Tampere University

OUTI ALANKO

Psychosocial Well-Being of Orthognathic Patients

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ACADEMIC DISSERTATION
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Tampere University, Faculty of Social Sciences
Turku University Hospital, Department of Oral and Maxillofacial Diseases
Tampere University Hospital, Oral and Maxillofacial Diseases
Finnish Student Health Service, Turku Unit
Finland

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ABSTRACT

Orthognathic treatment combining orthodontics and surgery aims at correcting severe dentofacial discrepancies and improving patients' quality of life. Several factors motivate patients to seek this treatment as severe dentofacial discrepancies affect patients' oral health and function, and psychosocial well-being. This thesis aimed at analyzing patients' psychosocial well-being before, during, and after orthognathic treatment using a prospective study design.

A systematic literature review on orthognathic patients' motivation for treatment, psychosocial well-being, and satisfaction with treatment outcome was conducted. According to the included studies (n=35), the main motives for treatment were improvements in the stomatognathic system, self-confidence, and appearance. Psychosocial well-being was evaluated using a range of questionnaires, and with varying data collection points. Overall, orthognathic patients did not experience psychiatric symptoms to a greater degree than others. The vast majority of patients were satisfied with treatment outcome.

Prospective orthognathic patients' psychosocial well-being was compared to that of young adults without orthognathic treatment need. Data was collected with questionnaires evaluating psychiatric symptoms (Symptom Checklist-90), self-esteem (Rosenberg Self-Esteem Scale), psychological flexibility (Acceptance and Action Questionnaire II), condition-specific quality of life (Orthognathic Quality of Life Questionnaire), and body image (body image questionnaire). Also, patients' assessed their daily emotions with a structured diary, and graded their own dental appearance on a scale from 1 to 10 Aesthetic Component of the Index of Orthodontic Treatment Need). Data was collected before beginning treatment. Most of the patients coped well with their dentofacial deformities despite experiencing evident masticatory problems. Among the patients who graded their dental appearance as worse, quality of life and body image were lower than among controls. Self-esteem and psychological flexibility did not differ between patients and controls.

Orthognathic patients' psychosocial well-being was evaluated in 6 treatment phases: before treatment (T0), after first orthodontic examination (T1), from 6 weeks to 2 months after placement of fixed orthodontic appliances (T2), 3–4 weeks before orthognathic surgery (T3), 6 weeks after surgery (T4), and 1 year after surgery (T5).

Control group data was collected at time points corresponding to patients' T0, T4, and T5. The results indicated that treatment produced improvements in patients' psychosocial well-being with regard to condition-specific quality of life, body image, and psychiatric symptoms. The results regarding patients' psychosocial well-being were equal to or even better than for controls 1 year after surgery.

In the future, prospective studies with both general measures of psychological well-being and condition-specific measures are needed to better understand the long-term effects of treatment. Furthermore, in addition to questionnaires, also structured diaries would bring new information about patients' emotions in their daily lives.

TIIVISTELMÄ

Hampaiden oikomishoitoa ja leikkaushoitoa yhdistävä, ns. ortognaattinen hoito tähtää vakavien leukojen välisten ja hammaskaarten välisten epäsuhtien korjaamiseen ja potilaiden elämänlaadun kohentamiseen. Vakavat leukojen ja hammaskaarten väliset epäsuhdat vaikuttavat potilaiden suun terveyteen ja toimintaan sekä psykososiaaliseen hyvinvointiin. Tämän väitöskirjatutkimuksen tarkoituksena oli analysoida prospektiivisellä tutkimusasetelmalla potilaiden psykososiaalista hyvinvointia ennen hoitoa, hoidon aikana ja hoidon jälkeen.

Ortognaattisten potilaiden hoitoon hakeutumisen syistä, psykososiaalisesta hyvinvoinnista ja tyytyväisyydestä hoidon lopputulokseen tehtiin systemaattinen kirjallisuuskatsaus. Tutkimukseen mukaan otettujen artikkelien (n=35) mukaan tärkeimmät tekijät hoitoon hakeutumiselle olivat purennan toiminnan, itseluottamuksen ja ulkonäön parantuminen. Psykososiaalista hyvinvointia arvioitiin tutkimuksissa vaihtelevilla menetelmillä ja mittausaikatauluilla. Kokonaisuutena ortognaattiset potilaat eivät kokeneet muita enempää psykiatrisia oireita. Enemmistö potilaista oli tyytyväisiä hoidon lopputulokseen.

Tulevien ortognaattisten potilaiden psykososiaalista hyvinvointia verrattiin tätä hoitoa tarvitsemattomien nuorten aikuisten psykososiaaliseen hyvinvointiin. Tutkimusaineisto kerättiin kyselylomakkeilla, jotka arvioivat psykiatrisia oireita (Symptom Checklist 90), itsetuntoa (Rosenberg Self-Esteem Scale), psykologista joustavuutta (Acceptance and Action Questionnaire II), terveydentilaspesifiä elämänlaatua (Orthognathic Quality of Life Questionnaire), ja kehonkuvaa. Lisäksi potilaat arvioivat päivittäisiä tunteitaan strukturoidun päiväkirjan avulla ja arvioivat hampaistonsa ulkonäköä asteikolla yhdestä kymmeneen. Aineisto kerättiin ennen hoidon alkua. Suurin osa potilaista selviytyi hyvin leukojen epäsuhdan kanssa, vaikka se aiheutti vaikeuksia esimerkiksi haukatessa ja pureskellessa. Elämänlaatu ja kehonkuva olivat verrokeita heikompia niillä potilailla, jotka arvioivat hampaistonsa ulkonäön huonommaksi. Itsetunto ja psykologinen joustavuus eivät eronneet potilaiden ja verrokeiden välillä.

Potilaiden psykososiaalista hyvinvointia arvioitiin hoidon kuudessa vaiheessa: ennen hoitoa (T0), ensimmäisen ortodonttisen tarkastuksen jälkeen (T1), kun kiinteät oikomiskojeet olivat olleet suussa 6 viikkoa -2 kuukautta (T2), 3-4 viikkoa

ennen ortognaattista leikkausta (T3), 6 viikkoa leikkauksen jälkeen (T4), ja vuosi leikkauksen jälkeen (T5). Verrokeiden aineisto kerättiin potilaiden aineistonkeruuhetkiä T0, T4 ja T5 vastaavina ajankohtina. Tulokset viittasivat siihen, että hoidon seurauksena potilaiden terveydentilaspesifi elämänlaatu ja kehonkuva paranivat ja psykiatriset oireet vähenivät. Kokonaisuutena potilaiden psykososiaalinen hyvinvointi näyttäytyi yhtä hyvänä tai jopa parempana kuin verrokeiden.

Hoidon pitkäkestoisten vaikutusten ymmärtämiseksi tulevaisuudessa tarvitaan lisää prospektiivisia tutkimuksia, joissa hyödynnetään sekä psyykkistä hyvinvointia laajemmin arvioivia menetelmiä että terveydentilaspesifejä menetelmiä. Lisäksi strukturoitujen päiväkirjojen hyödyntäminen täydentävänä tutkimusmenetelmänä lisää ymmärrystä niistä tunteista, joita potilaat kokevat jokapäiväisessä elämässään.

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ABBREVIATIONS

AAQ-II	Acceptance and Action Questionnaire II
AC of IOTN	Aesthetic Component of the Index of Orthodontic Treatment Need
OQLQ	Orthognathic Quality of Life Questionnaire
RSES	Rosenberg Self-Esteem Scale
SCL-90	Symptom Checklist

ORIGINAL PUBLICATIONS

Alanko, O., Svedström-Oristo, A-L., & Tuomisto, M. T. (2010). Patients' perceptions of orthognathic treatment, well-being, and psychological or psychiatric status: a systematic review. Acta Odontologica Scandinavica 68: 249-260.

Alanko, O., Svedström-Oristo, A-L., Peltomäki, T. Kauko, T. & Tuomisto, M. T. (2014). Psychosocial well-being of prospective orthognathic-surgical patients. Acta Odontologica Scandinavica 72: 887-897.

Alanko, O., Tuomisto, M. T., Peltomäki, T., Tolvanen, M., Soukka, T., & Svedström-Oristo, A-L. (2017). A longitudinal study of changes in psychosocial well-being during orthognathic treatment. International Journal of Oral and Maxillofacial Surgery, 46:1380-1386.

1 INTRODUCTION

1.1 The concept of orthognathic treatment

Orthognathic treatment is a procedure used to correct severe dentofacial discrepancies (e.g., severe Angle Class II or Class III malocclusion, facial asymmetry) that cannot be treated with conventional orthodontics alone (Bergkulla et al., 2017; Cunningham & Johal, 2015). It is a combination of orthodontic treatment and maxillofacial surgery (Cunningham & Johal, 2015; Proffit & White, 2015; Strohl & Vitkus, 2017). The standard procedure includes three stages: 1) presurgical orthodontics that aims at reversing dental adaptations and aligning of dental arches, 2) surgery that is performed to correct skeletal discrepancies (e.g., asymmetries and jaw relationships), and 3) postsurgical orthodontics (Bergkulla et al., 2017; Proffit & White, 2015) to refine the occlusion (Strohl & Vitkus, 2017). The achieved occlusal outcome is maintained during the final retention period (Proffit & White, 2015).

