Malocclusion, facial and psychological predictors of quality of life in adolescents

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Objective: To identify clinical and psychological predictors of OHRQoL. ***Methods:*** Cross-sectional clinical and questionnaire study with 332 adolescents aged 11-14 years. The facial profile was classified through photographs and dental malocclusion was classified by the Dental Health Component of the Index of Orthodontic Treatment Need. The psychosocial variables were assessed by the Aesthetic Component of IOTN, the Orthodontic Aesthetic Subjective Impact Score and the Global Negative Self-Evaluation. OHRQoL was measured using the Oral Health Impact Profile (OHIP-14). The associations were analyzed by multiple logistic regression models. ***Results:*** Higher aesthetic concern and low self-esteem were 3.43 and 3.34 times more likely to affect OHRQoL (p<0.05), respectively. The facial and dental aspects of malocclusion were unrelated to OHRQoL. ***Conclusions:*** Facial and dental aspects of malocclusion were unrelated to OHRQoL, whereas psychosocial variables such as self-perception of orthodontic treatment need and self-esteem predicted adolescents' oral health related quality of life.

Keywords: Quality of life, malocclusion, self-perception, facial profile

Introduction

There is a growing interest in relating occlusal problems to the individual perception of orthodontic treatment need, and the extent to which these aspects affect oral health-related quality of life (OHRQoL) (Cunningham and Hunt, 2001; Abu *et al*., 2005; Benson *et al*., 2015; Vedovello *et al*., 2016; Kunz *et al*., 2018). Thus the perception of the individuals should be used to complement the clinical assessments traditionally used for planning, allowing a more individualized and broader view of the underlying problem and orthodontic treatment need (Zhang *et al*., 2008; Johal *et al*., 2015; Eslamipour *et al*., 2017; Lin *et al*., 2018; Kallunki *et al*., 2018).

Malocclusion has a negative effect on adolescents' OHRQoL (Dimberg *et al*., 2015; Kallunki *et al*., 2018) predominantly affecting the emotional and social aspects of life (Scapini *et al*., 2013; Choi *et al*., 2015; Tuchtenhagen *et al*., 2015; Rosa *et al*., 2016), especially for adolescents with low self-esteem (Marques *et al*., 2006). However, epidemiological studies often focus on dental health, without considering the shape of the face or arrangement of the teeth (Marques *et al*., 2006; Scapini *et al*., 2013; Choi *et al*., 2015; Tuchtenhagen *et al*., 2015; Kragt *et al*., 2016; de Paula Júnior *et al*., 2018)

It is important to investigate the impact of skeletal pattern and malocccusion on OHRQoL because aesthetic concerns are the main motive for seeking orthodontic treatment (Chen *et al*., 2010; Pithon *et al*., 2016; Eslami

et al., 2016; Isiekwe *et al*., 2016). Pain, abnormal facial appearance and bullying may be related to low self-esteem in adolescence (De Oliveira *et al*., 2003; Agou *et al*., 2008; Clijmans *et al*., 2015), thus confirming the interaction of clinical and psychosocial factors in quality of life at this key developmental stage.

Our hypothesis was that adolescents with atypical skeletal patterns would report greater impact on OHRQoL than adolescents with normal skeletal morphology. Therefore, the aim of the present study was to identify clinical and psychological predictors of OHRQoL in adolescents.

Methods

A cross-sectional study was conducted with 332 adolescents aged 11 through 14 years, enrolled attending public schools in southern Brazil. The sample size was calculated based on a test power of 80%, 5% significance level and a 2.0 effect size, which required a minimum sample of 306 individuals. Adolescents with deciduous or mixed dentitions, current or previous orthodontic treatment, and/or physical or psychological problems that might hinder clinical examinations were excluded from the study, as were those who were absent at the examination day or whose parents had not authorized or agreed with participation in the study. The data were collected using questionnaires and dental clinical and photographic examinations.

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This study was approved by the Ethics Committee (#59581616.7.0000.5385) and performed according to the STROBE statement. Adolescents and their legal guardians were informed that participation was entirely voluntary. Once they agreed to participate, the adolescents and their legal guardians signed a statement of informed consent. They were informed about the objectives of the study and assured of the confidentiality of the data collected.

