

Impact of wearing fixed orthodontic appliances on quality of life among adolescents: *Case-control study*

Andréa A. Costa^a; Júnia M. Serra-Negra^b; Cristiane B. Bendo^a; Isabela A. Pordeus^c; Saul M. Paiva^c

ABSTRACT

Objective: To investigate the impact of wearing a fixed orthodontic appliance on oral health-related quality of life (OHRQoL) among adolescents.

Materials and Methods: A case-control study (1:2) was carried out with a population-based randomized sample of 327 adolescents aged 11 to 14 years enrolled at public and private schools in the City of Brumadinho, southeast of Brazil. The case group (n = 109) was made up of adolescents with a high negative impact on OHRQoL, and the control group (n = 218) was made up of adolescents with a low negative impact. The outcome variable was the impact on OHRQoL measured by the Brazilian version of the Child Perceptions Questionnaire (CPQ₁₁₋₁₄) – Impact Short Form (ISF:16). The main independent variable was wearing fixed orthodontic appliances. Malocclusion and the type of school were identified as possible confounding variables. Bivariate and multiple conditional logistic regressions were employed in the statistical analysis.

Results: A multiple conditional logistic regression model demonstrated that adolescents wearing fixed orthodontic appliances had a 4.88-fold greater chance of presenting high negative impact on OHRQoL (95% CI: 2.93–8.13; $P < .001$) than those who did not wear fixed orthodontic appliances. A bivariate conditional logistic regression demonstrated that malocclusion was significantly associated with OHRQoL ($P = .017$), whereas no statistically significant association was found between the type of school and OHRQoL ($P = .108$).

Conclusions: Adolescents who wore fixed orthodontic appliances had a greater chance of reporting a negative impact on OHRQoL than those who did not wear such appliances. (*Angle Orthod.* 2016;86:121–126.)

KEY WORDS: Orthodontic appliance; Quality of life; Adolescents

INTRODUCTION

Measuring oral health-related quality of life (OHRQoL) in orthodontic patients contributes to the de-

termination of treatment needs and allows a better understanding of patients' expectations. The increase in the demand for orthodontic treatment is due to the impact of malocclusion in terms of physical, psychological, and social well-being.¹⁻⁵ However, wearing an orthodontic appliance may also have an impact on OHRQoL in the form of functional limitations, pain, discomfort, and emotional and social well-being.^{3,4,6-8}

A number of studies have addressed experiences of discomfort and pain before and after the placement of orthodontic appliances, as well as in different phases of treatment.^{4,7-9} Other studies have assessed the dental and social impacts of wearing orthodontic appliances.^{3,6} Changes in OHRQoL attributed to orthodontic treatment have been measured in longitudinal studies involving Chinese adolescents.^{4,8} However, the studies cited were not carried out with population-based samples. Brazilian studies evaluating the impact of orthodontic appliances have employed a cross-sectional

^a Postdoctoral student, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.

^b Associate Professor, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.

^c Professor, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.

Corresponding author: Dr Andréa Antônia Costa, Rua Hélio Solha Maia 448, São Bento, 35460-000, Brumadinho, MG, Brazil (e-mail: andreacosta8@yahoo.com.br)

Accepted: February 2015. Submitted: October 2014.

Published Online: April 8, 2015

© 2016 by The EH Angle Education and Research Foundation, Inc.

design, population-based study.^{3,6} As the perception of quality of life depends on the culture of the individual, the impact of wearing an orthodontic appliance may vary across countries. To acquire knowledge on this issue, it is fundamental to investigate the association between wearing an orthodontic appliance and OHRQoL among adolescents employing a stronger study design. Case-control studies are considered the first step toward discovering the cause of an outcome and determining whether an increase in exposure is a risk factor for an increase in a disease.¹⁰ Investigating functional and emotional limitations caused by orthodontic appliances as well as patients' expectations and satisfaction is important in gaining a better understanding of the consequences of wearing an orthodontic appliance. This information assists orthodontists in the elaboration of appropriate strategies for conducting the treatment by establishing a preparation for the nuisances generated by wearing fixed orthodontic appliances, thus leading to greater patient cooperation and increasing the chances of successful treatment.

The aim of the present population-based case-control study was to investigate the effect of wearing fixed orthodontic appliances on OHRQoL among adolescents. The null hypothesis was that the wearing of fixed orthodontic appliances does not negatively impact adolescents' OHRQoL.

