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ORIGINAL ARTICLE

Comparing oral health-related quality of life, oral function and orofacial aesthetics among a group of adolescents with and without malocclusions

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ABSTRACT

Objective: The aim was to analyze how malocclusion relates to perception of oral health-related quality of life (OHRQOL), oral function and orofacial aesthetics among a group of adolescents in Sweden.

Material and methods: Thirty patients with a need for orthodontic treatment (IOTN-DHC grade 4 and 5) and 30 patients with normal occlusion (IOTN-DHC grade 1), aged 13–17 years, were included in the study. A questionnaire containing three parts was used; The Oral Health Impact Profile (OHIP-S14), Jaw Functional Limitational scale (JFLS-20) and Orofacial Aesthetic scale (OES). Malocclusions, orthodontic treatment need and confounders, such as earlier dental treatment and temporomandibular disorders, were registered.

Results: Adolescents with malocclusions were more often embarrassed by their mouth and teeth compared to controls ($p < .05$). Aesthetically, adolescents with malocclusions were more negatively affected by the appearance of the mouth and teeth as well as the over-all facial appearance ($p < .05$).

Conclusions: Malocclusions clearly affects the adolescents with need for orthodontic treatment in this study. It influences their OHRQOL in the psychosocial impact dimension. Aesthetically they perceive their oral and facial appearance as worse compared to controls. Although embarrassed and unpleased with their oral appearance they still rate themselves as having a good oral health with low jaw function limitations.

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Introduction

The prevalence of different types of malocclusions among Swedish school children varies between 71% and 74% and need for orthodontic treatment can vary from mild to severe according to different orthodontic indices [1,2]. Some malocclusions can self-correct in early age groups whereas other seem to worsen when the individuals change from primary to early permanent dentition [1]. In Sweden, the dental healthcare system entitles all children and adolescents from birth to 23 years of age free-of-charge dental care for prophylactic, restorative and orthodontic treatment if there is a need for treatment. The dental health component of the Index of orthodontic treatment need (IOTN-DHC) is widely used to determine the severity of the malocclusion and the need for orthodontic treatment [3]. However, IOTN-DHC does not take into consideration how the malocclusion affects the patient's quality of life and psychosocial well-being and it has been shown that perception of these can differ between the orthodontist and the patient [4,5]. Objective outcome, according to these specific indices, does not always correlate to the patient's subjective perception [6–8]. In order to evaluate how oral health affects the patient's quality of life, different health measurements scales and questionnaires has been developed.

A previous study undertaken on Swedish adolescents, aged 13 and 14, found that patients with malocclusions and need or great need for orthodontic treatment (according to IOTN-DHC grade 4 and 5) are affected by their condition and are repeatedly reminded about it [9]. However, Dimberg et al. [10] found limited and inconsistent impact on oral health-related quality of life (OHRQOL) in relation to malocclusion and orthodontic treatment need, when evaluating younger patients. It could be possible that awareness of malocclusion and oral aesthetics rises and becomes more important with age. In contrast, another study found that young children with excessive overjet expressed worse OHRQOL compared to children with unilateral posterior crossbite as well as children with normal occlusion [11]. A recent systematic review reported that there is high quality evidence that malocclusion has an impact on OHRQOL in adolescents and children. It is reported to particularly affect the emotional and social well-being when the malocclusion is expressed in the aesthetic zone [12]. Recent systematic reviews also concluded there is some (low to moderate) evidence that orthodontic treatment positively affects the OHRQOL in adolescents, as well as adults and that individuals without malocclusions

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have a higher OHRQOL than those with malocclusions and a need for orthodontic treatment [13,14]. Many studies on how malocclusion affects the OHRQOL are made on non-European adolescents [12]. Due to cultural differences, it is important to determine the impact of malocclusions on Scandinavian adolescents. Currently, only a handful of studies of Swedish children and adolescents have been performed [9–11]. Our study was designed to be conducted on adolescents and cover the aspects of self-perceived OHRQOL as well as jaw function and orofacial aesthetics.

The aim of this study was to analyze how malocclusion among a group of adolescents in Sweden relates to perception of OHRQOL, oral function and orofacial aesthetics compared to a matched group with normal occlusion.