The duration of presurgical orthodontics is estimated to vary from 12 to 24 months (Bergkulla et al., 2017; Luther, Morris, & Karnezi, 2003; Paunonen, Helminen, & Peltomäki, 2017) and the recuperation period after orthognathic surgery from 4 to 6 weeks (Bergkulla et al., 2017; Cunningham & Johal, 2015). According to the systematic literature review by Jędrzejewski, Smektala, Sporniak-Tutak, and Olszewski (2016), the most common complications related to orthognathic surgery are nerve injury / alterations in sensitivity (50.00%), temporomandibular joint problems (13.64%), and haemorrhage (9.09%). Postsurgical orthodontics should optimally be completed in 4 to 5 months (Proffit & White, 2015), although it often takes longer (Luther et al., 2007; Paunonen et al., 2017).

However, it has been suggested that orthognathic treatment should not only focus on correcting deviations from text book ideal occlusion or certain anatomic measures, but also on improving patients' quality of life (Song & Yap, 2016), as the success of the treatment also depends on the motivations, perceptions, and expectations of the patient (Soh & Narayanan, 2013).

1.2 Consequences of dentofacial discrepancy

Dentofacial discrepancies affect oral health and function, as well as psychological well-being (Soh & Narayanan, 2013). These effects are apparent throughout life (Cunningham & Johal, 2017). For example, orthognathic patients in Finland have reported various symptoms, such as headache, facial pain, temporomandibular joint problems, and chewing difficulties (Pahkala & Kellokoski, 2007; Svedström-Oristo, Ekholm, Tolvanen, & Peltomäki, 2016). Clinically, severe temporomandibular dysfunction (TMD) has been diagnosed in more than half of these patients (Pahkala & Kellokoski, 2007; Øland et al., 2010a). Dissatisfaction with both facial and dental appearance in orthognathic patients is common (Johnston, Hunt, Burden, Stevenson, & Hepper, 2010; Pahkala & Kellokoski, 2007), and patients have been noted to have excessive concerns regarding their health and body (Brucoli, Rodriquez y Baena, Boffano, & Benech, 2019). Patients describe feeling less attractive (Cadogan & Bennun, 2011; Gerzanic, Jagsch, & Watzke, 2002), different, and abnormal (Cadogan & Bennun, 2011).

In the review article by Thompson and Kent (2001), the psychological impact of congenital or acquired deformities included anxiety, depression, and low self-esteem. Orthognathic patients have been reported to have higher levels of psychiatric symptoms than healthy controls (Yao, Zhou, & Li, 2014): They have been noted to suffer from anxiety (Brucoli et al., 2019; Collins, Gonzales, Gaudilliere, Shrestha, & Girod, 2014). More than one in four patients have high levels of trait anxiety; while the percentage is even higher (42%) in patients with objectively defined severe facial deformity as compared to the corresponding percentage (23%) in adults with normal occlusion and harmonious faces (Kovalenko, Slabkovskaya, Drobysheva, Persin, Drobyshev, & Maddalone, 2012). Preoperative state- and trait anxiety has been found to be higher than postoperative (Scariot et al., 2019). However, Al-Bitar and Al-Ahmad (2017) have found preoperative patients to suffer less than controls from dental treatment anxiety, which, according to the authors, could be due to patients getting more familiar with their dentist and more used to the orthodontic treatment. Dental anxiety was associated with the total number of traumatic life events in both pre- and postsurgical patients. With regard to depression, most patients do not suffer from depression presurgically (de Ávila, de Molon, Loffredo, Massucato, & Hochuli-Vieira, 2013), but presurgical patients have reported more symptoms than the general

population (Takatsuji, Kobayashi, Kojami, Hasabe, Izumi, Saito, & Saito, 2015) with 30–42 % of preoperative orthognathic patients reporting depressive symptoms (Collins et al., 2014; Mladenović, Dodić, Stošić, Petrović, Cutović. & Kozomara, 2014). Some patients feel victimized (Ryan, Barnard, & Cunningham, 2012). Twenty-nine percent of patients have been found to have obsessive-compulsive symptoms (Collins et al., 2014).

Patients have also been found to have more social anxiety than the general population (Ryan, Moles, Shute, Clarke, & Cunningham, 2016). Forty per cent of patients report having problems in their social environment before treatment (Silva et al., 2016), meeting new people or being in new situations is difficult (Cadogan & Bennum, 2011), and social appearance anxiety has been found to be higher in preoperative patients than in controls (Agırnaslıgıl, Gul Amuk, Kılıc, Kutuk, Demırbas, & Alka, 2019). Orthognathic patients also have experienced bullying related to their appearance (Liddle, Baker, Smith, & Thompson, 2018). Ryan et al. (2012) describe a range of impacts on relationships and employment: Relationship impacts include completely avoiding meeting new people and socializing, feeling defensive and insecure, as well as problems forming intimate relationships, while impacts on employment included controlling working environments, and feeling discriminated due to the visible defect.

Before surgery, patients' quality of life is lower than that of controls (Frejman, Vasgas, Rösing, & Closs, 2013; Jung, 2016; Kurabe, Kojima, Kato, Saito, & Kobayashi, 2016; Ribeiro-Neto, Ferreira, Monnazi, Gabrielli, & Monnazi, 2018; Sun, Shang, He, Ding, Su, & Shi, 2018; Yi, Lu, Xiao, Li, Li, & Zhao, 2019). Patients' self-esteem (Agırnaslıgıl et al., 2019), or at least female patients' self-esteem (Jung, 2016; Yu, Fang, Wang, Wang, Chang, Dai, & Shen, 2013) has been found to be lower than the self-esteem of controls, and also lower than the self-esteem of orthodontic patients (Pabari, Moles, & Cunningham, 2012).

1.3 Who seeks orthognathic treatment?

Orthognathic surgery may be considered for patients up to 60 years and older (Proffit & White, 2017). In a review, patients' age range varied between 15 and 72 years (Pachêco-Pereira, Abreu, Dick, De Luca Canto, Paiva, & Flores-Mir, 2016), which is in line with studies conducted in Finland, in which ages of patients varied from 15 to 70 (Bergkulla et al., 2017; Kuhlefelt, Laine, & Thorén, 2016; Paunonen et al., 2017). Most patients are female (Bergkulla et al., 2017; Hernández-Alfaro,

Guijarro-Martinez, & Peiro-Guijarro, 2014; Kuhlefelt et al., 2016; Pahkala & Kellokoski, 2007; Pachêco-Pereira et al., 2016; Paunonen et al., 2017).

The most common malocclusions among patients seeking orthognathic treatment are severe skeletal Angle Class II and Class III malocclusions, deep bite, open bite, and asymmetry (Kurabe et al., 2016; Pahkala & Kellokoski, 2007), but also patients with obstructive sleep apnea are treated with orthognathic treatment (Faber, Faber, & Faber, 2019). For Class II patients, surgery often involves only advancement of the mandible, while in many Class III cases, surgery is bimaxillary (Cunningham & Johal, 2015). The objectively defined severity of malocclusion is not necessarily associated with the severity of its consequences (Cunningham & Johal, 2015). However, in some studies, objective measures, such as overjet, have been shown to be associated with patients' psychosocial well-being (Palomares, Celeste, & Miguel, Stagles, Popat, & Rogers, 2016; Yao et al., 2014).

Aesthetics, function, and psychosocial reasons are among the most commonly reported motivating factors for seeking orthognathic treatment (Patcas et al., 2017; Proothi, Drew, & Sachs, 2010; Tamme et al., 2017; Øland, Jensen, Papadopoulos, & Melsen, 2011). Patients have described a need to look "normal" or not to stand out (Liddle et al., 2018; Ryan et al., 2012). As orthognathic treatment is elective, it is crucial that the patient and the clinical team discuss the patient's expectations and the probable outcome in order to decide whether or not to commence treatment (Bergkulla et al., 2017; Paunonen et al., 2017).

1.4 Effectiveness of orthognathic treatment

Outcomes of orthognathic treatment include improved stomatognathic function (Pahkala & Kellokoski, 2007; Øland et al., 2010a), satisfaction with facial appearance (Liddle, Baker, Smith, & Thompson, 2015; Sar, Soydan, Ozcirpici, & Uckan, 2015), and improved quality of life (Baherimoghaddam, Tabrizi, Naseri, Pouzesh, Oshagh, & Torkan, 2016; Catt, Ahmad, Collyer, Hardwick, Shah, & Winchester, 2018; Choi, Lee, McGrath, & Samman, 2010; Emadian Razvadi, Soheilifar, Esmaeelinejad, & Naghdi, 2017; Esperão, de Oliveira, de Oliveira Almeida, Kiyak, & Miguel, 2010; Gabardo et al., 2019; Geramy, Mazaheri Nazarifar, Saffar Shahroudi, & Sheikhzadeh, 2019; Kurabe et al., 2016; Ni, Shong, & Zhou, 2019; Palomares et al., 2016; Ribeiro-Neto et al., 2018; Silva et al., 2016; Soh & Narayanan, 2012; Zamboni, de Moura, Brew, Rivaldo, Braz, Grossmann, & Bavaresco, 2019). Orthognathic treatment is also an effective option for treating obstructive sleep apnea (Faber et al., 2019).