MATERIALS AND METHODS

Ethical approval was obtained from the Human Research Ethics Committee of the Federal University of Minas Gerais, Brazil (0577.0.203.000, September 2009 protocol). Participants were informed about the examination procedures and assured of the confidentiality of the collected information. Only those who signed the informed consent form were included in the study.

Study Design and Sample Characteristics

A population-based case-control study was carried out among adolescents aged 11 to 14 years enrolled at public and private schools in the City of Brumadinho, which is located in southeastern Brazil.¹¹ The subjects were selected using a one-stage sampling method (random selection of four schools). Data collection was conducted from October 2009 to May 2010. This case-control study was nested in a cross-sectional study,⁶ and 579 adolescents representing schoolchildren from Brumadinho were eligible for allocation in the case and control groups.

Outcome Variable

The outcome variable was OHRQoL as measured by the Brazilian version of the Child Perceptions

Questionnaire (CPQ₁₁₋₁₄) – Impact Short Form (ISF:16).¹² The CPQ₁₁₋₁₄ is used to assess the impact of oral health conditions on quality of life among 11- to 14-year-old children. The CPQ₁₁₋₁₄ – ISF:16 is composed of 16 items distributed among four subscales: oral symptoms (OS), functional limitations (FL), emotional well-being (EW), and social well-being (SW). Each item addresses the frequency of events in the previous 3 months. For such, a five-point rating scale with the following options is used: “never” = 0; “once/twice” = 1; “sometimes” = 2; “often” = 3; and “every day/almost every day” = 4.^{12,13} Scores on the CPQ₁₁₋₁₄ – ISF:16 are computed by summing the item scores. The total score ranges from 0 to 64, for which a higher score denotes a greater negative impact on OHRQoL.¹⁴

For the determination of the case and control groups in the present study, CPQ₁₁₋₁₄ – ISF:16 scores were divided into tertiles using a database with 579 subjects. The first tertile was composed of individuals with the lowest scores (≤ 5), the second tertile was composed of those with intermediate scores ($6 \geq$ and < 12), and the third tertile was composed of those with the highest scores (≥ 12). To avoid the overlap of groups with very close scores, the decision was made to eliminate the group with intermediate scores (second tertile). Thus, the case group was made up of adolescents who scored in the third tertile (high negative impact on OHRQoL), and the control group was made up of adolescents who scored in the first tertile (low negative impact on OHRQoL). Two controls were individually matched for age and gender to each case.

Sample Size Calculation

The minimum sample size desired for this study was calculated using an odds ratio (OR) of 2.0; the probability of exposure among controls was set to 50.0%, test power was 90.0% ($\beta = .10$), and standard error was 5% ($\alpha = .05$). The calculation determined a minimum sample size of 109 cases and 218 controls to satisfy the requirements.

Independent Variables

The main independent variable was wearing fixed orthodontic appliance. Malocclusion was identified as a possible confounding variable and recorded based on the Dental Aesthetic Index (DAI).¹⁵ Type of school was used to determine the socioeconomic status of the adolescents. In Brazil, it is common for children/adolescents who attend public schools to live in poorer areas and belong to families with lower income and educational levels. Inversely, children/adolescents from families with higher income and educational

levels who live in better housing conditions tend to attend private schools.^{16,17}

Calibration Exercise

The training and calibration exercise consisted of a theoretical step and clinical step. The theoretical step involved a discussion of the criteria for the diagnosis of malocclusion and the analysis of 10 orthodontic dental models and photographs. A gold standard in orthodontics instructed the examiner on how to perform the examination and diagnosis using the DAI criteria. In the clinical step, 10 adolescents were examined and reexamined after a 2-week interval for the determination of intraexaminer agreement in the diagnosis of malocclusion. The Cohen kappa value ranged from 0.79 to 1.00, demonstrating satisfactory agreement. The adolescents who participated in the clinical step were not included in the other stages of the study.

Pilot Study

A pilot study involving 50 children was conducted at a school to test the proposed methodology. The individuals in the pilot study were not included in the main sample. The results of this pilot study revealed that there was no need to change the proposed methods. Therefore, the quality of data collected was ensured.