Materials and methods

Subjects

Seventy-three patients from the city of Eskilstuna, Sweden, were consecutively invited to participate in the study. Inclusion criteria for the malocclusion group were adolescents in the permanent dentition, between 13 and 19 years of age, with need and great need for orthodontic treatment (grade 4 and 5) according to IOTN-DHC [3]. Inclusion criteria for the control group were adolescents in the permanent dentition between 13 and 19 years of age, demonstrating normal occlusion with no orthodontic treatment need (grade 1) according to IOTN-DHC. Exclusion criteria were craniofacial syndromes, subjects currently undertaking orthodontic treatment, subjects who had previously undergone orthodontic treatment or were unable to read or understand Swedish.

Of the 73 patients invited, one subject in the malocclusion group, and four subjects in the control group chose not to participate. The mean age in the initial study sample were significantly higher in the control group compared to the malocclusion group. The main reason for this age difference was by the time the patients in need of orthodontic treatment reached the age of 18, their orthodontic treatment had already commenced, and they could therefore not be invited to participate in the study. To be able to make an adequate statistical analysis with two comparable groups, all subjects older than 18 years of age ($n = 11$) were excluded. In order to meet the power analysis calculation an additional three subjects were invited to participate and included in the data analysis (Figure 1). The final study sample comprized of a malocclusion group of 30 subjects with a mean(SD) age of 14.8(1.6) years and a control group of 30 subjects with a mean(SD) age of 14.6(1.3) years as described in Table 1.

The subjects were consecutively screened during their yearly dental examination. The orthodontic treatment need was determined using the IOTN-DHC which divides the treatment need in to five grades (1- none, 2- little, 3- moderate, 4- great, 5- very great) [3]. Subjects with great and very great need for treatment were referred to an orthodontic treatment centre without being on a waiting list and they were invited to participate in the study before orthodontic treatment commenced. The malocclusions were determined by using a method originally evolved by Bjoerk et al. [15] examining sagittal, vertical and transversal occlusion as well as space discrepancies and single tooth anomalies.

Subjects and their parents were verbally informed about the study and a consent form was signed by the patient, as well as the parent if the patient was under the age of 15. Subjects answered the questionnaire at the dental or orthodontic clinic respectively. The examiner was the same person collecting data for the control- and malocclusion group. The subjects received the same information, and the confounders were measured by the same person. Data collection took place between November 2017 and August 2020.

Prior to data collection, the study protocol was approved by the Ethical Review Board in Stockholm and the consent

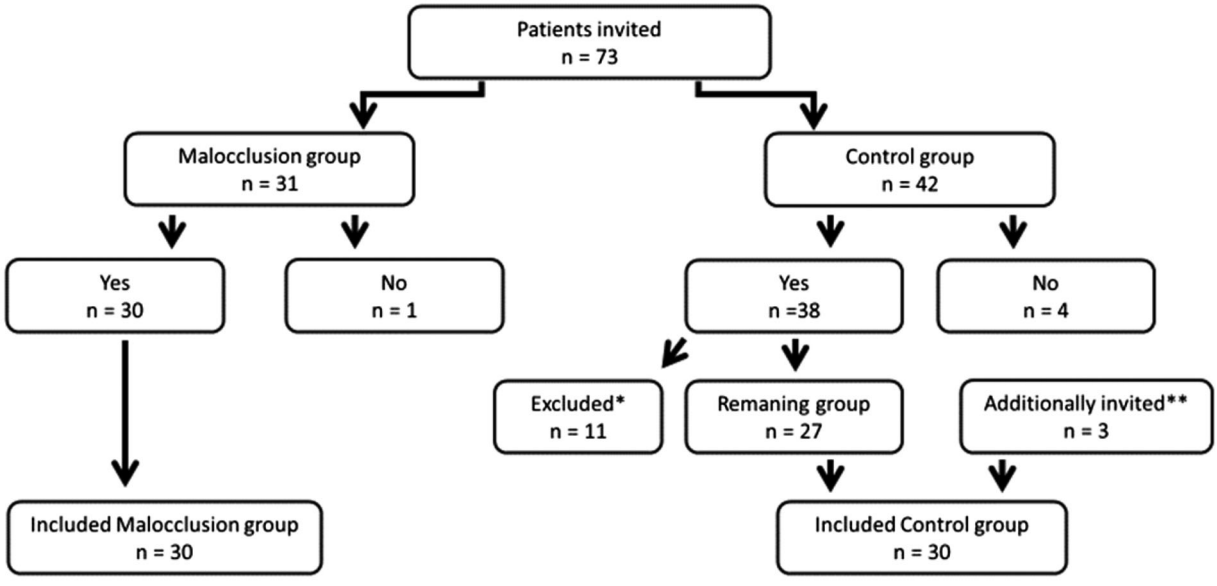

Figure 1. Flowchart describing study sample formation.

