

A longitudinal study of changes in psychosocial well-being during orthognathic treatment

Short title: Well-being during orthognathic treatment

Alanko, Outi^{1,2}, Tuomisto, Martti T. ¹, Peltomäki, Timo^{3,4}, Tolvanen, Mimmi⁵, Soukka, Tero.², Svedström-Oristo, Anna-Liisa^{2,6}

¹ Faculty of Social Sciences (Psychology), University of Tampere, Tampere, Finland

²Department of Oral and Maxillofacial Diseases, Turku University Hospital, Turku, Finland

³Faculty of Medicine and Life Sciences, University of Tampere, Tampere, Finland

⁴Oral and Maxillofacial Unit, Tampere University Hospital, Tampere, Finland

⁵Department of Community Dentistry, Institute of Dentistry, University of Turku, Turku, Finland

⁶Department of Oral Development and Orthodontics, Institute of Dentistry, University of Turku, Turku, Finland

Corresponding author: Anna-Liisa Svedström-Oristo, University of Turku, Institute of Dentistry, FI20014 University of Turku, Finland, tel. +35823338318, fax +35823338356, email anlisve@utu.fi

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1 ABSTRACT

2 The aim was to evaluate changes in orthognathic patients' (n = 22) psychosocial well-
3 being during treatment and compare it to that of adults without orthognathic treatment
4 need (n = 22). Patient data were collected before treatment (T0), after the first
5 orthodontic examination (T1), three times during treatment (T2–T4), and one year after
6 surgery (T5). In this article, for the controls, only data corresponding to patients' phase
7 T5 is reported. Participants filled in a structured diary and the modified version of
8 Secord and Jourard's body-image questionnaire, the Orthognathic Quality of Life
9 Questionnaire, the Rosenberg self-esteem scale, and the Acceptance and Action
10 Questionnaire II. Moreover, patients filled in the Symptom Checklist-90. After
11 placement of orthodontic appliances (T2), orthognathic quality of life, self-esteem, and
12 psychological flexibility were lower and psychiatric symptoms increased. Improvement
13 was observed from T2 to T5 in orthognathic quality of life, body image, self-esteem,
14 psychological flexibility, and psychiatric symptoms. Treatment resulted in
15 improvements from T0 to T5 in orthognathic quality of life, body image, and
16 psychiatric symptoms. At T5, patients' psychosocial well-being was comparable to or
17 even better than that of controls'. Orthognathic treatment seems to support
18 psychological well-being, but the range of individual variation is wide.

19 INTRODUCTION

20 According to previous studies, patients' main motives for seeking orthognathic
21 treatment are improvement in self-confidence, appearance, and oral function¹. More
22 specifically, these motives may include, e.g., recurrent headaches, facial pain,
23 temporomandibular joint problems, difficulties in biting and chewing, and
24 dissatisfaction with facial appearance²⁻³.

25 Preoperatively, orthognathic patients suffer from psychosocial problems, such as
26 bullying⁴⁻⁵. They also have lower condition-specific quality of life than those with only
27 mild malocclusion⁶ or adults with no need for orthodontic treatment⁴. Results regarding
28 preoperative psychiatric symptoms^{4, 7-8}, self-esteem, and self-confidence⁴⁻⁶ vary.

29 Postoperatively, orthognathic treatment improves patients' orthognathic quality of
30 life⁹⁻¹¹, oral health-related quality of life¹²⁻¹⁵, and aspects of generic quality of life⁷.
31 However, in a recent study by Brunault et al.¹⁶, the quality of life still remained lower
32 than that of the general population, while in the study by Kilinc and Ertas¹⁷, treatment
33 resulted in a quality of life similar to that of participants without dentofacial
34 deformities. Depressive symptoms seem to decrease from the presurgical level at both 6
35 months⁸ and 12 months after surgery¹⁶. However, no change in anxiety symptoms is
36 observed 12 months post-surgery¹⁶. The number of patients still suffering from
37 significant levels of depressive symptoms after surgery is high, from every third patient⁸
38 up to more than two out of three patients¹⁶.

