such as damages to the alveolar nerve, it is important to investigate whether patients benefit from this treatment at all.

In 2012, Soh et al. published a review of this topic, which included studies that investigated the quality of life in dysgnathic patients before and after treatment based on two questionnaires. The Overall Quality of Life (OQLQ) and the Oral Health Impact Profile (OHIP) questionnaires are suitable measures that gather information on the individual's quality of life based on different aspects such as function, social perception and aesthetics. In both questionnaires, high quality of life is expressed with low numbers (Soh and Narayanan, 2013).

The aim of this study was the continuation of the study by Soh et al. to clarify, based on the published literature, how much orthognathic therapy impacts patients' quality of life in the observed aspects, and whether patients with different indications are affected in different ways.

2. Material and methods

2.1. Registration and protocol

This systematic review was presented according to the Preferred

* Corresponding author. Department of Oral and Maxillofacial Surgery – Facial plastic Surgery, Medical Center of the Johannes Gutenberg-University of Mainz, Augustusplatz 2, 55131, Mainz, Germany.

E-mail address: gregor.schaefer@unimedizin-mainz.de (G. Schaefer).

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Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement 2020 (Page et al., 2021). The PICOS strategy (Patient, Intervention, Comparison, Outcome, and Study) was used to produce a well-formulated question. This systematic review was registered on the Platform of Registered Systematic Review and Meta-analysis Protocols (INPLASY), registration number INPLASY202330034.

2.2. Eligibility criteria

Included studies had to prospectively compare pre- and post-therapeutic quality of life scores based on OQLQ or OHIP questionnaires for patients undergoing combined orthodontic and orthognathic surgical therapy. Studies had to be published between 2012 and December 2021 in German or English. Studies including patients with congenital deformities, clefts or secondary malocclusion caused by trauma or cancer were excluded.

2.3. Information sources

In this systematic review, literature research was conducted only for English-language articles on PubMed, Medline and Google Scholar. All articles from June 2012 to December 2021 were included.

2.4. Search strategy

The combination of search terms was (orthognathic surgery OR dentofacial deformities) AND (psychosocial OR quality of life).

2.5. Selection process

For all studies found, publications were viewed by two authors independently. Abstracts were read. Studies that included patients with craniofacial deformities, syndromes, congenital deformities, lip-jaw-palate clefts, and secondary deformities after trauma or after tumor diseases were excluded.

2.6. Data collection process

Data were taken from publications and listed on a Microsoft Excel spreadsheet. The data were cross-checked by a second investigator.

2.7. Data items

Data collected from the articles were as follows: author, year of publication, study design, country, number of patients, mean age, age range, gender ratio, data collection period, angle classification, surgical procedure, chosen questionnaire(s), time of testing, pre-therapeutic scores, intermediate scores (if available), post-therapeutic scores, and difference between the scores.

2.8. Study risk-of-bias assessment

Following the ROBIS system, a review of the risk of bias was performed. However, no complete ROBIS analysis was carried out.

2.9. Effect measures

Absolute numbers were used in the distribution of questionnaires, changes in OQLQ and OHIP, patient numbers, average age, women's share and distribution, and surgery first vs. orthodontic first.

2.10. Synthesis methods

Data were collected with Microsoft Excel 16.43 (Microsoft Corp., Redmond, WA, USA) and then transferred to SPSS Statistics 22.0 (IBM Corp., Armonk, NY, USA). Subsequently, the articles were imported into

Endnote X9 software (Thompson Reuters, Philadelphia, PA, USA). Correlations were calculated with a *t*-test for normally distributed and Mann–Whitney *U* test for non–normally distributed variables.

2.11. Reporting bias assessment

Two review authors independently cross-checked the data.

3. Results

3.1. Study selection

Overall, 382 publications were found, based on the search terms. After exploration and selection according to the mentioned criteria, 23 publications were included in this study (Table A, Fig. 1).

3.2. Study characteristics

Study characteristics are shown in Table A.