The facial profile was assessed by photographs taken with the SLR D7000 digital camera (Nikon do Brasil Ltda) with Zoom Nikor lenses 18-200 mm VR f/3.5-5.6G II (Nikon do Brasil Ltda), which was positioned parallel to the floor on a leveled tripod. The adolescents were photografed seated on a chair placed beside a white wall looking forward horizontally, in the natural head position (Moorrees and Kean, 1956; Cassi et al., 2016). The angle of convexity of the facial profile (G-Sn-Pog' - G: Glabella point; Sn: Subnasal point; Pog': Soft tissue pogonion point) was traced from the photographs using Photoshop software (CS 8.0.1; Adobe Systems, San Jose, California). The adolescents were categorized according to soft tissue analysis (Jacobson, 1995; Eslami et al., 2016) where an angle of convexity of 8-16° indicated a straight profile, with greater or lower angles indicating convex or concave profiles respectively. For analytic purposes adolescents with convex and concave profiles were regarded as having an 'altered' facial profile and those with a straight profile were classified as 'normal'.

The Dental Health Component (DHC) of the Index of Orthodontic Treatment need (IOTN) was used to assess the dental aspects of malocclusion and normative orthodontic treatment need (Mandall et al., 1999). Although all changes were assessed, only the most severe condition was used to determine the severity of malocclusion and orthodontic treatment need of each individual, subsequently classified as mild/moderate malocclusion and no orthodontic treatment need (IOTN 1-2-3) or severe maloclussion with orthodontic treatment need (IOTN 4-5) (Brook and Shaw, 1989).

OHRQoL was assessed by the short version of the Oral Health Impact Profile (OHIP-14) questionnaire, which has two questions from each of the following dimensions: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and social disadvantage (Slade and Spencer, 1994; Slade, 1997; De Oliveira and Nadanovsky, 2005). Participants' answers were scored on a 5-point Likert scale (4 = always, 3 = frequently, 2 = sometimes, 1 = rarely, and 0 = never) and summed to produce a total OHIP-14 score with potential values ranging from 0 to 56. An OHIP score of 14 or less indicated no impact, while 15 or more, indicated negative impacts and worse OHRQoL (Slade, 1997; Isiekwe et al., 2016)

Self-esteem was assessed using the 6-item Global Negative Self-Evaluation (GSE) questionnaire. Each item has six precoded responses: 1, does not apply at all; 2, does not apply well; 3, applies somewhat well; 4, applies fairly well; 5, applies well; and 6, applies exactly. The mean item scores of each adolescent were classified as high (mean < 2.69) or low self-esteem (mean > 2.7) (Alsaker and Olweus, 1993).

Self-perceived orthodontic treatment need was assessed using the Orthodontic Aesthetic Subjective Impact Score (OASIS) (Mandall et al., 1999). The first five items,

each with seven answer options were scored in ascending order (1 to 7) on a Likert scale. The second part of OASIS includes the Aesthetic Component (AC) of the IOTN. The IOTN-AC assessed the psychosocial need of a person using a dental attractiveness scale illustrated by 10 colored photographs, in which image 1 represents the most attractive dental arrangement and image 10 the least attractive. Participants estimated their level of aesthetic compromise based on the scale images, which was taken to indicate the orthodontic treatment need due to an aesthetic concern (Brook and Shaw, 1989). The final self-perception score (OASIS) was obtained as the sum of the answers from the questionnaire and the value from the IOTN-AC. This value was dichotomized to 'minor' (OASIS < 14) or 'major' aesthetic concern (OASIS > 14) (Mandall et al., 1999; Dos Santos et al., 2017)

The method error for assessing the facial profile was verified in 30% of the sample randomly selected one month later. The systematic error was calculated using paired t tests at the 5% significance level. The casual error of the values obtained at different times was estimated according to Dahlberg (1948). Both tests showed excellent intra-examiner agreement.

The clinical oral examination was performed by one researcher who was properly calibrated and had epidemiological experience and orthodontic knowledge. The consistency of intra-examiner agreement was assessed by weighted Kappa, obtaining near-perfect values for the agreement scores (0.94). The data collected in the clinical examination were obtained with the students seated, under natural light, aided by a wooden spatula and dental explorer

Statistical analysis

The data were analyzed initially by frequency distribution tables. The associations between the impact of oral health conditions on the quality of life (OHIP-14) and the independent variables were analyzed initially using logistic regression models, estimating crude odds ratios and 95% confidence intervals (CIs). The variables with $p \leq 0.20$ in the individual analyses were tested in multiple logistic regression models, keeping variables with $p \leq 0.05$ in the model. Adjusted odds ratios and 95% CIs were estimated from the multiple regression model. The analyses were performed in the R software (R Foundation for Statistical Computing, Vienna, Austria).