Table 1. Descriptive data for the malocclusion group and the control group respectively.

	Malocclusion group			Control group			
	$N = 30$			$N = 30$			
		%	SD		%	SD	*p*-Value
Gender(n)*							
Boys	12	40		15	50		.604
Girls	18	60		15	50		
Age(year)**	14.8		1.6	14.6		1.3	.602
[a]Jaw opening(mm)**	49.6		5.3	49.5		6.5	.948
[b]Pain*							
no	30	100		30	100		
yes	0	0		0	0		
[c]DMFT**							
0	20	66.7		16	53.3		.284
1–6	9	30.0		13	43.4		
10–12	1	3.3		1	3.3		

[a]Maximum vertical jaw opening (mm).
[b]Pain from the joints during bilateral palpation.
[c]Decayed, missed, filled teeth index (DMFT).
*Pearson's chi-square test.
***t*-test.

form was obtained before commencing data collection. The questionnaires were kept safe in a locked cupboard. The questionnaires were also unidentified and coded prior to data analysis.

Clinical measures

Clinical examination screened for possible confounders such as decayed, missing and filled teeth index (DMFT) [16], calculated for 28 permanent teeth, as well as temporomandibular disorders by measuring maximal vertical jaw opening (mm) and pain from the masticatory system by bilateral palpation (yes or no).

Questionnaire

The questionnaire consists of three parts: The Oral health Impact Profile (OHIP-14) [17], Jaw Functional Limitational scale (JFLS-20) [18] and the Orofacial Aesthetic scale (OES) [19,20]. Subjects also rated their general health as well as their oral health (i.e. global oral health) on a five step ordinal scale (1- 'excellent', 2- 'very good', 3- 'good', 4- 'quite poor', 5- 'poor') (Supplementary Appendix). Global oral health questions have previously been used with OHIP-14 for validation [21].

OHIP is a method used to measure quality of life related to oral health [22]. OHIP-14, which consists of 14 questions is the shorter version of the questionnaire developed and validated for use in clinical studies [23]. The subjects rate how frequent they have experienced the impact on a 5-point ordinal scale (0- 'never', 1- 'hardly ever', 2- 'occasionally', 3- 'fairly often', 4- 'very often' or 'not applicable' if they did not wish to answer). The instrument measures different aspects of oral health such as oral function (5 item), orofacial pain (1 item), orofacial appearance (1 item) and psychosocial impact (7 item) [24]. The total score can range from 0 to 56, where 56 is the highest score which indicates negative impact on OHRQOL. In this study, we used the Swedish version of the instrument (OHIP-S14) which has demonstrated good reliability and validity [17,25].

JFLS-20 [18] is an instrument used for evaluating functional limitations. It measures mastication, vertical jaw mobility, verbal and emotional expression as well as miscellaneous functions such as swallow food and yawn. This instrument is a 20-item questionnaire which exhibits good reliability and validity and has been shown to be useful in assessing functional limitations of the jaws [18]. Subjects rate their jaw functional limitations on a numeric rating scale (0- 'no limitation', 10- 'extreme limitation'). Total score can range from 0 to 200, where 200 is the highest score which indicates extreme limitations.

OES [20] is an instrument used to evaluate self-perceived orofacial aesthetics and the reliability and validity has been investigated previously [19,26]. The instrument is an eight-item questionnaire which measures aesthetic components such as appearance of the face, facial profile, mouth, alignment, tooth shape, tooth colour and gum as well as a general orofacial aesthetic assessment. Subjects respond on a 0–10 numeric rating scale (0- 'very dissatisfied', 10- 'very satisfied') or mark the answer 'not applicable' if they do not wish to answer. The total score can range from 0 to 70, where 70 is the highest score which indicates very high satisfaction. Subjects were allowed to ask questions if needed but answered the questionnaires on their own.