3.3. Overview of the studies

The 23 publications were from 13 different countries (4 Brazil; 3 each Iran and China; 2 each Finland, Sweden and Japan; 1 each Germany, Saudi-Arabia, Italy, New Zealand, India, Great Britain and Taiwan). Two studies had a prospective randomized design with control groups, 8 were prospective without randomization but with a control group and 13 were prospective without randomization and without a control group. Altogether 1039 patients were included, with a mean number of 45 patients per publication (range, 9–228). Of the patients, 39.71% were male and 60.29% were female, with an overall mean age of 22.7 years.

3.4. Risk of bias in studies

Following the ROBIS system, a review of the risk of bias was performed. However, no complete ROBIS analysis was carried out.

3.5. Results of individual studies and results of syntheses

3.5.1. Overview of the questionnaires

Of the 23 included studies 7 used both OQLQ and OHIP questionnaires (Kavin et al., 2012; Silva et al., 2016; Feu et al., 2017; Pelo et al., 2017; Sun et al., 2018; Avelar et al., 2019; Ni et al., 2019), 8 publications used only OQLQ (Abdullah, 2015; Alanko et al., 2017; Emadian Razvadi et al., 2017; Eslamipour et al., 2017; Zingler et al., 2017; Tachiki et al., 2018; Saghafi et al., 2020; Vongkamolchoon et al., 2021) and 8 only OHIP for quality of life assessment (Goelzer et al., 2014; Silvola et al., 2014; Baherimoghaddam et al., 2016; Corso et al., 2016; Huang et al., 2016; Kurabe et al., 2016; Bengtsson et al., 2018; Nichols et al., 2018) (Fig. 2).

All 15 OQLQ publications showed a highly significant improvement ($p < 0.001$) in the post-therapeutic mean score (23.9 ± 8.6) compared to pre-therapeutic numbers (48.6 ± 10.6) [6–20]. The greatest difference could be observed in the study by Avelar et al., with 54.1 points (Avelar et al., 2019). Considering the different aspects that are questioned in the OQLQ, the highest improvements were found in the social domain in 5 publications (Abdullah, 2015; Eslamipour et al., 2017; Avelar et al., 2019; Ni et al., 2019; Saghafi et al., 2020) and for facial aesthetics in 4 studies (Silva et al., 2016; Sun et al., 2018; Tachiki et al., 2018; Saghafi et al., 2020) (Fig. 3).

Similar results were found for OHIP questionnaires. Pre- and post-therapeutic scores again showed highly significant improvements (18.3 ± 11.4 vs 6.25 ± 7.0 ; $p < 0.001$) (Kavin et al., 2012; Goelzer et al., 2014; Silvola et al., 2014; Baherimoghaddam et al., 2016; Corso et al., 2016; Huang et al., 2016; Kurabe et al., 2016; Silva et al., 2016; Feu et al., 2017; Pelo et al., 2017; Bengtsson et al., 2018; Nichols et al., 2018; Sun

Tab. A
Overview of the included studies.

Title	Year	Study design	Patient n	Follow-up	test type
Abdullah et al.	2014	Prospective cohort study without control group	17	12 Months	OQLQ
Alanko et al.	2017	Prospective cohort study with control group	22	12 Months	OQLQ
Avelar et al.	2019	Prospective cohort study without control group	20	4–6 Months	OHIP-14 OQLQ
Baherimoghaddam et al.	2016	Prospective cohort study without control group	58	12 Months	OHIP
Bengtsson et al.	2017	Randomized cohort study with control group	55	12 Months	OHIP
Corso et al.	2015	Prospective cohort study with control group	30	3 Months	OHIP
Eslamipour et al.	2017	Prospective cohort study without control group	43	6 Months	OQLQ
Feu et al.	2017	Prospective cohort study with control group	16	24 Months	OQLQ, OHIP
Göelzer et al.	2014	Prospective cohort study without control group	74	4–6 Months	OHIP
Huang et al./Wang et al.	2016	Prospective cohort study with control group	50	18 Months	OHIP
Kavin et al.	2012	Prospective cohort study without control group	14	6 Months	OQLQ, OHIP
Kurabe et al.	2016	Prospective cohort study with control group	65	6 Months	OHIP- J54
Ni et al.	2019	Prospective cohort study with control group	45	8 Months	OHIP- 14 OQLQ
Nichols et al.	2018	Prospective cohort study without control group	22	60 Months	OHIP
Pelo et al.	2017	Randomized cohort study with control group	30	1 Months	OQLQ, OHIP
Razvadi et al.	2017	Prospective cohort study without control group	24	4 Months	OQLQ
Saghafi et al.	2020	Prospective cohort study without control group	32	6 Months	OQLQ
Silva et al.	2017	Prospective cohort study without control group	50	6 Months	OQLQ, OHIP