Clinical Oral Examination

The adolescents were clinically examined by a single, trained, calibrated examiner (Dr Costa) to determine the presence or absence of fixed orthodontic appliance and malocclusion in an isolated room of the school. The examiner used appropriate equipment to protect against individual cross-infection, with all necessary instruments and materials packaged and sterilized in sufficient quantities for each workday.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 19.0, SPSS Inc, Chicago, Ill) and involved descriptive statistics (frequency distribution, mean, and standard deviation [SD]). Bivariate conditional logistic regression analysis was conducted to measure the association between wearing an orthodontic appliance and possible confounding variables, such as malocclusion and type of school. Fixed orthodontic appliance was dichotomized as present or absent. Malocclusion was categorized as absent/mild (DAI \leq 25), defined malocclusion (DAI = 26 to 30), or severe (DAI \geq 31). Mann-Whitney *U*-test was conducted for comparing scores of each item of the CPQ₁₁₋₁₄ among adolescents with and without fixed orthodontic appliance. Multiple conditional

logistic regression for matched case-control studies was used in the multivariate analysis. The independent variables were incorporated into the model based on statistical significance in the bivariate analysis ($P < .20$). The significance level in the final model was set to 5% ($P < .05$).

RESULTS

The present population-based case-control study involved 327 adolescents—109 cases with high negative impact on OHRQoL and 218 controls with low negative impact and individually matched for age and gender with cases at a ratio of 1:2. Table 1 displays the distribution of the possible confounding variables used for matching cases and controls. No statistically significant differences were found between groups regarding gender or age ($P = 1.000$). The sample size was considerably larger than the estimated minimum size needed to satisfy the requirements ($n = 240$). Table 1 also displays the results of the bivariate conditional logistic regression analysis. Adolescents wearing a fixed orthodontic appliance had a greater chance of experiencing high negative impact on OHRQoL than those without an orthodontic appliance. Malocclusion was significantly associated with OHRQoL ($P = .017$), whereas no statistically significant association was found between type of school and OHRQoL ($P = .108$).

Table 2 displays the scores of each CPQ₁₁₋₁₄ item for groups without and with fixed orthodontic appliance. The scores in all items of the four subscales were significantly higher among adolescents who wore a fixed orthodontic appliance than those who did not wear an orthodontic appliance.

Table 3 displays data from the multiple logistic regression analysis adjusted for malocclusion and type of school. The results demonstrate that adolescents wearing an orthodontic appliance had a 4.88-fold (95% CI: 2.93–8.13) greater chance of experiencing high negative impact on OHRQoL than those who did not wear a fixed orthodontic appliance.

DISCUSSION

The main finding of the present study was that adolescents who wore a fixed orthodontic appliance had a 4.88-fold greater chance of reporting a negative impact on OHRQoL than those who did not wear such appliances. This result was determined after controlling for the covariates type of school and malocclusion. The importance of this study resides in the fact that it is the first population-based, case-control study to evaluate the impact of wearing a fixed orthodontic appliance on OHRQoL among adolescents. Previous investigations have assessed the impact of orthodontic appliances on OHRQoL using different study designs.^{3,6}

Table 1. Frequency Distribution of Independent Variables for Matched Case and Control Groups (n = 327)

Variables	Case Group (n = 109)	Control Group (n = 218)	Unadjusted	P Value ^a
	n (%)	n (%)	OR (95% CI)	
Gender				
Male	52 (47.7)	104 (47.7)		
Female	57 (52.3)	114 (52.3)		1
Age, mean (SD)	12.52 (1.19)	12.52 (1.18)		1
Type of school				
Private	34 (31.2)	50 (22.9)	1	
Public	75 (68.8)	168 (77.1)	0.66 (0.39–1.10)	.108
Wearing orthodontic appliance				
No	42 (38.5)	169 (77.5)	1	
Yes	67 (61.5)	49 (22.5)	5.10 (3.00–8.68)	<.001
Malocclusion				
Absent/mild	79 (72.5)	195 (89.4)	1	
Defined	21 (19.3)	16 (7.3)	3.26 (1.62–6.56)	.001
Severe	9 (8.3)	6 (2.8)	3.72 (1.28–10.80)	.017

^a Bivariate conditional logistic regression.