With regard to condition-specific quality of life, a meta-analysis concluded that after six months of surgery especially social aspects, facial appearance, and oral function improved (Yi et al., 2019). However, six months postoperatively, in addition to improvements in oral health-related quality of life, ideal cephalometric outcomes have also been associated with worsening of some aspects of it, which may be related to a delay in adaptation to a new jaw position (Geramy et al., 2019). Facial appearance changes may also result in patients being unrecognizable to their acquaintances (Liddle et al., 2018).

Patients have been noted to experience an increase in self-esteem following surgery (Nicodemo, Pereira, & Ferrera, 2008; Agırnaslıgıl et al., 2019).After treatment, patients are also seen in a more positive light by peers (Jesani, DiBiase, Cobourne, & Newton, 2014). With regard to psychiatric symptoms, twelve months after surgery orthognathic patients suffer less from depressive symptoms than before surgery, but no change is detected in anxiety symptoms (Brunault et al., 2016). Moreover, dental anxiety does not seem to change from the presurgical state to one year postsurgery (Al-Bitar & Al-Ahmad, 2017). However, improvements in social appearance anxiety as well as improvements in sensitivity to criticism have been reported six months postsurgically (Agırnaslıgıl et al., 2019). In general, postoperatively most patients (89.9 %) do not seem to suffer from psychological distress (Song & Yap, 2019).

Although results from studies considering temporomandibular dysfunction symptoms and orthognathic treatment have been contradictory (Song & Jap, 2017), functional as well as appearance-related motives for treatment are most often fulfilled (Tamme et al., 2017; Øland et al., 2011), and the majority of patients are satisfied with treatment outcome (Al-Asfour, Waheedi, & Koshy, 2018; Dantas, Neto, de Carvalho, Martins, de Sousa, & Sarmento, 2015; Liddle et al., 2015; Schilbred Eriksen, Moen, Wisth, Løes, & Klock, 2018; Sar et al., 2015; Soh & Narayanan, 2013; Tamme et al., 2017; Zamboni et al., 2019). Factors associated with satisfaction include gender, type of surgery, aesthetic outcome, changes in a patient's self-concept and perceived social benefits (Pachêco-Pereira et al., 2016). However, satisfaction with treatment outcome seems not to be associated with post-treatment anxiety symptoms, or major depressive or other psychiatric symptoms (Øland, Jensen, Melsen, & Elklit, 2010b); thus patients' psychological status seems not to be clearly related to the surgical outcomes. On the other hand, according to a systematic review on patients' satisfaction with orthognathic treatment, dissatisfaction is associated with treatment length, postsurgical functional impairment, dysfunction,

and lack of information related to the risks of surgery (Pachêco-Pereira et al., 2016). Dissatisfaction has been noted to diminish over time (Zamboni et al., 2019).

1.5 Methodological aspects

1.5.1 Variation related to applied methods

According to the systematic review by Soh & Narayanan (2013), studies of orthognathic patients' quality of life have typically utilized three different methods: the Short Form Health Survey (SF-36; Ware & Sherbourne, 1992) to measure generic health-related quality of life, the Short Form of the Oral Health Impact Profile 14 (OHIP-14; Slade, 1997) to measure oral health-related quality of life, and the Orthognathic Quality of Life Questionnaire (OQLQ; Cunningham, Garratt, & Hunt, 2000) to measure condition-specific quality of life. In a recent meta-analysis all of the included 24 studies assessed oral health-related quality of life with either OHIP or OQLQ (Yi et al., 2019). Other, more seldom involved measures include a range of questionnaires designed for specific studies to gather patients' experiences (see Kanatas & Rogers, 2010). Also WHO quality of life-BREF has lately been used to measure generic quality of life (Brunault et al., 2015; Gabardo et al., 2019).

Some studies (e.g., Choi et al., 2010; Khadka et al., 2011; Ni et al., 2019; Silva et al., 2016; Sun et al., 2018) have compared results using several quality of life measures from generic to condition-specific measures. These measures produce somewhat different results (Bortoluzzi, de Camargo Smolarek, Claudino, Campagnoli, & Manfro, 2015). For example, in the study by Sun et al. (2018), the condition-specific measure was slightly more sensitive in distinguishing patients and controls than the oral health-related measure. The condition-specific measure has also detected decline in quality of life in the presurgical orthodontic phase, which was not found with the oral health-related measure (Ni et al., 2019). Furthermore, Choi et al. (2010) found improvement in overall oral health-related quality of life at 6 months after surgery, whereas with condition-specific measures improvement was found already 6 weeks postsurgery. However, in the subscales, the results are somewhat different. For example, at 6 weeks after surgery, patients had greater functional limitations as measured with oral health-related measures, but with condition-specific measures, no change on oral function was found. On the other hand, at 6 weeks postsurgery,

social aspects of dentofacial deformity improved, but no change was found on oral health-related measures regarding social disability.

Patients' psychological status has been studied with the Symptom Checklist 90 (SCL-90; Derogatis, Lipman, & Covi, 1973; see e.g., Chen, Zhang, & Wang, 2002; Motegi, Hatch, Rugh, & Yamaguchi, 2003; Phillips, Kiyak, Bloomquist, & Turvey, 2004; Yao et al., 2014) and the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1967; see Chen et al., 2002, Brucoli et al., 2019). In some studies, depressive symptoms have been evaluated with the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983; see, e.g., Williams et al., 2009), but it has later been found not to be valid for the orthognathic population (Shelton, Houghton, Morris, Latchford, Bekker, & Munyombwe, 2015). Self-esteem of patients has been evaluated with the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965; see e.g., Jung, 2016; Nicodemo et al., 2008; Williams et al., 2009). Healthy psychological functioning involves psychological flexibility, which can be defined as the ability to experience the present moment and engage in behavior that is consistent with one's values (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). However, according to preset knowledge, the psychological flexibility of orthognathic patients has not been studied previously. Recently, a questionnaire developed for evaluating well-being of orthognathic patients was created (Shelton et al., 2015). A screening tool for finding suitable candidates for elective cosmetic surgery and cosmetic dentistry has been created, but no studies analyzing its suitability for the orthognathic patient population have been conducted (Honigman, Jackson, & Dowling, 2011).

1.5.2 Type of study design

Studies focusing on well-being of orthognathic patients have mainly used prospective, cross-sectional, or retrospective designs. It has been stated that more randomized clinical studies are needed in the future (Soh & Narayanan, 2013). For example, of the 28 full-length orthognathic articles published in 2011–2012 in the British Journal of Oral and Maxillofacial Surgery, one was a randomized trial, seven were prospective, and nine were retrospective (Goodson, Payne, Tahim, Colbert, & Brennan, 2013). In the systematic review on orthognathic surgery and quality of life by Soh & Narayanan (2013), of the 21 included studies published between 2001 and 2012, one was a randomized trial, ten were prospective, and the remaining were either case–control studies, cross-sectional studies, or retrospective studies.

Furthermore, in a meta-analysis including randomized controlled trials, controlled clinical trials, and prospective cohort studies investigating the impact of combined orthodontic-surgical treatment on oral health-related quality of life, 23 prospective studies and one RCT were included, all published between 2008 and 2018 (Yi et al., 2019). In most of the studies no suitable control groups were used (Liddle et al., 2015; Soh & Narayanan, 2013).

1.5.3 Timing

Various data collection schedules have been applied in studies on orthognathic patients. Before surgery, data has been collected for example at the first visit, 1 month before surgery, 1 week before surgery, or generally before surgery (see Zamboni et al. (2019) for a summary). Liddle et al. (2015) have discussed whether the first data collection points reflect a true baseline, as in many studies the first data collection has been conducted after the start of preoperative treatment. As presurgical orthodontics have been found to, for example, negatively impact facial aesthetics and oral function in Class III patients (Tachiki, Nishii, Takaki, & Sueishi, 2018), psychological discomfort in Class II patients (Baherimoghaddam et al., 2015), and condition-specific quality of life as a whole (Yi et al., 2019), the presurgical orthodontic stage cannot, according to Liddle et al. (2015), represent a true baseline, i.e., a baseline that has not been affected by preoperative treatment. The treatment process itself (Liddle et al., 2018) and the professional diagnosis (Ryan et al., 2012) may raise awareness of the dentofacial deformity, and therefore baseline data would ideally be collected before extensive consultation. Some patients may expect instant changes after surgery and therefore be disappointed due to swelling and continuing use of braces (Liddle et al., 2018), which may affect data collected soon after surgery. Furthermore, in many studies the follow-up periods have been six months or less, which may be insufficient to detect long-term changes (Liddle et al., 2015), as adjusting to changes in appearance is a process (Liddle et al., 2017). In some studies the follow-up periods have been significantly longer, lasting until the end of treatment (see Zamboni et al., 2019, for a summary). Data has frequently been collected before treatment, before surgery, 1-2 months after surgery, and approximately 6 months after surgery (Yi et al., 2019).