Tab. A (continued)

Title	Year	Study design	Patient n	Follow-up	test type
Silvola et al.	2014	Prospective cohort study with control group	38	36 Months	OHIP
Sun et al.	2018	Prospective cohort study with control group	85	7 Months	OQLQ, OHIP
Tachiki et al.	2017	Prospective cohort study without control group	20	3 Months	OQLQ
Vongkamolchoon et al.	2021	Prospective cohort study without control group	228	12 Months	OQLQ
Zingler et al.	2017	Prospective cohort study without control group	9	3 Months	OQLQ

et al., 2018; Avelar et al., 2019; Ni et al., 2019). The greatest difference was seen in the publication by Huang et al., with 34.79 points in patients who underwent surgery as the first treatment (Huang et al., 2016). Most of the studies found the greatest difference for psychological discomfort (Goelzer et al., 2014; Baherimoghaddam et al., 2016; Nichols et al., 2018; Sun et al., 2018; Avelar et al., 2019) (Fig. 4).

3.5.2. Angle classification

Five publications included only patients with Class III dysgnathia (Huang et al., 2016; Feu et al., 2017; Bengtsson et al., 2018; Tachiki et al., 2018; Ni et al., 2019), while all other studies performed no selection. Unfortunately, not all publications differentiated the pre- and post-therapeutic scores according to Class II and Class III. Baherimoghaddam et al. showed that Class II patients demonstrated greater improvement in pain and psychological impairment, while class III patients had greater improvement in psychological discomfort (Baherimoghaddam et al., 2016).

Eslamipour et al. showed that while, for both classes, the quality of life scores improved with the therapy, the difference was significantly greater for Class III patients (Eslamipour et al., 2017). Similar results were found by Göelzer et al. (Goelzer et al., 2014).

3.5.3. Surgery first vs. orthodontics first

Feu et al., Huang et al., Pelo et al. and Saghafi et al. included patients who either underwent orthodontics first (OF) or surgery first (SF) (Huang et al., 2016; Feu et al., 2017; Pelo et al., 2017; Saghafi et al., 2020). Huang et al. and Pelo et al. showed that SF patients had greater improvement in OQLQ scores (Huang et al., 2016; Pelo et al., 2017), while Saghafi et al. observed the opposite, with better results in OF patients (Saghafi et al., 2020). While both SF and OF showed a significant improvement in these studies, there was no significant difference between those two groups in the publication by Pelo et al. (2017).

However, studies that assessed intermediate results could observe that OF patients had worsened quality-of-life scores during the orthodontic treatment prior to surgery. These numbers then improved after surgery. In fact, the mean duration of therapy was significantly shorter in SF patients (16.6 vs. 25.3 months) (Huang et al., 2016; Pelo et al., 2017).