Statistics

Data from the questionnaires were analyzed using the R. version 3.4.4 software package. Mann-Whitney-Wilcoxon's test was used to analyze non-parametric ordinal data in all three questionnaires, *t*-test was used for parametric data and Pearson's chi-square test was used for categorical data. Spearman's correlation test was used to analyze any correlations between the questionnaires. Power analysis was based on a significant level of $\alpha = .05$ and a power of 80% and gave us a sample size of 29 subjects in each group.

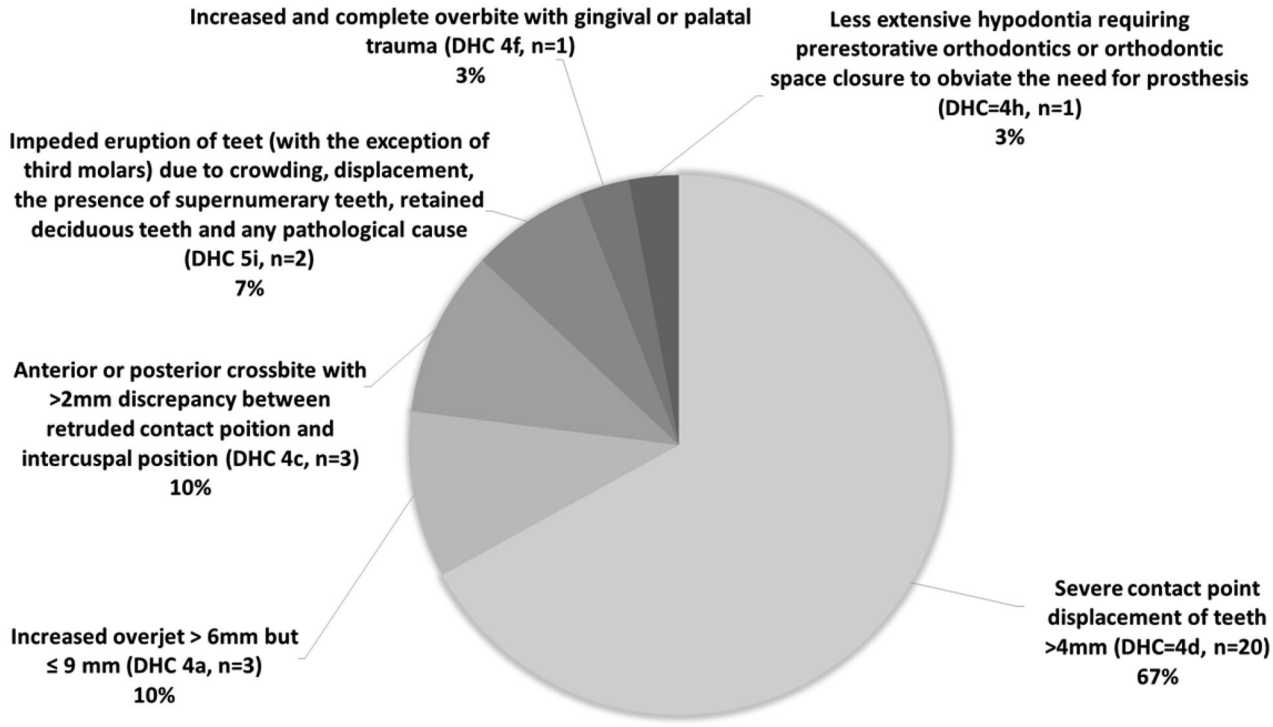

Figure 2. Distribution of malocclusions in the orthodontic group.

Results

The distribution of the malocclusions in the sample group are presented in Figure 2. Subjects had a low record of previous invasive dental care and caries as well as no signs of temporomandibular disorders. Subjects rated their general health and oral health as high with a median score of 2 - 'very good' in the malocclusion and control group. There were non-significant differences between the groups regarding general health or oral health.

Subjects in the malocclusion group and the control group reported low scores (median 5.5 (range 0–34) and 6.0 (range 0–22), respectively) when rating the daily impact on OHRQOL in the first questionnaire (OHIP-S14). A low score indicating good self-perceived OHRQOL (possible range 0–56). There were non-significant differences between the groups comparing total score or the four aspects of OHRQOL; oral function, orofacial pain, orofacial appearance and psychosocial impact. However, subjects in the malocclusion group were more often embarrassed by their mouth and teeth ($p = .017$) compared to subjects in the control group. Also, in the aspect of orofacial appearance and how frequent the subjects had been self-conscious because of their teeth and mouth the malocclusion group were more affected 'fairly often' or 'very often' ($n = 6$) compared to the control group ($n = 1$), although this finding was non-significant ($p = .053$). However, subjects in the control group were more affected in the dimension of oral function and more often felt that food was tasteless ($p = .018$).