2 AIMS OF THE STUDY

The main aim of this study was to evaluate orthognathic patients' psychosocial well-being before, during, and after treatment, and to compare it to the psychosocial well-being of young adults not in need of orthognathic treatment. The specific objectives were the following:

To conduct a systematic literature review of orthognathic patients' motivation for treatment, psychological status, self-esteem and self-confidence, body image, social activity and daily life before and after treatment, and satisfaction with treatment outcome (Study I).

To analyze body image, orthognathic quality of life, psychological flexibility, self-esteem, psychiatric symptoms, daily emotions, and bullying experiences of patients referred for evaluation of orthognathic treatment need, and to compare them to those of young adults not in need of orthognathic treatment or to national norms (Study II).

To analyze orthognathic patients' body image, orthognathic quality of life, psychological flexibility, self-esteem, and psychiatric symptoms in different treatment phases, and to compare the situation 1 year after orthognathic surgery to that of young adults not in need of orthognathic treatment (Study III).

3 METHODS

3.1 Systematic review of previous studies

In study I, articles published from 1.1.2001 to 30.6.2009 were searched from PubMed, Web of Science, and PsycINFO. Articles that were not written in English were excluded as well as case reports, congress abstracts, letters to the editor, and review articles. Furthermore, studies outside the scope of the study were excluded in collaboration with two reviewers. The literature search produced 35 articles that were included in the systematic review. Results of the included articles were arranged under six headings (motivation for treatment, psychological status, self-esteem and self-confidence, body image, social activity and daily life, and satisfaction with treatment outcome) and from pre- to post-treatment results, where applicable. Methods of data collection were taken into account in reviewing results.

3.2 Original studies

3.2.1 Procedure

Studies II and III are part of a larger study evaluating orthognathic patients' well-being before, during, and after treatment. Voluntary university students without orthognathic treatment need served as controls. Psychosocial well-being, physical symptoms, severity of malocclusion, and radiological changes in temporomandibular joints (not reported in the present study) were studied. It is a collaborative study between the Department of Oral and Maxillofacial Diseases of Turku University Hospital, the Oral and Maxillofacial Unit of Tampere University Hospital, and the Turku unit of the Finnish Student Health Service, University of Tampere and University of Turku. All patients were referred to the clinics. Data were collected from clinical records, questionnaires, and diaries. Written consent was obtained from all participants. This study was approved by the Ethics Review Committees of the

Hospital District of South-west Finland (ETMK 80/180/2009) and the Joint Municipal Authority of the Pirkanmaa Hospital District (RO9181).

Patients' psychosocial well-being was evaluated six times: before beginning of treatment (T0), after first orthodontic examination (T1), 6 weeks–2 months after placement of fixed orthodontic appliances (T2), 3–4 weeks before orthognathic surgery (T3), 6 weeks after surgery (T4), and 1 year after surgery (T5). Control group data was collected three times corresponding to phases T0, T4, and T5 (Figure 1).

3.2.2 Subjects

All patients in this study had been referred to the clinics for evaluation of orthognathic treatment need. In Study II, the patient group consisted of 60 patients, of whom 44 were female and 16 male and who were willing to take part in the study. At T0, mean age of the patients was 34 years (SD 11 years) with an age range of 17–61 years. Patients with cleft lip or palate, syndromes affecting craniofacial anatomy, or insufficient Finnish language skills were excluded. The control group consisted of 29 young adults who were first-year university students and had attended a dental examination at the Turku unit of the Finnish Student Health Service. Of the 29 controls 28 were female and 1 male. Mean age of the controls was 25 years (SD 7 years) with an age range of 19–49 years (T0).

Participants in Study III also participated in Study II. However, participants from whom data was not obtained in the first and last data collection phases were excluded. The patient group in Study III consisted of 22 patients, of whom 16 were female and 6 male. The mean age of the patient group was 36 years (SD 10 years), and age range 18–54 years (T0). Patients were treated with presurgical orthodontics, surgery, and postsurgical orthodontics. Most patients had bilateral sagittal split osteotomy (59% of the patients). Twenty-seven per cent of the patients had bimaxillary surgery and 14% maxillary surgery. Mean treatment duration was 29 months (range 11–47 months). At this stage, the control group consisted of 22 young adults from whom data was obtained in the first and last phases of data collection. All participants in the control group were female. The mean age of the control group was 25 years (SD 8 years), and age range 19–49 years (T0).

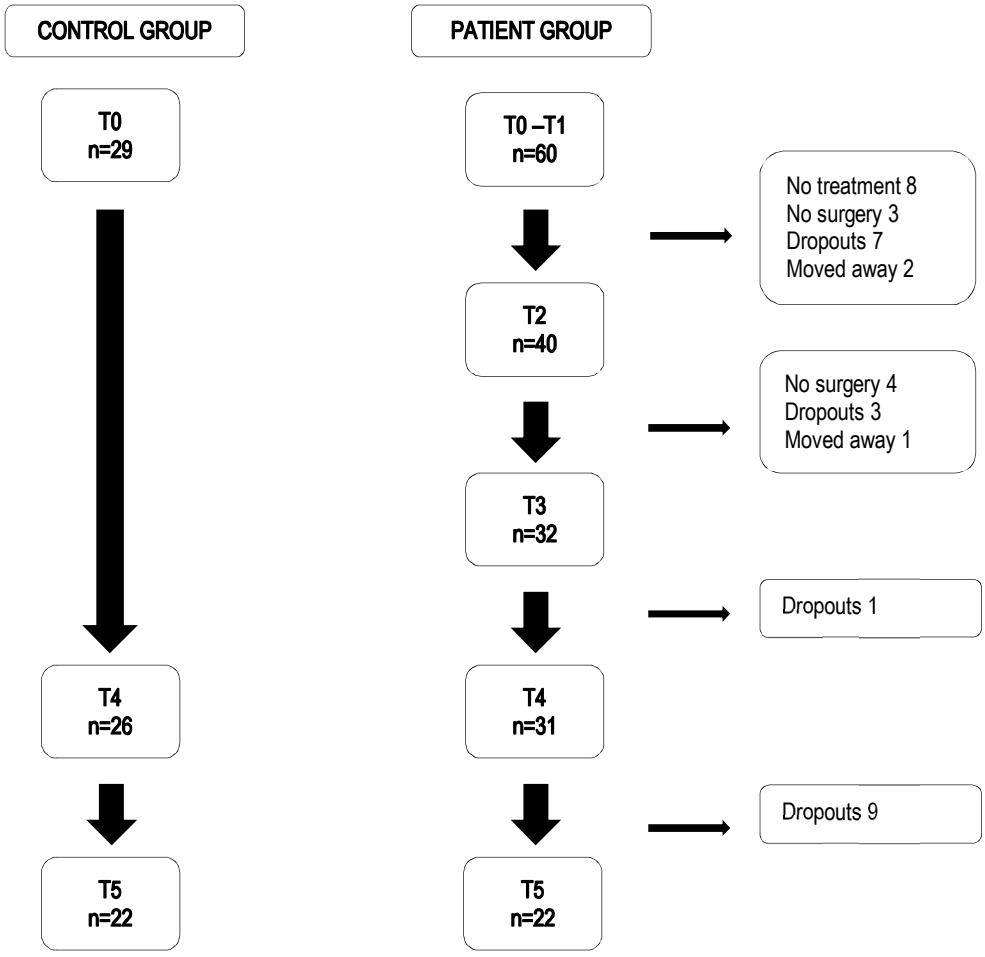

Figure 1. Control group and patient group sample sizes at different phases of study.

3.2.3 Assessment of psychosocial status

At each phase, patients filled in the Symptom Checklist-90 (SCL-90; Derogatis et al., 1973), the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965), the Acceptance and Action Questionnaire II (AAQ-II; Bond et al., 2011), the Orthognathic Quality of Life Questionnaire (OQLQ; Cunningham et al., 2000), and a structured diary (Alanko, Svedström-Oristo, Peltomäki, Kauko, & Tuomisto, 2014) that included a body image questionnaire (Kiyak, West, Hohl, & McNeill, 1982; Secord & Jourard,

1953). Participants in the control group filled in the same questionnaires and diaries excluding the SCL-90. Study II assessed patients' psychosocial well-being at phase T0, before treatment. Patients' results in SCL-90 were compared to national values (Holi, Sammallahti, & Aalberg, 1998; Holi, 2003). Results of other questionnaires were compared to controls' results at the corresponding time point. In Study III, patients' results at different phases were compared to their own corresponding results at other phases. Patients' results at T5 were also compared to controls' results at the corresponding time point.

3.2.4 Assessment of dental appearance

In Study II, patients graded their own dental appearance on a scale from 1 to 10. The scale was anchored with photographs representing grade 1 (good occlusion, no treatment need) and grade 10 (extremely deviating occlusion, definite treatment need) in the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN; Brook & Shaw, 1989). Patients' subjective evaluations were used to group patients into two groups. In the first group, patients evaluated their dental appearance with grades 1–4, which, in accordance with the AC of the IOTN were interpreted to indicate no orthodontic treatment need; and in the second group with grades 5–10, which were interpreted to indicate either borderline or definite treatment need based on aesthetics. Patients' dental appearance was also assessed with the AC of IOTN by an orthodontist who was well trained in applying this method.