3.5.4. Sex and age

Overall, it was found that female patients showed worse mean scores in pre-therapeutic assessment than did male patients (45 vs. 30). These numbers, however, almost converged by the end of the treatment (14.5 vs. 10) (Eslamipour et al., 2017). In particular, Sun et al. emphasized that

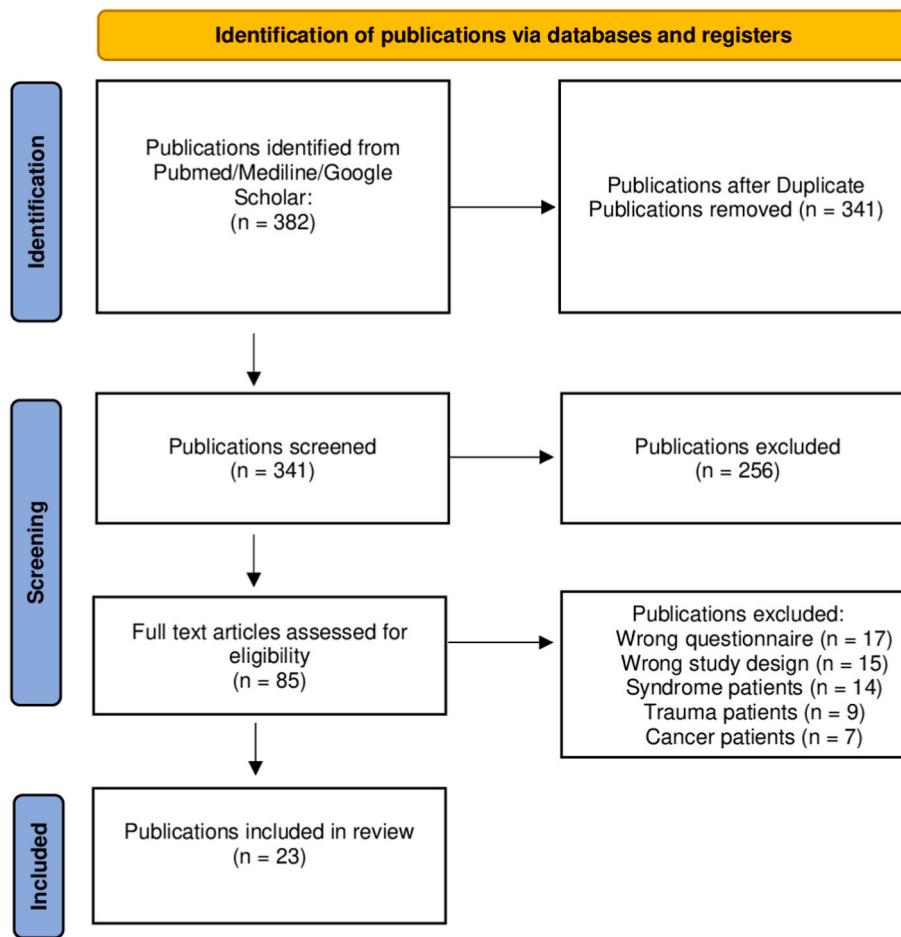


Fig. 1. PRISMA flow diagram of the screening and selection process.

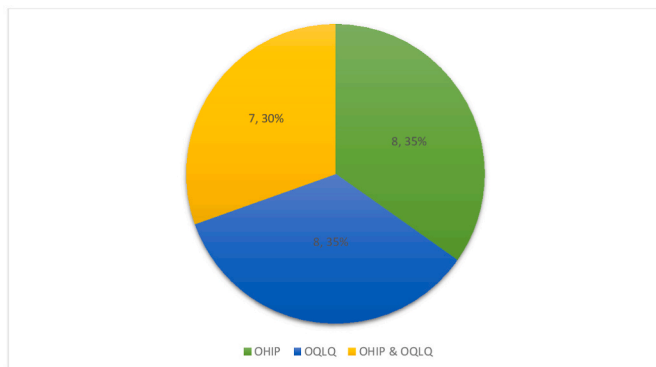


Fig. 2. Distribution of the questionnaires used in the studies included in this publication.

women showed high numbers in OQLQ for facial aesthetics before treatment, but the authors mention further that the numbers were almost even between the two sexes in the post-therapeutic assessment (Corso et al., 2016; Sun et al., 2018). Only a few studies did not find significant differences between male and female patients.