39 During the course of orthognathic treatment, it is plausible that psychosocial well-
40 being changes as different phases of treatment begin and end, and as treatment takes a
41 long time. In the beginning, the impact of fixed orthodontic appliances on oral health-
42 related quality of life is negative, but quality of life returns to pre-treatment levels after

43 completion of treatment¹⁸. However, self-esteem has been found to react differently:
44 The beginning of treatment does not affect self-esteem, while post-treatment it is higher
45 than at baseline¹⁸. In a systematic review focusing on quality of life¹⁹, 10 out of 21
46 studies reported data at only one time point. Three prospective studies with controls
47 were included; they reported data on two occasions. A single study focusing on post-
48 operative changes collected data at three time points following surgery⁹. At the moment,
49 more knowledge on the longitudinal changes in patients' well-being is needed, as most
50 studies so far have collected data by cross-sectional designs or on only a few data
51 collection points. According to previously published results⁴, before beginning
52 orthognathic treatment, patients' body image is lower along with their orthognathic
53 quality of life in all other dimensions except for social aspects, while self-esteem and
54 psychological flexibility are equal to those of the controls. The aim of the current study
55 was to further elucidate changes in psychosocial well-being before, during and after
56 orthognathic treatment and to compare patients' well-being to that of controls' without
57 orthognathic treatment need.

58 **MATERIALS AND METHODS**

59 This prospective study recruited patients referred to two university hospitals for
60 evaluation of orthognathic treatment need. Patients with cleft lip or palate, syndromes
61 affecting craniofacial anatomy, and those whose Finnish language skills did not allow
62 them to complete the questionnaires were excluded from the study. Sample sizes at
63 different time points are presented in Figure 1. At T0, 60 patients participated. In the
64 course of the study, 38 patients dropped out, leaving a final sample of 22 patients (16
65 females and 6 males, mean age 36 years, age range 18–54 years) for whom data were
66 available at least at phases T0 and T5.

67 Before treatment, the main complaints reported by the patients were gingival
68 trauma (n = 8), headache (n = 6), masticatory problems (n = 5), sleep apnea (n = 4), and
69 unsatisfactory dental appearance (n = 4). Orthognathic treatment was conducted in a
70 conventional manner, including pre-surgical orthodontics, surgery, and post-surgical
71 orthodontics. The most frequent procedure was bilateral sagittal split osteotomy (59%)
72 followed by bimaxillary surgery (27%) and maxillary surgery (Le Fort I/three-piece-
73 maxillary surgery; 14%). The duration of treatment varied from 11 to 47 months (mean
74 29 months). At post-treatment, three patients experienced symptoms in
75 temporomandibular joints and one patient had decreased lower lip sensitivity.

76 The control group consisted of university students attending a dental examination.
77 At the beginning of the study, 29 students participated. During the study, seven dropped
78 out, leaving a control group of 22 adults (22 females, mean age 25 years, age range 19–
79 49). Patient data were collected at six phases (Table 1): before beginning of treatment
80 (T0), after first orthodontic examination (T1), three times during treatment (T2–T4), and
81 one year after surgery (T5). From T0 to T1 the patients were in que for beginning
82 treatment. This time period lasted 8 months (range 2-14 months). The mean duration
83 from the first clinical examination (T1) by the treating orthodontist to the day of the
84 surgical operation was 23 months (range 6-41 months).