3.2.5 Systematic literature review

In Study I, suitable research articles were searched in PubMed, PsycINFO, and Web of Science in collaboration between two reviewers (see Table I, Study I for list of search terms). Included articles were written in English and published between January 2001 and June 2009. Exclusion due to type of treatment (e.g., surgically assisted rapid maxillary expansions, rhinoplasties combined with orthognathic surgery), or patient group (e.g., patients with clefts or tumors) was carried out in collaboration between two researchers. In total, 35 articles were included in the review.

3.2.6 Statistical analysis

In Study II, patients' and controls' results were compared with the Mann-Whitney U-test or the independent samples t-test. Psychosocial well-being in groups with AC 1–4 and AC 5–10 were compared with the Mann-Whitney U-test. Name calling and bullying experiences according to self-perceived dental appearance were cross-tabulated and significance was calculated with the Fisher exact test. The Spearman rank correlation coefficient was used to compare patients' self-evaluated dental appearance with orthodontist's evaluation of dental appearance. Comparison of the diary variables between work days and days off work were carried out with the Wilcoxon signed rank test. These analyses were performed with IBM SPSS Statistics, version 21.0. Generalized linear mixed modeling was used to analyze effects of psychosocial well-being results obtained by questionnaires on daily emotion variables. Analyses were carried out with the SAS System for Windows, version 9.3.

In Study III, general linear modeling was used to detect changes in patients' well-being during the treatment process. Comparison of results between two chosen time points was carried out with the paired samples t-test. The Mann-Whitney U-test was used to compare patients' and controls' scores. IBM Statistics version 22.0 was used in the analyses.

Effectiveness of orthodontic-surgical treatment was evaluated for the summary of the thesis by calculating the difference between patients' mean scores and dividing it with the standard deviation of the earlier treatment phase (T0/T2), a method that has been proposed for calculating effect size for repeated measures data (Morris & DeShon, 2002). IBM Statistics version 22.0 was used in the analyses.

4 RESULTS

4.1 Patients' motivation and reasons for treatment

According to the systematic review (Study I), several factors motivated patients to seek treatment. Ranges in percentages of patients reporting specific reasons were wide. Overall, patients reported motives related to function, appearance, self-esteem and self-confidence as well as social issues (Table 1).

Table 1. Motivating Factor Groups and Factors for Treatment

Function	
Functional reasons, unspecified	33–60%
Occlusion	71–94%
Chewing and eating	23–81%
Health reasons	
Future oral health problems	27–70%
Speech	12–68%
General health	3–44%
Pain in the head region	5–43%
Temporomandibular joint problems	27–30%
Prevention of future oral health problems	27–70%
Esthetics	
Esthetic reasons, unspecified	30–96%
Facial appearance	11–95%
Dental appearance	11–89%
Smile	65%
Psychosocial reasons	
Self-confidence	68–85 %
Other social reasons	5–69 %
Self-esteem	38 %

4.2 Psychiatric symptoms

Figure 2 shows the SCL-90 subscale scores at different phases of treatment. The figure illustrates an increase in psychiatric symptoms from before treatment (T0) to application of fixed orthodontic appliances (T2) after which the symptoms slowly decrease. The increase of symptoms from before treatment (T0) to application of fixed appliances (T2) as well as the decrease from application of fixed appliances

(T2) to one year after surgery (T5) was significant in the general symptomatic index (Study III, Table III).

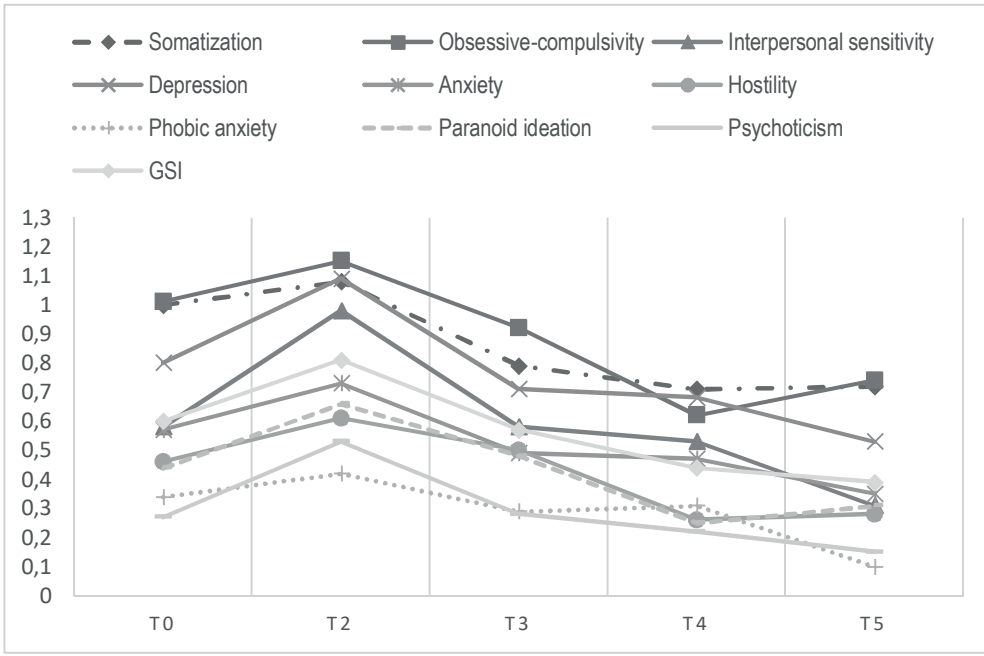

Figure 2. SCL-90 subscale scores at different treatment phases for patients participating in T5.

4.2.1 Depressive symptoms

According to the systematic review (Study I), studies using standardized questionnaires of depressive symptoms did not generally report depressive disorders either before or after treatment, but with other questionnaires the percentages of patients suffering from postsurgical low mood or depression ranged from 17% to 52%.

In Study II, before treatment 40% of patients had scores at or above the Finnish national threshold. During treatment (Study III; Figure 1), a significant change in depressive symptoms emerged. However, the increase was only significant from pre-treatment (T0) to placement of fixed appliances (T2), and the decrease was significant from placement of fixed appliances (T2) to one year after surgery (T5).

No change in depressive symptoms from pre-treatment (T0) to one year after surgery (T5) was found.

4.2.2 Anxiety symptoms

Results regarding anxiety are analogous to those of depression. In the systematic review, on standardized questionnaires patients were not found to have higher scores than controls or the population in general. On other questionnaires, 40% of patients had preoperative anxiety (Study I).

In the baseline study (Study II), 28% had anxiety scores at or above the Finnish national threshold before treatment. In Study III (Figure 1) a significant decrease from pre-treatment (T0) to one year after surgery (T5) was found.

4.3 Self-esteem

According to previous research in the systematic review (Study I), self-esteem of orthognathic patients was equal to controls' self-esteem both before and after treatment when evaluated with standardized questionnaires of self-esteem. This was also seen in the present sample with regard to self-esteem before treatment (Study II), and one year after surgery (Study III). However, patients' self-esteem did change during treatment, and was significantly lower after application of fixed appliances, but returned to pre-treatment level as treatment proceeded (Figure 3).

4.4 Psychological flexibility

Before treatment, patients' psychological flexibility did not differ from that of controls' (Study II). Psychological flexibility decreased from pre-treatment (T0) to application of fixed orthodontic appliances (T2), but returned to pre-treatment level one year after surgery (T5) (Study III), as seen in Figure 3.

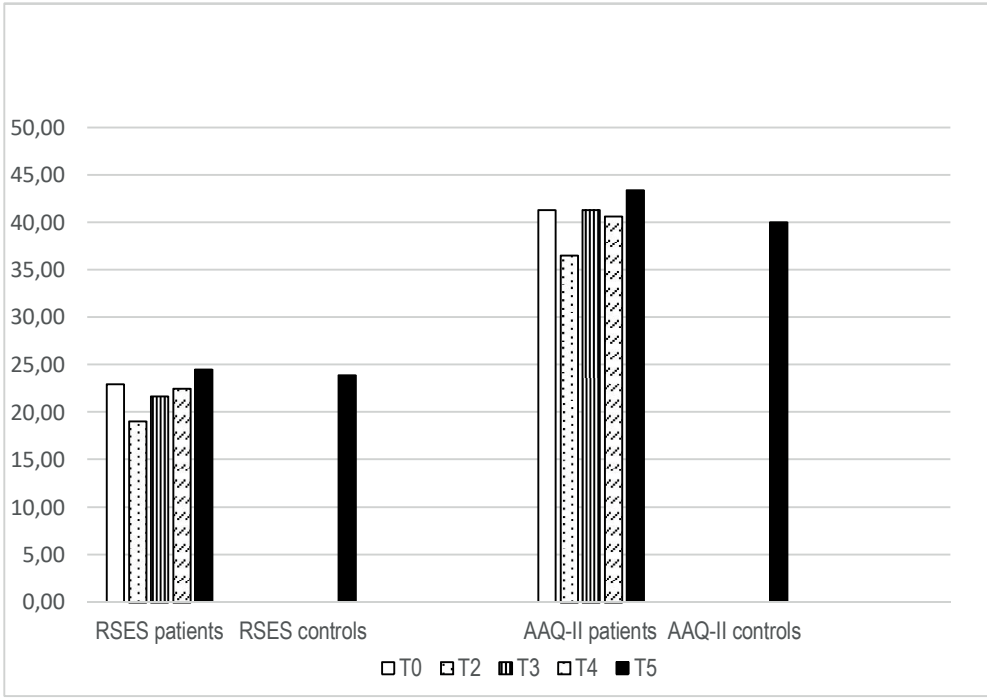

Figure 3. RSES and AAQ-II for patients included in T5 at different time points and for controls at T5.