With a mean age of 22.7 years, the patients were in general as young as expected. The improvement rates depending on the patients' age that were found in the included studies were very different. Vongkamolchoon et al. stated that patients between 23 and 30 years showed the greatest reduction and therefore the best improvement in quality of life compared to other age groups (Vongkamolchoon et al., 2021). However,

the greatest improvement among all publications was found in the study by Avelar et al., in patients over 60 years of age (Avelar et al., 2019), and Corso et al. did not observe any difference at all between the different age groups (Corso et al., 2016).

3.5.5. Reporting biases

Two review authors independently cross-checked the data.

4. Discussion

This review aimed to investigate the literature on the quality of life for patients undergoing combined orthodontic and orthognathic surgical therapy for dysgnathia. Only prospective studies that used either OQLQ or OHIP or both questionnaires were eligible for the review. A total of 23 studies with 1039 patients were included.

In general, all publications found significant or highly significant improvement rates in the comparison of pre- and post-therapeutic scores. While the OQLQ studies showed the greatest improvement in the social domain and in regard to facial aesthetics (Abdullah, 2015; Silva et al., 2016; Eslamipour et al., 2017; Sun et al., 2018; Tachiki et al., 2018; Avelar et al., 2019; Ni et al., 2019; Saghafi et al., 2020), the OHIP-based studies showed the lowest numbers (highest quality score) for psychological discomfort by the end of the treatment. These observations correlate with clinical experience, since patients with Class II or Class III dysgnathia often dislike their facial profile. Both a receding and a prominent chin lead to a disproportion of the lower facial third and usually result in worse facial aesthetics, commonly leading to reduced self-confidence (Corso et al., 2016; Sun et al., 2018).

While many of the studies did not differentiate between Class II and

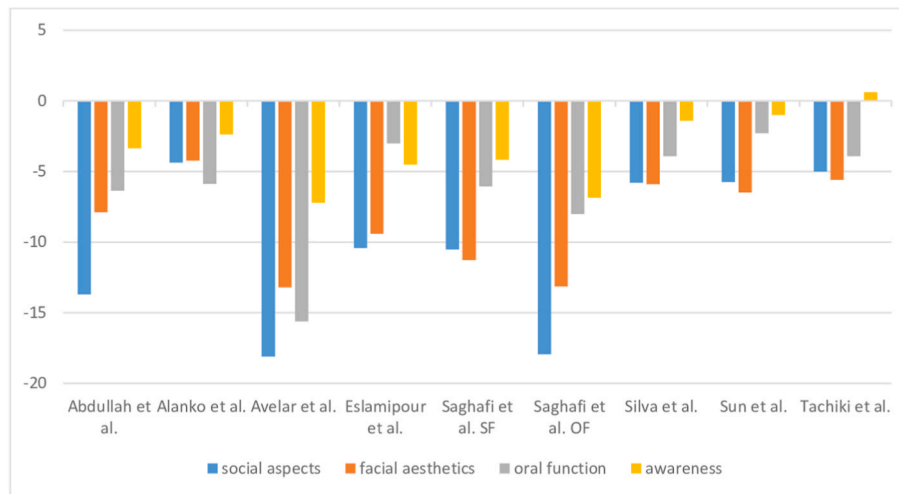


Fig. 3. Overview of changes in the various domains of the OQLO by study. The figures represent the magnitude of the difference between pre- and post-therapeutic values.