85 At T5, one year after surgery, orthodontic appliances had been removed from all
86 but one of the patients. From the controls, data were collected at three time points (1) at
87 the beginning of the study (corresponding to phase T0), (2) two years later
88 (corresponding to T4), and (3) four years after T0 (corresponding to T5). Only controls'
89 data corresponding to T5 is reported in the current study. At every time point, all
90 participants filled in a structured diary on two separate days, four times a day. The diary

91 was developed by the authors and included questions about daily activities, emotions,
92 negative and positive attention, bullying, and name-calling⁴. In addition, patients filled
93 in five and controls four questionnaires: (1) The modified version²⁰ of Secord and
94 Jourard's²¹ body-image questionnaire that includes 20 items and assesses participants'
95 satisfaction with different body parts. (2) The Orthognathic Quality of Life
96 Questionnaire²² (OQLQ) that consists of 22 items which form subscales on oral
97 function, facial aesthetics, awareness of dentofacial aesthetics, and social aspects of
98 dentofacial deformity. Items are answered on a five-point scale (N/A = 0, "bothers me a
99 little" = 1 – "bothers me a lot" = 4). Higher scores indicate lower orthognathic quality of
100 life (sum score range 0–88). The reliabilities of the subscales range from 0.83 to 0.93.
101 (3) The Rosenberg self-esteem scale²³ (RSES) is a ten-item questionnaire with a four-
102 point Likert scale (strongly disagree – strongly agree), where higher scores indicate
103 higher self-esteem (sum score range 0 – 30). The reliability of the RSES in a Finnish
104 population was found to be 0.86²⁴. (4) The Acceptance and Action Questionnaire II²⁵
105 (AAQ II) is a seven-item questionnaire for the assessment of psychological flexibility
106 (i.e., the ability to accept and experience current feelings and emotions)²⁶. Items are
107 answered on a seven-point scale (never true = 1 – always true = 7). Higher scores
108 indicate greater psychological flexibility (sum score range 7–49). The mean α -
109 coefficient of AAQ II is 0.84²⁵. (5) The Symptom Checklist-90²⁷ (SCL-90) is a self-
110 report questionnaire that was only filled in by the patients. The patients rated the
111 occurrence of psychiatric symptoms on a five-point Likert scale (not at all = 0 –
112 extremely = 4, sum score range 0–360). SCL-90 has 90 items which form the following
113 scales: somatization, obsessive-compulsivity, interpersonal sensitivity, depression,
114 hostility, anxiety, phobic anxiety, paranoid ideation, psychoticism, and global severity

115 index (GSI). The reliability of these in the Finnish version ranges from 0.77 to 0.90²⁸.
116 The study protocol was approved by the Ethics Review Committees of the Hospital
117 District of Southwest Finland and the Joint Municipal Authority of the Pirkanmaa
118 Hospital District. Informed consent was obtained from all patients and controls before
119 the study. Participation in this study was voluntary.

120 Changes in OQLQ, body image, facial body image, RSES, AAQ-II, SCL-90, and
121 emotional variable scores were evaluated using GLM for repeated measures with
122 Greenhouse-Geisser sphericity correction. Changes between phases T0 and T2 and
123 between T2 and T5 were evaluated using paired samples t-test. Differences between
124 patients and controls at T5 were evaluated with Mann-Whitney U test. All analyses
125 were conducted using SPSS Statistical Package (IBM SPSS Statistics, V22.0, Armonk,
126 NY). P-values < 0.05 were interpreted as statistically significant.

127 **RESULTS**

128 **Changes in patient well-being during treatment**

129 Patients' scores in all OQLQ subscales, body image, facial body image, RSES,
130 AAQ-II, and most subscales of SCL-90 changed during treatment (T2–T4); Table 2).
131 Only in the hostility, phobic anxiety, and psychoticism subscales of SCL-90 did scores
132 remain stable.

133 *Changes from pre-treatment (T0) to placement of fixed orthodontic appliances (T2)*

134 Patients' OQLQ sum score and oral function subscale scores rose from baseline
135 values, indicating a decrease in orthognathic quality of life (Table 3). Other aspects of
136 OQLQ remained stable, as well as body image and facial body image. Both RSES and
137 AAQ-II scores dropped, which indicates a decrease in self-esteem and psychological
138 flexibility, respectively. SCL-90 sum score and GSI scores rose, indicating more
139 psychiatric symptoms overall. Significantly higher scores were found in the subscales of
140 interpersonal sensitivity, depression, and psychoticism.