4.5 Body image

The systematic review shows that prospective orthognathic patients were less satisfied with their facial appearance than others, but their satisfaction increased during treatment. With regard to overall body image, patients' satisfaction did not differ from others. In the present study, 17% of the patients gave their dental appearance a grade of 1 to 4, indicating no orthodontic treatment need, while 33% of the patients gave their dental appearance a grade of 5 to 10 on the same scale, indicating a borderline or definite treatment need based on aesthetics (Study II). On the questionnaire measuring body image and facial body image satisfaction, patients were less satisfied than controls on both aspects (Study II). Further analyses revealed that body image and facial body image were lower than those of the controls only in the patient group that gave their dental appearance a grade of 5 to 10. No change in body image from before treatment (T0) to application of fixed orthodontic appliances (T2) was found, but a significant improvement in both body and facial

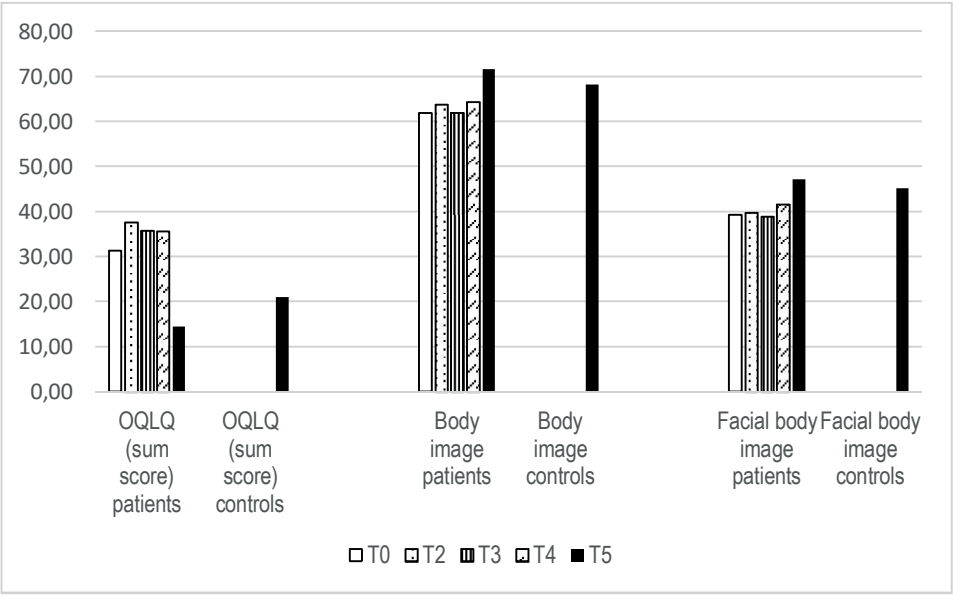

Figure 4. OQLQ sum score, body image, and facial body image for patients included in T5 at different time points and for controls at T5.

as seen in Figure 4. One year after surgery patients and controls had equal body image and facial body image.

4.6 Quality of life

It was found that the quality of life of orthognathic patients has been assessed with generic health measures, oral health measures, and condition-specific measures (Study I). With generic health-related quality of life measures, no change was detected during treatment, while with both oral health- and condition-specific measures, patients' quality of life was found to improve during treatment.

In the present sample, patients' quality of life before treatment with regard to social aspects was equal to that of controls', but worse with regard to facial aesthetics, awareness of dentofacial aesthetics, and oral function (Study II). Patients' oral function deteriorated after placement of fixed orthodontic appliances (T2), but improved from placement of appliances (T2) to one year after surgery (T5). Facial aesthetics, awareness of dentofacial aesthetics, and social aspects of dentofacial deformity did not change from before treatment (T0) to placement of fixed orthodontic appliances (T2), but did improve from placement of orthodontic

appliances (T2) to one year after surgery (T5). The improvement from before treatment (T0) to one year after surgery (T5) was also significant with all subscales of the OQLQ (Study III). Figure 4 illustrates the sum scores at different time points and Figure 5 illustrates the changes in mean scores of the OQLQ subscales. This figure shows that the change from application of fixed appliances (T2) to one year after surgery (T5) was not stable. Instead, the scores seem to be stable from application of fixed appliances (T2) to 6 weeks after surgery (T4), after which a significant drop in scores (indicating a higher quality of life) to one year after surgery (T5) occurred. Patients who rated their dental appearance as worse had lower orthognathic quality of life overall (Study II). Figure 6 illustrates the changes in OQLQ scores at different treatment phases for patients with subjective AC-grades 1–4 (no treatment need) and with grades 5–10 (borderline or definite treatment need) for the patients included in Study III. The trajectories for these two groups seem to differ: while those with borderline or definite treatment need experience a deterioration in quality of life from T0 to T2 and improvement thereafter, those with no treatment need experience a deterioration from T0 until T4 and improvement from T4 to T5. One year after surgery patients did not differ from controls with regard to oral function and facial aesthetics, while patients had even better quality of life with regard to social aspects of dentofacial deformity and awareness of dentofacial aesthetics.

4.7 Bullying and daily emotions

Studies included in the systematic literature review showed that many patients had been called names and bullied before treatment, but after treatment less bullying occurred (Study I). In the present sample, 12% of patients had been called names and 15% bullied (Study II). One year after surgery, only one patient out of 20 (5%) reported bullying (Study III).

Before treatment (Study II), especially in the morning, patients felt more negative emotions compared to the controls. During the day, patients felt they received less positive and more negative attention than the controls. Experiencing psychiatric symptoms in greater amounts also was associated with increases in the amounts of negative emotions in patients, and with decreases in feeling satisfied or happy. As a whole, patients did not experience changes in the intensity of their daily emotions during treatment (Study III).

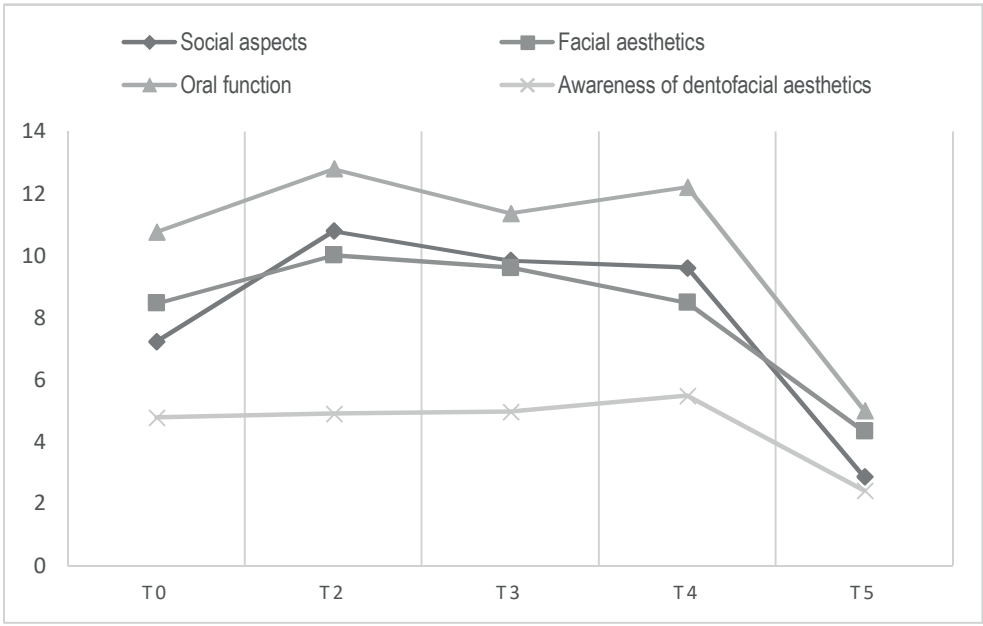

Figure 5. OQLQ subscale mean scores at different treatment phases for patients participating in T5. Lower scores indicate higher quality of life

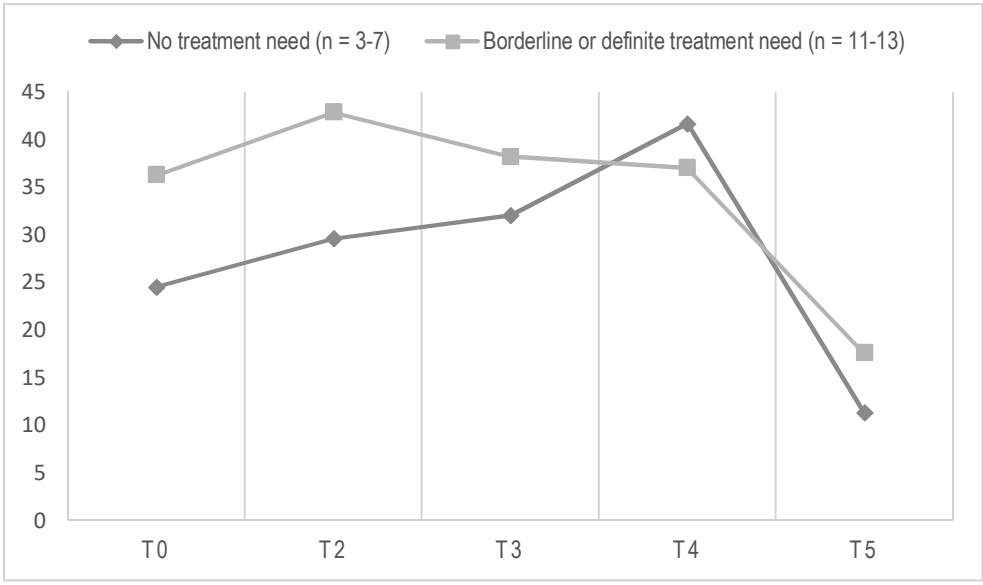

Figure 6. Patients' subjective evaluation of dental appearance and orthognathic quality of life sum score means at different treatment phases. Number of patients in parentheses.