Results

Characteristics of the 332 participants are presented in Table 1. Most of participants had a straight profile (51.2%) and a severe malocclusion (61.4%). Most had no impact on OHRQoL (72.6%), showed a minor aesthetic concern (60.2%) and high self-steem (69.9%).

Table 2 presents the impacts on OHRQoL in relation to gender, facial profile, dental malocclusion, self-perception and self-steem. The facial profile was unrelated to OHRQoL (p=0.92). Greater aesthetic concern and low self-esteem were associated with worse OHRQoL (p < 0.05). Higher aesthetic concern and low self-esteem were 3.43 (95% CI: 2.00-5.88) and 3.34 (95% CI: 1.94-5.76) times more likely to affect OHRQoL (p<0.05), respectively.

Table 1. Description of 332 participants.

Variable	Category	%
Impact on OHRQoL*	No impact	72.6
	With impact	27.4
Sex	Female	49.1
	Male	50.9
Facial profile**	Straight	51.2
	Concave and convex	48.8
Dental malocclusion	Mild/Moderate	38.5
IOTN (DHC)***	Severe	61.4
Self-perception	Higher concern	39.8
(OASIS)†	Minor concern	60.2
Self-esteem	Low	30.4
(GSE)#	High	69.6

*OHIP score ≤ 14 = no impact; score ≥ 15 = negative impacts and lower OHRQoL; ** angle of convexity: 8-16° straight profile, < 8° concave profile and > 16° convex profile; *** IOTN 1-2-3: mild/moderate malocclusion, IOTN 4-5 severe malocclusion; †OASIS < 14: minor aesthetic concern, and OASIS > 14 higher aesthetic concern; #GSE score ≥ 2.7 low self-esteem; score ≤ 2.69 high self-esteem.

Discussion

This study assessed facial and psychological factors and malocclusion as predictors of OHRQoL in adolescents. Participants with that greater aesthetic concerns and low self-esteem reported worse impacts on OHRQoL. OHRQoL was unrelated to facial profile or moderate and/or severe dental malocclusion. These results suggest that psychological characteristics are more closely related to OHQRoL than clinical factors, even when analyzing the face.

It was expected that the adolescents with skeletal malocclusion as reflected in by a convex or concave profile would report negative impacts on OHRQoL. Atypical skeletal profiles were unrelated to OHRQoL in multiple regression analysis. This finding may reflect the lower aesthetic impact of the profile in a frontal view, which is how individuals usually see themselves in daily life (Yin et al., 2014).

Clinical assessments of malocclusion were also unrelated to the OHRQoL of adolescents. The impact of malocclusion on OHRQoL presents contrasting results in the literature. Some studies confirm (Marques et al., 2016; Sun et al., 2018) and others reject and association (Liu et al., 2009; Kolawole et al., 2012; Sousa et al., 2014; Kragt et al., 2016). Young people may adapt psychologically to their morphological condition, especially as the development of malocclusion is a slow process. Associated with this, the daily activities seem to be more affected by psychological characteristics than dentofacial appearance.

The adolescents who perceived they had a malocclusion reported negative impacts on OHRQoL, corroborating previous studies (Arcis et al., 2013; Sousa et al., 2014; Benson et al., 2015; Kragt et al., 2017). This finding indicates that the subjective experience of orthodontic treatment need has more impact on OHRQoL than malocclusion diagnosed clinically. If a person considers their dental aesthetics unfavorable even without a clinical diagnosis, this will affect their OHRQoL negatively (Gavric et al., 2015). These psychosocial characteristics are related to demand for orthodontic treatment (Badran et al., 2010; Lin et al., 2016; Isiekwe et al., 2016). Additionally, the present findings showed that self-esteem was related to OHRQoL. Self-esteem is a complex psychological trait relatively unrelated to craniodentofacial characteristics (Gavric et al., 2015). Thus, the adolescents assessed in this study reinforce the influence of psychosocial aspects on OHRQoL, such as self-perception of orthodontic treatment need and low self-esteem.