141 *Changes from placement of fixed orthodontic appliances (T2) to one year post-surgery*
142 *(T5)*

143 The OQLQ scores dropped in all aspects, indicating an improvement in
144 orthognathic quality of life. Body image, facial body image, RSES, and AAQ-II scores
145 rose, indicating a more positive body image, better self-esteem, and psychological
146 flexibility, respectively. SCL-90 sum score, GSI, somatization, interpersonal sensitivity,
147 depression, anxiety, and psychoticism scores dropped, indicating a decrease in
148 psychiatric symptoms.

149 *Changes from pre-treatment (T0) to one year post-surgery (T5)*

150 When examining the overall change from T0 to T5, patients had lower OQLQ
151 scores at T5 than at T0, indicating a higher quality of life in all aspects of OQLQ. Both
152 body image and facial body image scores were higher at T5, indicating a more positive
153 body image. In RSES and AAQ-II, no change was found. SCL-90 sum score, GSI,
154 somatization, interpersonal sensitivity, anxiety, and phobic anxiety scores were lower at
155 T5, thus indicating a decrease in psychiatric symptoms.

156 *Comparison of patient scores one year post-surgery (T5) to controls' scores*

157 At T5, patients and controls had equal results on orthognathic quality of life as a
158 whole (Table 4). Inspection of the subscales revealed that while no differences were
159 found between patients' and controls' results on oral function and facial aesthetics,
160 patients had better scores on social aspects of dentofacial deformity and awareness of
161 dentofacial aesthetics. Patients' and controls' body image and facial body image were
162 equal. Patients' self-esteem was equal to and their psychological flexibility better than
163 that of the controls.

164 *Self-reported variables in every day (diary variables)*

165 An inspection of patients' self-reported emotions revealed that in most aspects, no
166 change was found during treatment. The only variables showing change during
167 treatment were in feeling tired and feeling hurried; at T4, patients reported less tiredness
168 and feeling hurried. Other mean values remained stable (Table 5).

169 **DISCUSSION**

170 The aim of this prospective study was to analyze changes in orthognathic patients'
171 psychosocial well-being from the pre-treatment level to at least one year after surgery.

172 In addition, the findings were compared to those of controls not needing orthognathic
173 treatment. In the current study, patients' psychosocial well-being decreased in many
174 respects after placement of fixed orthodontic appliances, which is in line with findings
175 by Johal et al.¹⁸. In general, the results suggest that treatment succeeded in contributing
176 to patients' psychosocial well-being. The results support previous findings indicating
177 that treatment leads to increased orthognathic quality of life⁹⁻¹¹. In the current study,
178 patients' orthognathic quality of life partially outperformed that of the controls, which is
179 an even better outcome than reported in previous studies¹⁶⁻¹⁷, but may be related to age
180 distribution of the groups. Despite different methods, the decrease in most of the
181 psychiatric symptoms during the course of treatment is in line with previous studies^{7, 16,}
182 ²⁹. However, a closer inspection of the distribution of the scores in the current study
183 shows that individual changes in well-being may differ significantly from the results at
184 the group level, as there is wide variation in scores. This study has also added new
185 views on how patients feel in their everyday life. Interestingly, the only self-reported
186 views on psychological well-being showing change were tiredness and feeling hurried.
187 These variables were reported at lower levels at T4, which may be explained by the sick
188 leave following jaw surgery. In routine cases, the sick leave usually lasts for four weeks.