4.8 Effectiveness of treatment

With regard to OQLQ sums score, oral function, facial aesthetics, facial body image, and body image, the effect sizes between time points T0 and T5 are large. Medium effect sizes are found between time points T0 and T5 in social aspects of dentofacial deformity and awareness of dentofacial aesthetics, while small effect sizes are found between the same time points for self-esteem, psychological flexibility, and general symptomatic index of the SCL-90.

Table 2. Effect Sizes for Psychosocial Measures

Measure	Effect size T0-T5	Effect size T2-T5
OQLQ Sum score	(31.38-14.50)/20.71 = 0.82	(37.67-14.50)/24.71 = 0.94
OQLQ Social aspects of dentofacial deformity	(7.23-2.86)/8.29 = 0.53	(10.79-2.86)/10.55 = 0.75
OQLQ Oral function	(10.76-5.00)/4.73 = 1.22	(12.79-5.00)/5.44 = 1.43
OQLQ Facial aesthetics	(8.45-4.23)/4.39 = 0.96	(10.00-4.23)/6.52 = 0.88
OQLQ Awareness of dentofacial aesthetics	(4.77-2.41)/4.10 = 0.58	(4.89-2.41)/4.62 = 0.54
Body image	(61.98-71.67)/12.35 =- 0.78	(63.85-71.67)/14.33 = -0.55
Facial body image	(39.34-47.21)/7.98 =- 0.99	(39.75-47.21)/9.59 = -0.78
RSES	(22.95-24.50)/5.71 = -0.27	(19.11-24.50)/7.70 = -0.70
AAQ-II	(41.36-43.41)/9.02 = -0.23	(36.59-43.41)/10.90 = -0.63
SCL-90 General symptomatic index	(53.68-34.96)/50.61 = 0.37	(70.37-34.96)/64.78 = 0.55

OQLQ = Orthognathic Quality of Life Questionnaire; RSES = Rosenberg Self-Esteem Scale; AAQ-II = Acceptance and Action Questionnaire II; SCL-90 = Symptom Checklist-90

5 DISCUSSION

This study has explored changes in psychosocial well-being of orthognathic patients and compared patients' well-being to that of controls. All patients included in the study had been referred for evaluation of orthognathic treatment need to two university hospitals. The control group consisted of adults not in need of orthognathic treatment but who attended a routine examination of oral health in the beginning of their university studies. Participation in the study was voluntary.

There are four main findings to this study. First, in some aspects, prospective orthognathic patients of the present sample do not seem to differ from young adults who are not in need of treatment. In detail, at group level, patients' self-esteem and psychological flexibility did not differ from those of the controls. In contrast, at group level, orthognathic patients' quality of life in general and body image were worse than those of the controls. However, within the group of orthognathic patients, only those who rated their dental appearance as worse had lower body image and orthognathic quality of life than controls. The rest of the patients only differed from the controls with respect to oral function-related quality of life. This is an important finding, since it has been suggested that dentofacial deformities affect patients' psychosocial well-being in many ways. According to our results, however, some patients cope well.

Second, as expected based on the systematic literature review, patients' psychosocial well-being improved in the examined sample from before treatment to one year after surgery. This was the case with orthognathic quality of life, body image, and facial body image as well as many of the psychiatric symptoms, but not with self-esteem and psychological flexibility. These results are in line with previous studies where improvement has been found in depression (Brunault et al., 2016; Kim, Kim, Shin, Chun, & Kim, 2009), and orthognathic quality of life (Catt et al., 2018; Choi et al., 2010; Emadian Razvadi et al., 2017; Palomares et al., 2016; Silva et al., 2016; Soh & Narayanan, 2012; Sun et al., 2018). However, in the present study, improvement in anxiety was found (Study III), which contradicts the results of Brunault et al. (2016), according to which orthognathic treatment did not improve anxiety. Orthognathic treatment did not improve self-esteem (Study III), but

according to the results of Study II, self-esteem had not been lower in patients compared to controls before treatment either.

Third, in this study, orthognathic treatment seemed to diminish the gap in psychosocial well-being between patients and controls. As a result of improved psychosocial well-being during treatment, at the end of the treatment, patients' orthognathic quality of life was comparable to that of controls, or even better than controls' with regard to social aspects and awareness of dentofacial deformity. Also psychological flexibility was better among patients than controls. In a recent study by Sun et al. (2018), patients' overall orthognathic quality of life was equal to that of controls. On social aspects and facial aesthetics, patients and controls did not differ, but on oral function and awareness of dentofacial aesthetics, patients' quality of life was lower. Thus, compared to the results of Sun et al. (2018), the results of the current study are more encouraging.

Fourth, in the current study changes in domains of psychosocial well-being did not improve linearly. Rather, in most aspects well-being decreased from before treatment to beginning of orthodontic treatment. Thereafter the situation gradually improved. This is important with regard to psychological preparation of patients but also for the selection of the baseline in future studies.

Although the results of this study are positive at group level, an examination of the range of results reveals that not all patients experienced improvements in their psychosocial wellbeing. This can be seen in both negative and positive values in Table III of Study III. As noted by Øland et al. (2010a), some patients experience a clinical and/or subjective deterioration in oral function during treatment, and the results in the current study regarding condition-specific quality of life show that actually, for some patients, quality of life deteriorates from before treatment to one year after surgery (Study III), depicted in increased quality of life scores from T1 to T5. Adverse effects are also found regarding body image, self-esteem, psychological flexibility, and psychiatric symptoms. Thus, patients react very differently to their dentofacial discrepancies and their treatment. This might be due to a number of reasons. Thompson and Kent (2001) have summarized results regarding psychological distress and disfiguring conditions. However, as dentofacial deformities have other effects as well, their model may not be fully applicable with orthognathic patients. In their article, reasons for individual variation in adapting to disfigurement were grouped into clinical severity and visibility, demographic characteristics, social support, and coping strategies, of which demographic and physical factors were considered less important. With regard to clinical severity and visibility, it could be expected, that patients with more noticeable visible

disfigurements would experience greater levels of distress, but results are contradictory. In studies with orthognathic patients, the type of malocclusion has been associated with quality of life and depression. Angle Class III patients have been shown to have higher levels of depressive symptoms than Class II patients before surgery, while after surgery symptoms have been found to be significantly lower for Class III, but not for Class II patients (Takatsuji et al., 2015). In a longitudinal study by Baherimoghaddam et al. (2016) with Class II and Class III patients, Class III patients experienced a decrease in psychological discomfort, and psychological disability from baseline to just before surgery, as well as from baseline to 12 months after debonding. Class II patients, however, experienced an increase in psychological disability from baseline to just before surgery, but at 12 months after debonding it was lower than at baseline. On the other hand, the patterns of change were identical for Class II and Class III patients regarding functional limitation and physical disability: both patient groups experienced a worsening from baseline to just before surgery, after which the situation improved. As noted in the recent study by Tachiki et al. (2018), changes in different aspects of quality of life probably depend on the type of malocclusion, but also on the social surroundings, as in different ethnic groups certain types of malocclusion are more common than others.

Although all patients in our sample had skeletal and dental deviations that required orthognathic treatment, not all patients had lower orthognathic quality of life than controls, with the exception of functional aspects. Furthermore, the objectively defined treatment need based on dental appearance, did not differentiate between patients with lower or higher self-esteem, facial and body image, or orthognathic quality of life. These results indicate, that patients' adaptation to their condition is explained by other reasons than the objectively defined severity of their condition. The differences in adaptation to disfigurement may be explained by differences in coping skills as proposed by Thompson and Kent (2001). Orthognathic patients have been found to use avoidance and modifying behaviour to minimize the impact of their dentofacial deformity (Ryan et al., 2012). Avoidance included avoiding seeing or thinking about the defect, not smiling, and not eating in public, to name a few. Patients used a wide range of altered behaviors, such as covering their mouth to hide the teeth, not biting together to hide their bite, and purposefully ruining photographs. Some patients have reported avoiding information regarding subsequent stages of treatment or have decided not to prepare themselves (Liddle et al., 2018). Avoidance may, however, worsen the psychological distress (Thompson & Kent, 2001). Lastly, social support may affect psychological adjustment (Yao et al., 2014). Patients valued highly the support from family and

friends in the decision-making process (whether or not to commence treatment), and in the postsurgical period (Liddle et al., 2018).