A distinguishing feature of this study was investigating correlates of the facial profile, as previous epidemiology has only assessed the dental aspects of malocclusion. Profiles were investigated using photographs, which enhanced reliability in the diagnosis of the skeletal pattern. However, the cross-sectional character of the study prevents causal infereces. A longitudinal design may better elucidate the role of clinical and psychosocial aspects on OHRQoL.

Table 2. Predictors of OHRQoL in unadjusted and adjusted logistic regression models.

Variable	Category	Impact on OHRQoL		*Crude OR ($95%CI)	p	Adjusted OR (95%CI)	p
		No impact	With impact				
Gender	Female	112 (68.7%)	51 (31.3%)	1.47 (0.90-2.39)	0.1206		
	Male	129 (76.3%)	40 (23.7%)	Ref.			
Facial profile	Straight	123 (72.4%)	47 (27.6%)	Ref.			
	Concave and convex limits	118 (72.8%)	44 (27.2%)	0.98 (0.60-1.58)	0.9209		
Dental malocclusion	Mild/Moderate	98 (76.6%)	30 (23.4%)	Ref.			
IOTN (DHC)	Severe	143 (70.1%)	61 (29.9%)	1.39 (0.84-2.31)	0.1997		
Self-perception	Higher concern	72 (54.6%)	60 (45.4%)	4.54 (2.72-7.59)	<0.0001	3.43 (2.00-5.88)	<0.001
(OASIS)	Minor concern	169 (84.5%)	31 (15.5%)	Ref.		Ref.	
Self-esteem	Low	51 (50.5%)	50 (49.5%)	4.45 (2.71-7.61)	<0.0001	3.34 (1.94-5.76)	<0.001
(GSE)	High	190 (82.3%)	41 (17.7%)	Ref.		Ref.	

*Odds ratio;
$95% confidence interval;
&Reference level.
OASIS: Oral aesthetic subjective impact score;
IOTN: Index of treatment need;
DHC: Dental health component;
GSE: Global self-evaluation.

Conclusion

Facial and dental aspects of malocclusion were unrelated to OHRQoL, whereas psychosocial variables such as self-perception of orthodontic treatment need and self-esteem predicted adolescents oral health related quality of life.

References

Abu Alhaija, E.S.J., Al-Nimiri, K.S. and Al-Khateeb, S.N. (2005): Self-perception of malocclusion among north Jordanian school children. *European Journal of Orthodontics* **27**, 292–295.

Agou, S., Locker, D., Streiner, D. L. and Tompson, B. (2008): Impact of self-esteem on the oral-health-related quality of life of children with malocclusion. *American Journal of Orthododontic and Dentofacial Orthopedic* **134**, 484-89.

Alsaker, F.D. and Olweus, D. (1993): Global self-evaluations and perceived instability of self in early adolescence: a cohort longitudinal study. *Scandinavian Journal of Psychology* **34**, 47–63.

Arcis, C.B., Montiel-Company, J.M. and Almerich-Silva, J.M. (2013): Psychosocial impact of malocclusion in Spanish adolescents. *Korean Journal of Orthodontics* **43**,193-200.

Badran, S.A. (2010) The effect of malocclusion and self-perceived aesthetics on the self-esteem of a sample of Jordanian adolescents. *European Journal of Orthodontics* **32**, 638-644.

Benson, P.E., Da'as, T., Johal, A., Mandall, N.A., Williams, A.C. and Baker, S.R. (2015): Relationships between dental appearance, self-esteem, socio-economic status, and oral health-related quality of life in UK schoolchildren: A 3-year cohort study. *European Journal of Orthodontics* **37**, 481-490.

Brook, P.H. and Shaw, W.C. (1989): The development of an index of orthodontic treatment priority. *European Journal of Orthodontic* **11**, 309–320.

Cassi, D., De Biasea, C., Tonnic, I., Gandolfinib, M., Di Blasiob, A. and Piancino, M. (2016): Natural position of the head: review of two-dimensional and three-dimensional methods of recording. *British Journal of Oral and Maxillofacial Surgery* **54**, 233–240.

Chen, M., Wang, D.W. and Wu, L.P. (2010): Fixed Orthodontic Appliance Therapy and its impact on Oral Health-Related Quality of Life in Chinese Patients. *Angle Orthodontist* **80**, 49-53.