The wearing of fixed orthodontic appliances and malocclusion showed statistically significant impact on OHRQoL. Negative impact in the OHRQoL of adolescents who wear a fixed orthodontic appliance has been reported previously.^{3,4} Another cross-sectional study using the Oral Impacts on Daily Performance (OIDP) administered to Brazilian adolescents aged 15 and 16 years found that one quarter of the adolescents who wore an orthodontic appliance reported negative impacts on OHRQoL.³ The most affected functions

were eating and speaking. Chen et al.,⁴ using the Chinese version of the 14-item Oral Health Impact Profile (OHIP-14), found a negative impact on OHRQoL, with the greatest impact occurring 1 week after placement of the fixed appliance.

The short version of the CPQ_{11–14} was used in this case-control study.¹² Previous prospective cohort studies also used the CPQ_{11–14} to evaluate fixed orthodontic treatment on the OHRQoL of adolescents.^{8,18} Chinese adolescents during fixed orthodontic

Table 2. Mean and Standard Deviation of Child Perceptions Questionnaire (CPQ_{11–14}) Scores Among Adolescents With and Without Fixed Orthodontic Appliance

Items on CPQ _{11–14}	Without Fixed Orthodontic Appliance (n = 211)	With Fixed Orthodontic Appliance (n = 116)	P Value ^a
	Mean (SD)	Mean (SD)	
Oral symptoms			
Pain in teeth/mouth	0.60 (0.81)	0.88 (1.01)	.02
Mouth sores	0.58 (0.77)	1.11 (1.00)	<.01
Bad breath	0.50 (0.68)	0.73 (0.80)	.01
Food caught between teeth	0.71 (0.79)	1.05 (0.97)	.01
Functional limitations			
Taken longer to eat a meal	0.33 (0.71)	0.78 (0.99)	<.01
Difficulty chewing firm foods	0.26 (0.60)	0.92 (1.20)	<.01
Difficulty saying words	0.20 (0.51)	0.52 (0.94)	<.01
Difficulty eating/drinking hot/cold foods	0.80 (0.99)	1.28 (1.18)	<.01
Emotional well-being			
Irritable/frustrated	0.24 (0.67)	0.77 (1.08)	<.01
Shy	0.24 (0.59)	0.63 (0.89)	<.01
Upset	0.27 (0.66)	0.68 (0.95)	<.01
Concerned what people think about your teeth/mouth	0.38 (0.85)	0.80 (0.99)	<.01
Social well-being			
Avoided smiling/laughing	0.13 (0.50)	0.44 (0.94)	<.01
Argued with children/family	0.23 (0.68)	0.69 (1.05)	<.01
Was teased/called names	0.25 (0.76)	0.46 (0.92)	<.01
Asked questions about your teeth/mouth	0.24 (0.62)	0.76 (0.96)	<.01

^a Mann-Whitney U-test.

Table 3. Multiple Conditional Logistic Regression Model for Impact of Fixed Orthodontic Appliance on Oral Health-Related Quality of Life of Adolescents (n = 327)

Variable	Adjusted OR (95% CI) ^a	P Value ^b
Wearing fixed orthodontic appliance		
No	1	<.001
Yes	4.88 (2.93–8.13)	

^a Model adjusted for malocclusion and type of school.

^b Multiple conditional regression.

appliance therapy showed lower scores of the CPQ_{11–14} during treatment in comparison to the pretreatment period. However, negative impact on OHRQoL occurred in the first week of treatment, indicating difficulty with the initial adaptation of the orthodontic appliance in the oral cavity.⁸ A recent Brazilian study that assessed the effect of the first 12 months of orthodontic treatment on the OHRQoL of adolescents showed a positive effect of wearing a fixed appliance on the OHRQoL.¹⁸ A previous cross-sectional study involving Brazilian adolescents aged 11 to 14 years that assessed the impact of wearing a fixed orthodontic appliance on OHRQoL using the ISF:16 of the CPQ_{11–14} found that those who wore a fixed orthodontic appliance had significantly poorer OHRQoL than adolescents who did not wear such appliances. Other studies have employed different methods to assess OHRQoL and reported similar results.^{3,4,7}

The OS, FL, EW, and SW subscale scores were significantly higher for adolescents wearing a fixed orthodontic appliance than for those not wearing an appliance.⁶ According to previous studies,^{3,6} our findings show that orthodontic appliances may cause pain, discomfort, shyness, trouble eating, talking, and smiling.