In this study, patients' satisfaction with their treatment result was not assessed. However, as the results described in Table III in Study III suggest that some patients experienced a deterioration in orthognathic quality of life, body image, self-esteem, or psychological flexibility, it could be anticipated that not all patient were satisfied. In the paper by Moon and Kim (2016) factors associated with postoperative dissatisfaction were unanticipated postsurgical events, unrealistic expectations, lack of emotional preparation, insufficient explanation of the surgical experience, poor coping mechanisms for stress, significant pain, and inadequate support from others. Many of these factors could be avoided with sufficient psychological support during treatment. Adjusting to changes in appearance is a process and at first patients may feel that adjusting is difficult and question their decision to commence treatment (Liddle et al., 2018). Satisfaction with patient-clinician communication has also been associated with overall satisfaction with surgery (Kufta, Peacock, Chuang, Inverso, & Levin, 2016). However, as an example, 81% of British consulting orthodontists had had no education in psychological assessment or management, whilst 85% felt they would benefit having instruction in this area (Juggins, Feinmann, Shute, & Cunningham, 2006). It has also been suggested, that all orthognathic or cosmetic dentistry patients should undergo psychological screening in order to identify patients who would benefit from psychological support during treatment (Honigman et al., 2011; Yu et al., 2013). Approximately 95% of orthognathic patients view referral to a psychologist or a psychiatrist positively (Ryan, Shute, & Cunningham, 2009).

As patients with the most severe facial deformities have been found to experience more anxiety and emotional instability than patients with less severe facial deformities (Kovalenko et al., 2012), they also need more support during treatment. Even if poorer psychological well-being is related to severity of deformity, high levels of anxiety and emotional instability should not be the sole reasons for postponing orthognathic treatment. On the other hand, significant depression prior to surgery has been found to be associated with poorer outcomes regarding quality of life, and the majority of patients, who are depressed before surgery also are depressed postsurgically. Consequently, patients may benefit from interventions targeting depression (Brunault et al., 2016). Decisions regarding postponing treatment must be made individually. More multidisciplinary team work is needed in order to support patients. Clinicians could also benefit from using structured questionnaires, such as the OQLQ, prior to treatment, as they effectively inform clinicians of patients'

concerns (Song & Yap, 2016). Psychological support for patients could also be beneficial in the process of adjusting to changes in appearance, as many patients find it distressing (Liddle et al., 2018). Understanding the risk factors for poorer postoperative outcome is important from the standpoint of offering patients the treatment and support they need.

5.1 Methodological aspects

The results of the current study seem quite straightforward: before treatment patients' psychosocial well-being is lower than the controls' in some aspects, but improves during treatment, and after treatment is at least equal to that of controls. However, a closer examination reveals a number of caveats. First of all, although the present study found statistically significant improvements in many measures, are these changes clinically important in patients' lives? In previous studies of quality of life but with cancer and oral ulcer patients, a 5–10% change in the instrument range has been suggested to be clinically significant (Hayran, Mumcu, Inanc, Ergun, Direskeneli, 2009; John, Reissman, Szentpétery, & Steele, 2009; Ringash, O'Sullivan, Bezjak, & Redelmeier, 2007). In this prospective study, the change in the orthognathic quality of life scores was larger than the suggested percentage, which in the case of OQLQ would be 4–9 points. With regard to effect sizes, in the present sample, the largest effect sizes from before treatment to one year after surgery were found for oral function, facial aesthetics, and facial body image, while the effect sizes regarding measures of self-esteem, psychological flexibility, and the general symptomatic index of the SCL-90 were small.

In previous studies, orthognathic treatment has been found to improve different aspects of quality of life, as described above. However, according to the results of Study III and the results of Johal et al. (2015), patients' quality of life decreases after the beginning of orthodontic treatment. In the previous studies (e.g., Brunault et al., 2016; Emadian Razvadi et al., 2017; Kurabe et al. ,2016) the baseline measures were obtained before surgery, but the time frame was not described in detail, and in the study by Murphy et al. (2011), baseline measures were collected during the presurgical orthodontic treatment. Therefore, it is possible that the baselines of these studies were not "true" baselines (Liddle et al., 2015). Thus, the results of previous studies may not reveal whether quality of life improves from pretreatment levels. The inspection of effect sizes stresses the importance of baseline selection: For

example, with regard to self-esteem and psychological flexibility, larger effect sizes in the present sample would have been obtained if the baseline had been chosen to correspond to T2. On the contrary, effect sizes regarding for example, body image and facial body image, would in that case have been smaller.

One possible reason for the discrepancies between the current and others' results may be related to study design, i.e., prospective studies vs. cross-sectional or retrospective studies. However, also the cross-sectional results of Palomares et al. (2016) suggest, that both condition-specific and oral health-related quality of life are better in patients treated for their dentofacial discrepancies than in patients not yet treated. Furthermore, the differences in results may be related to selection criteria for orthognathic treatment. In Finland, criteria for orthognathic treatment within public healthcare emphasize functional aspects. Thus, patients who are mainly concerned about their appearance are not included in our sample.

As noted in Study I, appearance is an important factor in orthognathic treatment. Indeed, the results of Study II suggest that self-perceived dental appearance differentiates patients into groups of lower and higher quality of life. However, this was not the case with objectively assessed dental appearance that could not differentiate patients as well as subjective assessments. It may also be, that the wide range of results reported in Study III, could to some extent be explained by the differences in self-perceived dental appearance reported in Study II. Unfortunately, the smaller number of patients in the last data collection point limited further analyses.

5.2 Strengths and limitations

The main strength of this study relates to the prospective study design with controls. Especially prospective studies of self-esteem and body image that include both orthognathic patients and controls are lacking. Therefore, these results bring new information about changes in self-esteem during treatment.

Secondly, the current study patients' experiences were collected through diaries. To present knowledge, (in addition to the current study), only the study by Phillips et al. (2008) has gathered data using diaries. Patients' responses to the questions in the diaries are thought interpreted to reflect their current states, whereas in questionnaires patients typically have to assess their well-being retrospectively. In the current study, as a whole, no differences in daily emotion intensities were found,

although the questionnaires used in the current study detected changes. A recent model of personality traits (Roberts, 2018) points out that responses to these global measures are affected by one's mood, and suggests that continuous assessment of states is preferable instead of retrospective questionnaires. Another recent article suggested that sustainable improvements in daily affect should not be expected following orthognathic treatment, as people tend to adapt to changes in their life circumstances, and the benefits of these changes on psychological well-being are thus short-term (Ashton-James & Chemke-Dreyfus, 2019). In the future, diaries should be used more frequently in studies on orthognathic patients in order to add our understanding of these issues. Moreover, application of general measures of well-being, in addition to condition-specific measures increases knowledge on whether improvements in condition-specific measures have an effect on well-being in general.

However, this study also has its limitations. A considerable number of patients dropped out after baseline measures thus reducing the sample size. Due to the small number of respondents in the last data collection phase, it was not possible to conduct analyses on how patients' pretreatment status affected psychosocial outcomes of treatment. In addition, the patient sample mainly consisted of females, which is a limitation of the study, albeit most orthognathic patients being female. Furthermore, the gender distributions among patients and controls differed, as the proportion of females was larger in the control group, and the patient group included older subjects than the control group. Therefore the control group was not ideal in terms of gender and age. The rationale for selecting first-year students as a control group relates to them being easier to contact, as their contact details, including their email address, stay the same for several years until they graduate. As the students attended an examination of oral health, they represent oral health service users, which the patients are as well. In addition, with regard to the questionnaires, it has been suggested that the AAQ-II may be a more valid measure of psychological distress than of psychological flexibility (Wolgast, 2014). In this study, the change in AAQ-II followed the overall trend of psychological well-being of patients. However, to our knowledge, AAQ-II has not been used in other studies on orthognathic patients, thus our results offer new information on how patients cope with their distressing thoughts and on the impact of these thoughts on their behavior. Domain-specific psychological flexibility questionnaires are available as well, and could be utilized in the study of orthognathic patients, although to our knowledge, no specific measure for dentistry patients has been created.

5.3 Conclusions

This study supported earlier findings of positive effects of orthognathic treatment on patient well-being. Although patients have reported many motivators for treatment, in the current study oral function seemed to be a central problem for patients. Aesthetics has been reported as another common motive, and it was a central factor that divided patients into groups of lower and higher psychosocial well-being. Orthognathic treatment seemed to improve the psychosocial well-being of patients, but the changes did not occur linearly. After treatment patients had no problem areas in their psychological well-being compared to the controls.

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PUBLICATIONS

PUBLICATION I

Patients' Perceptions of Orthognathic Treatment, Well-Being, and Psychological or Psychiatric Status: A Systematic Review

Alanko, O., Svedström-Oristo, A.-L., & Tuomisto, M. T.

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PUBLICATION II

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