Choi, S.H., Kim, B.I., Cha, J.Y. and Hwang, C.J. (2015): Impact of malocclusion and common oral diseases on oral health-related quality of life. *American Journal of Orthododontic and Dentofacial Orthopedic* **147**, 587-595.

Clijmans, M., Lemiere, J., Fieuws, S. and Willems, G. (2015): Impact of self-esteem and personality traits on the association between orthodontic treatment need and oral health-related quality of life in adults seeking orthodontic treatment. *European Journal of Orthodontic* **37**, 643–650.

Cunningham, S.J. and Hunt, N.P. (2001): Quality of life and its importance in orthodontics. *Journal of Orthodontics* **28**, 152-158.

Dahlberg, G. (1948): *Statistical methods for medical and biological students*. New York: Interscience (ed), Vol.1.

De Oliveira, B. and Nadanovsky, P. (2005): Psychometric properties of the Brazilian version of the Oral Health Impact Profile-short form. *Community Dentistry Oral Epidemiology* **33**, 307-314.

De Oliveira, C.M. and Sheiham, A. (2003): The relationship between normative orthodontic treatment need and oral health-related quality of life. *Community Dentistry Oral Epidemiology* **31**, 426–436.

de Paula Júnior, D.F., Mendonça, E.F., da Costa, P.S.S. and Leles, C.R. (2018): Malocclusion and maxillofacial characteristics of young girls having precocious puberty. *International Journal of Paediatric Dentistry* **28**, 540-546.

Dimberg, L., Arnrup, K. and Bondemark, L. (2015): The impact of malocclusion on the quality of life among children and adolescents: a systematic review of quantitative studies. *European Journal of Orthodontic* **37**, 238-247.

Dos Santos, P.R., Meneghim, M.C., Ambrosano, G.M., Vedovello Filho, M. and Vedovello, S.A.S. (2017): Influence of quality of life, self-perception, and self-esteem on orthodontic treatment need. *American Journal of Orthodontics and Dentofacial Orthopedics* **151**, 143-151.

Eslami, N., Omidkhoda, M., Shafaee, H. and Mozhdehifard, M. (2016): Comparison of esthetics perception and satisfaction of facial profile among male adolescents and adults with different profiles. *Journal of Orthodontic Science* **5**, 47-51.

Eslamipour, F., Riahi, F.T., Etemadi, M. and Rihadi, A. (2017): Correlation coefficients of three self-perceived orthodontic treatment need indices. *Dental Research Journal* **14**, 37-42.

Gavric, A., Mirceta, D., Jakobovic, M., Pavlic, A., Zrinski, M.T. and Spalj, S. (2015): Craniodentofacial characteristics, dental esthetics-related quality of life, and self-esteem. *American Journal of Orthodontics and Dentofacial Orthopedics* **147**, 711-718.

Isiekwe, G.I., Sofola, O.O., Onigbogi, O.O., Utomi, I.L., Sanu, O.O. and Da Costa, O.O. (2016): Dental esthetics and oral health-related quality of life in Young adults. *American Journal of Orthododontic and Dentofacial Orthopedic* **150**, 627-635.

Jacobson, A. (1995): *Radiographic Cephalometry: From Basics to Video Imaging*. Hanover Park: Quintessence Publishing Co, 1st ed.

Johal, A., Alyaqoobi, I., Patel, R. and Cox, S. (2015): The impact of orthodontic treatment on quality of life and self-esteem in adult patients. *European Journal of Orthodontics* **37**, 233-237.

Kallunki, J., Sollenius, O., Paulsson, L., Petrén, S., Dimberg, L. and Bondemark, L. (2018): Oral health-related quality of life among children with excessive overjet or unilateral posterior crossbite with functional shift compared to children with no or mild orthodontic treatment need. *European Journal of Orthodontic* **7**. [E-pub ahead of print]

Kolawole, K.A., Ayeni, O.O. and Osiatuma, V.I. (2012): Psychosocial impact of dental aesthetics among university undergraduates. *International Orthodontics* **10**, 96-109.

Kragt, L., Wolvius, E.B., Jaddoe, V.W.V., Tiemeier, H. and Ongkosuwito, E.M. (2017): Influence of self-esteem on perceived orthodontic treatment and oral health-related quality of life in children: the Generation R Study. *European Journal of Orthodontics* **25**, 254-261.