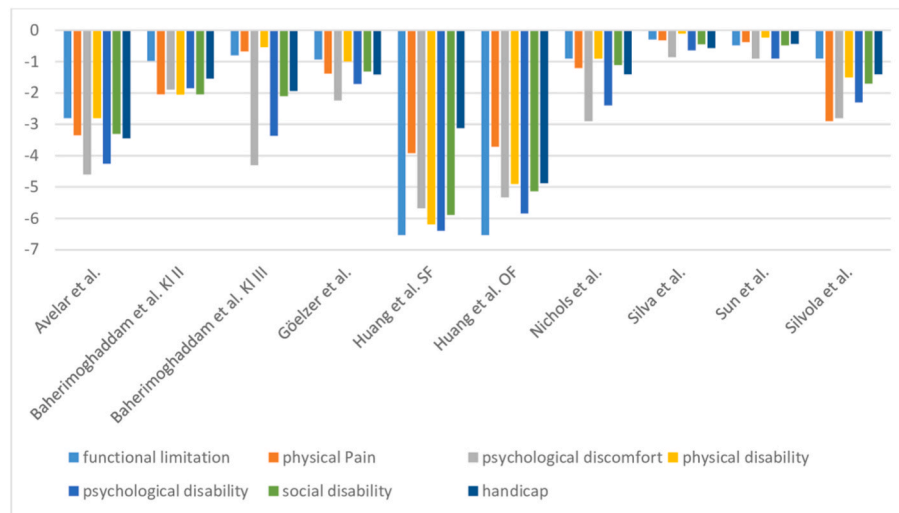


Fig. 4. Overview of changes in the various domains of OHIP by study. The figures represent the magnitude of the difference between pre- and post-therapeutic values.

III patients, some authors subclassified their results according to the angle classes (Avelar et al., 2019). These publications state that while both classes improved significantly in their quality-of-life scores, those with Class III show an even more positive effect of the treatment (Sun et al., 2018). Interestingly these studies also show that the patients seem to benefit in different ways. Class II patients show mostly a functional improvement with the reduction of pain, while Class III patients benefit from a reduction in psychological discomfort (Corso et al., 2016).

The mean age in the study was 22.7 years, which is in accordance with the general literature. Normally, patients undergoing orthognathic therapy are of younger age, as dentists usually refer them to orthodontists before the end of their body growth. Yet, more and more adults seek out orthodontists, and in fact the reasons for patients to undergo a treatment are very different, depending on their age. Therefore, one might assume that, based on the different motivations, the improvement rates have to differ between the age groups. Evaluation of the included studies, however, did not show a clear pattern, since some authors showed the greatest improvement rates with younger patients (Sun et al., 2018; Vongkamolchoon et al., 2021), while the overall greatest improvement could be found in the study by Avelar et al. in patients over 60 years of age (Avelar et al., 2019).

Regarding sex differences, calculations for all patients showed that women scored significantly higher than men on pretherapeutic assessments (Eslamipour et al., 2017). Yet, the numbers of men and women almost converged by the end of the treatment. This means that women are more affected by the effects of dysgnathia, which, as mentioned by Sun et al., seem to be especially due to dislike of their facial aesthetics (Sun et al., 2018). On one hand, this explains why, out of 1039 patients from this study, almost two-thirds were female; on the other hand, it is yet again further proof for the immense positive effect on facial aesthetics and psychological discomfort that can be achieved with the combined treatment.

Of course, the duration of the treatment is a very important factor. Concerning intermediate results, it can be shown that the decompensation of the teeth in OF patients prior to surgery leads to lower quality of life in all studies. This is mainly due to the worsened occlusion, and becomes even more relevant in the comparison of OF patients with those undergoing SF treatment. In SF patients, the scores are immediately better after surgery and usually stay in a good range throughout the whole therapy, leading to higher patient satisfaction. The scores at the end of the treatment were identical for both OF and SF patients (Huang et al., 2016; Feu et al., 2017). However, one must bear in mind that not

every patient is suitable for SF therapy, and that these numbers could be affected by a selection bias.

5. Conclusion

In conclusion, the study shows that patients undergoing combined orthodontic and orthognathic surgical therapy benefit from the treatment in many different respects, with the greatest improvements observed in facial aesthetics and psychological discomfort. These numbers can be found for both Class II and Class III patients as well as for both men and women with different emphases. Based on the data, it can furthermore be recommended to perform surgery first in patients who, based on their clinical findings, are eligible for this treatment.

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Ethical approval

This article does not contain any clinical studies with human participants or animals performed by any of the authors.

Informed consent

For this type of study, formal consent is not required.

Declaration of competing interest

All authors declare that they have no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jcms.2023.10.004>.