JFLS-20 showed non-significant differences between the two groups when comparing total score or the four aspects of limitation: mastication, vertical jaw mobility, miscellaneous functions and verbal and emotional expressions. In general, the malocclusion and control group reported low scores (median 1.0 (range 0–121) and 2.0 (range 0–56), respectively). A low score indicating no functional limitation (possible range 0–200). Mean value for maximal vertical jaw opening was within the normal range for the malocclusion group, mean(SD) 49.6(5.3) mm, and the control group, mean(SD) 49.5(6.5) mm.

Table 2. Orofacial Aesthetic Scale scores for all subjects in the malocclusion group and the control group.

All subjects		Malocclusion group	Control group	
Components	Range	Median	Median	*p*-Value
Face	0–10	7	8	.163
Profile	0–10	7.5	8	.303
Mouth	0–10	4	7	<.001*
Alignment	0–10	3	7.5	<.001*
Shape	0–10	5.5	8	.039*
Tooth colour	0–10	6.5	6	.911
Gingiva	0–10	9	8.5	.390
Total score OES (1–7)	0–70	42.5	52	.009*
Overall impression	0–10	6	8	.005*

A low score indicates low aesthetic satisfaction, and a high score indicates high aesthetic satisfaction. *= statistically significant $p < .05$.

OES showed statistically significant differences between the malocclusion and control group when evaluating their overall impression. Also, the total score of the OES, as well as different aspects of the mouth and teeth, demonstrated statistically significant differences between the malocclusion group and the control group, with the malocclusion group more negatively affected (Table 2). A low score indicating low aesthetic satisfaction. A low score on the OES also showed a moderate correlation to how often the person was embarrassed by his or her mouth in the OHIP-S14 questionnaire ($r = -.44$, $p < .001$). Also, statistically significant differences were shown comparing boys in the malocclusion group

Table 3. Orofacial Aesthetic Scale scores for boys in the malocclusion group and the control group.

Boys Components	Range	Malocclusion group Median	Control group Median	*p*-Value
Face	0–10	7	8	.875
Profile	0–10	8.5	8	.414
Mouth	0–10	4	7	.008*
Alignment	0–10	3.5	7	.013*
Shape	0–10	6	8	.184
Tooth colour	0–10	8	6	.520
Gingiva	0–10	8	8	.747
Total score OES (1–7)	0–70	45	52	.304
Overall impression	0–10	6.5	7.5	.324

A low score indicates low aesthetic satisfaction, and a high score indicates high aesthetic satisfaction. *= statistically significant $p < .05$.

Table 4. Orofacial Aesthetic Scale scores for girls in the malocclusion group and the control group.

Girls Components	Range	Malocclusion group Median	Control group Median	*p*-Value
Face	0–10	6.5	9	.106
Profile	0–10	6	9	.056
Mouth	0–10	4	9	<.001*
Alignment	0–10	3	9	.002*
Shape	0–10	5.5	9	.104
Tooth colour	0–10	4	5	.730
Gingiva	0–10	9.5	9	.442
Total score OES (1–7)	0–70	38.5	59	.017*
Overall impression	0–10	6	9	.008*

A low score indicates low aesthetic satisfaction, and a high score indicates high aesthetic satisfaction. *= statistically significant $p < .05$.

with boys in the control group (Table 3), as well as girls in the malocclusion group with girls in the control group (Table 4).

Discussion

Adolescents in the study ranked their general health and oral health as high, and even though the malocclusion group were more embarrassed and affected by their mouth aesthetically they still rated themselves as having a good oral health. The reason for this finding could be that subjects in our study had low records of previous invasive dental care. Self perceived oral health is affected by caries and tooth-loss experience and subjects with low previous invasive dental experience often reports better self perceived oral health [21]. The main finding in our study is that malocclusion impacts OHRQOL, mainly the psychosocial impact since the adolescents are affected by their teeth and mouth aesthetically and are often embarrassed by this. This implies that malocclusions impact these adolescents in social interactions in daily life. Overall, the subjects reported low scores in the OHIP-S14 questionnaire, indicating that most of them have good self-perceived OHRQOL. However, there was a large individual variation where a few subjects from the malocclusion group and control group stood out, indicating low self-perceived OHRQOL on individual basis. The frequency of self-consciousness because of their teeth and mouth 'fairly often' and 'very often' were over-represented in the malocclusion group compared to the control group. Although, this finding was non-significant, it is still clinically relevant. These findings are in accordance with the study made by Taghavi et al. [9] who reported how the subjects would hide their teeth and were repeatedly reminded of their malocclusion. It is also in line with previous findings where adolescents with malocclusions were affected in the psychosocial dimension [27] as well as aspects of social and emotional wellbeing [12,28,29].