Kunz, F., Platte, P., Keβ, S., Geim, L., Zeman, F., Proff, P., Hirschfelder U, and Stellzig-Eisenhauer A. (2018): Correlation between oral health-related quality of life and orthodontic treatment need in children and adolescents – a prospective interdisciplinary multicenter cohort study. *Journal of Orofacial Orthope*dic **79**, 297-308.

Lin, F., Ren, M., Yao, L., He, Y., Guo, J. and Yef, Q. (2016): Psychosocial impact of dental esthetics regulates motivation to seek orthodontic treatment. *American Journal of Orthodontics and Dentofacial Orthopedics* **150**, 476-82.

Lin, F., Ye, Y., Ye, S., Wang, L., Du, W., Yao, L. and Guo, J. (2018): Effect of personality on oral health-related quality of life in undergraduates. *Angle Orthodontist* **88**, 215-220.

Liu, Z., McGrath, C. and Hagg, U. (2009): The impact of malocclusion/orthodontic treatment need on the quality of life. A systematic review. *The Angle Orthodontist* **79**, 585-591.

Mandall, N.A., McCord, J.F., Blinkhorn, A.S., Worthington, H.V. and O'Brien, K.D. (1999): Perceived aesthetic impact of malocclusion and oral self-perceptions in 14-15-year-old Asian and Caucasian children in Greater Manchester. *European Journal of Orthodontic* **22***, 175-183.

Marques, L., Ramos-Jorge, M., Paiva, S. and Pordeus, I. (2006): Malocclusion: Esthetic impact and quality of life among Brazilian schoolchildren. *American Journal of Orthododontic and Dentofacial Orthopedic* **129**, 424-427.

Moorrees, C.F.A., and Kean, M. (1956): Natural head position, a basic consideration in the interpretation of cephalometric radiographs. *American Journal of Physical Anthropology* **16**, 213-234.

Pithon, M.M., Santos, C.R., Santos NL, Lima S, Coqueiro, R.S. and Santos R.L. (2016): Impact of malocclusion on affective/romantic relationships among young adults. *Angle Orthodontist* **86**, 638-43.

Rosa, G., Tomazoni, F. and Alves, L. (2016): Association of malocclusion, happiness, and oral health–related quality of life (OHRQoL) in schoolchildren. *Journal of Public Health Dentistry* **76**, 85-90.

Scapini, A., Feldens, C.A., Ardenghi, T.M., and Kramer, P.F. (2013): Malocclusion impacts adolescents oral health-related quality of life. *The Angle Orthodontist* **83**, 512-518.

Slade, G. (1997): Derivation and validation of a short form oral health impact profile. *Community Dentistry Oral Epidemiology* **25,** 284-90.

Slade, G. and Spencer, A. (1994): Development and evaluation of the Oral Health Impact Profile. *Community Dental Health* **11**, 3-11.

Sousa, R.V., Clementino, M.A., Gomes, M.C., Martins, C.C., Granville-Garcia, A.F. and Paiva, S.M. (2014): Malocclusion and quality of life in Brazilian preschoolers. *European Journal of Oral Science* **122**, 223-229.

Sun, L., Wong, H.M. and McGrath, C.P.J. (2018): The factors that influence oral health-related quality of life in 15-year-old children. *Health and Quality of Life Outcomes* **16,** 19.

Tuchtenhagen, S., Bresolin, C.R., Tomazoni, F., da Rosa, G.N., Del Fabro, J.P., Mendes, F.M., Antunes, J.L.F., and Ardenghi T.M. (2015): The influence of normative and subjective oral health status on schoolchildren's happiness. *BMC Oral Health*, 15.

Vedovello, S.A.S., Ambrosano, G.M.B., Pereira, A.C., Valdrighi, H.C., Vedovello Filho, M. and Meneghim, M.C. (2016): Association between malocclusion and the contextual factors of quality of life and socioeconomic status. *American Journal of Orthododontic and Dentofacial Orthopedic* **150**, 58-63.

Yin, L., Jiang, M., Chen, W., Smales, R.J., Wang, Q. and Tang, L. (2014): Differences in facial profile and dental esthetic perceptions between young adults and orthodontists. *American Journal of Orthodontics and Dentofacial Orthopedics* **145**, 750-756.

Zhang, M., McGrath, C. and Hägg, U. (2008): Changes in oral health-related quality of life during fixed orthodontic appliance therapy. *American Journal of Orthododontic and Dentofacial Orthopedic* **133**, 25-29.