189 When analyzing changes in patients' well-being, it is obvious that timing of data
190 collection has a significant impact on the results. Thus, variability in results of different
191 studies may partly be explained by variation in data collection points. For example,
192 Cunningham et al.³⁰ focused especially on analyzing pre-surgical results in order to find
193 a suitable baseline for orthognathic studies. They reported that beginning orthodontic
194 treatment had minimal, if any, effects on anxiety, depression, self-esteem, and body
195 image. In their study, T1 data were collected after the first orthodontic-surgical

196 consultation and T2 data after the pre-surgical orthodontic phase. In the study by Ryan
197 et al.⁵, some patients described how an appointment with an orthodontic specialist made
198 them become fixated on their dentofacial deformity. Therefore, it is possible that the
199 timing of T1 in the Cunningham et al.³⁰ study may have been too late to find out
200 patients' self-monitoring views. It is plausible that hearing any professional comments
201 may affect the way patients see themselves; consequently, it may affect patients'
202 responses on questionnaires. Instead, baseline evaluations should be conducted before
203 the first appointment with the orthodontic-surgical team. The issue of postoperative
204 changes has also been spotlighted by Choi et al.⁹, who discussed the possibility that
205 continuing orthodontic treatment 6 months post-surgery may affect patients' OQOL. In
206 their study, results improved from 6 months to the completion of treatment. The authors
207 suggested that, at the earliest, quality of life should be assessed one year following the
208 completion of all treatment. Based on the current finding – that patients' well-being
209 gradually improved from the time of receiving the orthodontic appliances to one year
210 post-surgery (all but one patient had orthodontic appliances removed) – it may be that
211 changes in well-being should not be considered final until treatment has been
212 completed. Moreover, as shown by the data, multiple data collection points reveal a
213 different story compared to pre- and post-treatment comparisons, and give a more
214 comprehensive view. Multiple questionnaires at multiple time points may add an extra
215 strain on patients during the demanding treatment process, as patients are asked to fill in
216 the same questionnaires several times. This too can be seen in our study: 63% of
217 patients dropped out before treatment was completed, which is a limitation of this study.
218 In light of two recent Finnish studies, the sample in the current study can be, however,
219 considered representative³¹⁻³². A larger sample size would have allowed for

220 segmentation of the results based on, for example, initial motivation for treatment, type
221 of surgery, or self-perceived dental appearance before treatment. As a result of the small
222 sample size, differences between controls and patients cannot be detected as easily as
223 with larger samples. Furthermore, the vast majority of the subjects were female, which
224 reduces the generalizability of results to men. On the other hand, women frequently
225 make up the majority of orthognathic patients³¹⁻³². On the basis of recent literature, two
226 reasons may explain the majority of females in our sample. First, TMD symptoms are
227 more often experienced by females than males³³. Secondly, the threshold for seeking
228 treatment may be higher for men than for women³⁴.

229 It is a challenge to recruit a control group with suboptimal occlusion, i.e. with
230 only minor if any need for orthodontic treatment. In this study, first year university
231 students were chosen as a control group, as it was expected that this study would last for
232 several years. We assumed that they would be easily available during the forthcoming
233 years, because the completion of many university studies in Finland ideally takes
234 approximately 5 years. University studies are free of charge. Also dental treatment
235 including orthodontics, is offered free of charge to children and adolescents up to 15
236 years of age, and with marginal costs to anyone older than 15 whose malocclusion is
237 considered severe enough. Malocclusions are prioritized according to the Uniform
238 Criteria for Access to Non-emergency Treatment. Therefore, the students' need for
239 dental treatment should not differ from those of their peers.

240 This study sheds light on the changes that occur in patients' psychosocial well-
241 being during the process of orthognathic treatment. With more detailed knowledge, it is
242 possible to inform future patients about what to expect from a psychosocial point of
243 view, and to offer psychosocial support when it is mostly needed. The results also

244 suggest that the timing of data collection is important. In the future, it would be useful
245 to study how different aspects of psychosocial well-being change in the long term. At
246 least one year after surgery, the changes seem to be positive.

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249

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251 All authors have read the manuscript and agreed to the submission.

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