References

- Abdullah, W.A., 2015. Changes in quality of life after orthognathic surgery in Saudi patients. *Saudi Dent J* 27 (3), 161–164.
- Alanko, O., Tuomisto, M.T., Peltomaki, T., Tolvanen, M., Soukka, T., Svedstrom-Oristo, A.L., 2017. A longitudinal study of changes in psychosocial well-being during orthognathic treatment. *Int. J. Oral Maxillofac. Surg.* 46 (11), 1380–1386.
- Avelar, R.L., Silva, P.G.B., Magalhaes, M.T.C., Parente, A.E.A., Alencar, N.M.C., Barros, L. O., 2019. Quality of life assessment for elderly patients treated with orthognathic surgery. *J. Craniofac. Surg.* 30 (7), e633–e637.
- Baherimoghaddam, T., Tabrizi, R., Naseri, N., Pouzesh, A., Oshagh, M., Torkan, S., 2016. Assessment of the changes in quality of life of patients with class II and III deformities during and after orthodontic-surgical treatment. *Int. J. Oral Maxillofac. Surg.* 45 (4), 476–485.
- Bengtsson, M., Wall, G., Larsson, P., Becktor, J.P., Rasmusson, L., 2018. Treatment outcomes and patient-reported quality of life after orthognathic surgery with computer-assisted 2- or 3-dimensional planning: a randomized double-blind active-controlled clinical trial. *Am. J. Orthod. Dentofacial Orthop.* 153 (6), 786–796.
- Corso, P.F., Oliveira, F.A., Costa, D.J., Kluppel, L.E., Rebellato, N.L., Scariot, R., 2016. Evaluation of the impact of orthognathic surgery on quality of life. *Braz. Oral Res.* 30.
- Emadian Razvadi, E.S., Soheilifar, S., Esmaeelinejad, M., Naghdi, N., 2017. Evaluation of the changes in the quality of life in patients undergoing orthognathic surgery: a multicenter study. *J. Craniofac. Surg.* 28 (8), e739–e743.
- Eslamipour, F., Najimi, A., Tadayonfard, A., Azamian, Z., 2017. Impact of orthognathic surgery on quality of life in patients with dentofacial deformities. *Int J Dent*, 4103905.
- Feu, D., de Oliveira, B.H., Palomares, N.B., Celeste, R.K., Miguel, J.A.M., 2017. Oral health-related quality of life changes in patients with severe Class III malocclusion treated with the 2-jaw surgery-first approach. *Am. J. Orthod. Dentofacial Orthop.* 151 (6), 1048–1057.
- Frejman, M.W., Vargas, I.A., Rösing, C.K., Closs, L.Q., 2013. Dentofacial deformities are associated with lower degrees of self-esteem and higher impact on oral health-related quality of life: results from an observational study involving adults. *J. Oral Maxillofac. Surg.* 71 (4), 763–767.
- Goelzer, J.G., Becker, O.E., Haas Junior, O.L., Scolari, N., Santos Melo, M.F., Heitz, C., de Oliveira, R.B., 2014. Assessing change in quality of life using the Oral Health Impact Profile (OHIP) in patients with different dentofacial deformities undergoing orthognathic surgery: a before and after comparison. *Int. J. Oral Maxillofac. Surg.* 43 (11), 1352–1359.
- Huang, S., Chen, W., Ni, Z., Zhou, Y., 2016. The changes of oral health-related quality of life and satisfaction after surgery-first orthognathic approach: a longitudinal prospective study. *Head Face Med.* 12, 2.
- Kavin, T., Jagadesan, A.G., Venkataraman, S.S., 2012. Changes in quality of life and impact on patients' perception of esthetics after orthognathic surgery. *J. Pharm. BioAllied Sci.* 4 (Suppl. 2), S290–S293.
- Kurabe, K., Kojima, T., Kato, Y., Saito, I., Kobayashi, T., 2016. Impact of orthognathic surgery on oral health-related quality of life in patients with jaw deformities. *Int. J. Oral Maxillofac. Surg.* 45 (12), 1513–1519.