Regarding functional limitation (JFLS-20), there were non-significant differences between the malocclusion group and the control group. Both groups mostly presented low scores throughout the questionnaire, indicating no functional limitations. However, large differences were shown on individual basis, where a few subjects in the malocclusion group and control group indicated moderate functional limitations. Subjects who were more affected in the OHIP-S14 questionnaire usually showed more functional limitations on the JFLS-20 questionnaire as well. This pattern was more obvious in the malocclusion group than in the control group. Vertical jaw movements were within normal range in both groups and subjects in the malocclusion group were still able to chew crackers (masticate), open wide enough to bite into a sandwich (vertical jaw mobility), yawn (miscellaneous functions), talk and smile (verbal and emotional expression) despite their malocclusions. A previous study including adults with severe skeletal malocclusions found that subjects with vertical open bite were more affected and more often showed discomfort while eating compared to those with normal vertical overbite or deep bite [30]. However, our study did not include subjects who required surgical intervention, which could be one reason for these results. Nevertheless, there was a significant difference in the aspect of oral function (OHIP-S14) where subjects in the control group were more affected and often thought the food was tasteless. This finding, though statistically significant, showed that eight subjects in the control group responded 'hardly ever' compared to three subjects in the malocclusion group. Also, three subjects answered 'occasionally' or 'fairly often' compared to none in the malocclusion group. This could explain the significant difference although, in this trial, not clinically relevant. There were non-significant differences in possible confounders such as temporomandibular disorder or DMFT between the two groups, and for both groups DMFT and pain from the masticatory system was low.

All malocclusions were considered to be of aesthetic concern since the deviations were expressed in the aesthetic zone. The OES indicates that the adolescents in the malocclusion group are more negatively affected by their aesthetic appearance, both in different aspects of the face and mouth, as well as their overall impression of their orofacial appearance. Girls in the malocclusion group were more affected by their overall orofacial appearance as well as their mouth and teeth, whereas the boys in the malocclusion group were more affected by the mouth and the teeth only, compared to controls. Also, girls in the malocclusion group had a lower total median score compared to boys in the malocclusion group, indicating a lower aesthetic satisfaction. Even though we divided the sample into smaller subgroups, significant results could still be found. This is in line with previous findings where girls would assess their dental appearance as more negative compared to boys, even though the same malocclusions were expressed [6].

The strength of our study is the use of three assessment tools to evaluate OHRQOL among adolescents. By combining these three assessment tools we were able to find correlations and more fully understand the impact of malocclusion in daily life.

Traditionally in Sweden, free-of-charge orthodontic treatment is offered to correct malocclusions, depending on the orthodontic treatment need, according to different indices. However, malocclusions mainly impact adolescents in the aesthetic and psychosocial dimension in this study, which is not being accounted for up to this date. It is possible that in the future these indices can be complemented regarding the impact on these patient's OHRQOL in relation to their malocclusions.

A wide range of malocclusions were included in this study, representing the population typically treated in an orthodontic clinic. The most common malocclusion in our sample was severe crowding, which is also the most common malocclusion in the Swedish population [2]. However, the small sample size in our study is a limitation and future investigation with a larger study group representing different malocclusions would be appropriate in order to compare one malocclusion to another regarding OHRQOL, orofacial aesthetics and jaw function limitations.

Conclusions

The adolescents in our study are affected by their malocclusions in the psychosocial impact dimension since they are more often embarrassed by their mouth and teeth. Aesthetically they perceive their mouth, teeth and appearance as worse compared to a control group without malocclusions. Although embarrassed and unpleased with their oral appearance they still rate themselves as having a good oral health with low jaw function limitations.

Disclosure statement

The authors report no conflict of interest.

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