- Ni, J., Song, S., Zhou, N., 2019. Impact of surgical orthodontic treatment on quality of life in Chinese young adults with class III malocclusion: a longitudinal study. *BMC Oral Health* 19 (1), 109.
- Nichols, G.A.L., Antoun, J.S., Fowler, P.V., Al-Ani, A.H., Farella, M., 2018. Long-term changes in oral health-related quality of life of standard, cleft, and surgery patients after orthodontic treatment: a longitudinal study. *Am. J. Orthod. Dentofacial Orthop.* 153 (2), 224–231.
- Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McGuinness, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P., Moher, D., 2021. The PRISMA 2020 Statement: an updated guideline for reporting systematic reviews. *BMJ* 372, n71.
- Pelo, S., Gasparini, G., Garagiola, U., Cordaro, M., Di Nardo, F., Staderini, E., Patini, R., de Angelis, P., D'Amato, G., Saponaro, G., Moro, A., 2017. Surgery-first orthognathic approach vs traditional orthognathic approach: oral health-related quality of life assessed with 2 questionnaires. *Am. J. Orthod. Dentofacial Orthop.* 152 (2), 250–254.
- Rivera, S.M., Hatch, J.P., Dolce, C., Bays, R.A., Van Sickels, J.E., Rugh, J.D., 2000. Patients' own reasons and patient-perceived recommendations for orthognathic surgery. *Am. J. Orthod. Dentofacial Orthop.* 118 (2), 134–141.
- Saghafi, H., Benington, P., Ayoub, A., 2020. Impact of orthognathic surgery on quality of life: a comparison between orthodontics-first and surgery-first approaches. *Br. J. Oral Maxillofac. Surg.* 58 (3), 341–347.
- Seehra, J., Fleming, P.S., Newton, T., DiBiase, A.T., 2011. Bullying in orthodontic patients and its relationship to malocclusion, self-esteem and oral health-related quality of life. *J. Orthod.* 38 (4), 247–256 quiz 294.
- Silva, I., Cardemil, C., Kashani, H., Bazargani, F., Tarnow, P., Rasmusson, L., Suska, F., 2016. Quality of life in patients undergoing orthognathic surgery—a two-centered Swedish study. *J. Cranio-Maxillo-Fac. Surg.* 44 (8), 973–978.
- Silva, M., Francisco, I., Sanz, D., Palmeira, L., Vale, F., 2021. Negative social comparisons and social discomfort in dentofacial deformity: a cross-sectional study. *Minerva Dent. Oral Sci.* 70 (2), 88–94.
- Silvola, A.S., Varimo, M., Tolvanen, M., Rusanen, J., Lahti, S., Pirttiniemi, P., 2014. Dental esthetics and quality of life in adults with severe malocclusion before and after treatment. *Angle Orthod.* 84 (4), 594–599.
- Soh, C.L., Narayanan, V., 2013. Quality of life assessment in patients with dentofacial deformity undergoing orthognathic surgery—a systematic review. *Int. J. Oral Maxillofac. Surg.* 42 (8), 974–980.
- Sun, H., Shang, H.T., He, L.S., Ding, M.C., Su, Z.P., Shi, Y.L., 2018. Assessing the quality of life in patients with dentofacial deformities before and after orthognathic surgery. *J. Oral Maxillofac. Surg.* 76 (10), 2192–2201.
- Tachiki, C., Nishii, Y., Takaki, T., Sueishi, K., 2018. Condition-specific quality of life assessment at each stage of class iii surgical orthodontic treatment—a prospective study. *Bull. Tokyo Dent. Coll.* 59 (1), 1–14.
- Vongkamolchoon, S., Sinha, S.P., Liao, Y.F., Chen, Y.R., Huang, C.S., 2021. The impact of a surgery-first approach on oral health-related quality of life. *Int. J. Oral Maxillofac. Surg.* 50 (10), 1336–1341.
- Zingler, S., Hakim, E., Finke, D., Brunner, M., Saure, D., Hoffmann, J., Lux, C.J., Erber, R., Seeburger, R., 2017. Surgery-first approach in orthognathic surgery: psychological and biological aspects—a prospective cohort study. *J. Cranio-Maxillo-Fac. Surg.* 45 (8), 1293–1301.