Valid, reliable instruments should measure OHRQoL considering the subjective, multidimensional nature of this issue.¹⁹ Moreover, OHRQoL exerts an influence on the physical, social, and emotional development of children and adolescents.²⁰ In the present case-control study, OHRQoL was the outcome variable, and the use of a fixed orthodontic appliance was the main independent variable.

The case group was composed of adolescents with a high negative impact on OHRQoL, and the control group was made up of those who reported a low negative impact on OHRQoL. A previous study involving adolescents aged 15 and 16 years also employed the case-control design and investigated the impact of a history of orthodontic treatment on the quality of life of Brazilian adolescents using the OIDP. The case group was composed of adolescents with at least one condition-specific impact attributed to malocclusion in the previous 6 months, and the control group was made

up of adolescents with no condition-specific impact. Adolescents with a history of orthodontic treatment were less likely to have physical, psychological, and social impacts associated with malocclusion than those with no history of orthodontics.²⁰

One of the strengths of the present study was the method of determining cases and controls. There is no consensus in the literature on cutoff points to rate the impact on OHRQoL. One cross-sectional study that analyzed groups with lesser and greater impact used the median overall score of CPQ_{11–14} to separate the groups.⁶ Another evaluated groups with and without condition-specific impact attributed to malocclusion.²⁰ This method of separating cases and controls considered impact on OHRQoL, and the cutoff point may have caused overlap due to very close scores in the two groups. The elimination of subjects with intermediate CPQ_{11–14} scores avoided overlap caused by very close scores between groups and enhanced the odds of detecting significant differences between cases and controls.

The present study has limitations that should be recognized. The participants were likely in different stages of treatment, which may have affected the responses, since a portion of the sample may have already adapted to treatment. To minimize this possibility, the population-based sample was randomized and was representative of students between 11 and 14 years of age in the City of Brumadinho.

Adolescents with malocclusion that affect anterior dental esthetics may experience negative repercussions on daily living.²¹ Orthodontic correction enhances esthetics and leads to a considerable improvement in OHRQoL.^{7,8} However, orthodontic treatment can last for years, is costly and causes pain, which may deter adolescents from seeking such treatment. Considering the effects of wearing a fixed orthodontic appliance on OHRQoL, it is important for orthodontists to explain the possible discomfort and consequences of treatment. It is important to make clear that most of the negative consequences are temporary and get better during the treatment.⁷ This information may enhance adherence to treatment, as successful orthodontics is facilitated by adequate communication between the orthodontist and patient. In addition it should intensify preventive and interceptive orthodontics to minimize treatment time with fixed appliances orthodontics.

CONCLUSION

- The present findings reject the null hypothesis by demonstrating that adolescents who are wearing fixed orthodontic appliances had a greater chance of reporting a negative impact on OHRQoL than those who are not wearing such appliances.

ACKNOWLEDGMENTS

This study was supported by the Brazilian fostering agencies National Council for Scientific and Technological Development (CNPq), Coordination for Higher Education Personnel (CAPES), and the State of Minas Gerais Research Foundation (FAPEMIG), Pro-reitoria de Pesquisa UFMG (PRPq UFMG).

REFERENCES

- Mandall NA, Wright J, Conboy F, Kay E, Harvey L, O'Brien KD. Index of orthodontic treatment need as a predictor of orthodontic treatment uptake. *Am J Orthod Dentofacial Orthop.* 2005;128:703–707.
- Zhang M, McGrath C, Hägg U. The impact of malocclusion and its treatment on quality of life: a literature review. *Int J Paediatr Dent.* 2006;16:381–387.
- Bernabé E, Sheiham A, Oliveira CM. Impacts on daily performances related to wearing orthodontic appliances. *Angle Orthod.* 2008;78:482–486.
- Chen M, Wang DW, Wu LP. Fixed orthodontic appliance therapy and its impact on oral health-related quality of life in Chinese patients. *Angle Orthod.* 2010;80:49–53.
- Albino JE, Lawrence SD, Tedesco LA. Psychological and social effects of orthodontic treatment. *J Behav Med.* 1994; 17:81–98.
- Costa AA, Ferreira MC, Serra-Negra JM, Pordeus IA, Paiva SM. Impact of wearing fixed orthodontic appliances on oral health-related quality of life among Brazilian children. *J Orthod.* 2011;38:275–281.
- Liu Z, McGrath C, Hägg U. Changes in oral health-related quality of life during fixed orthodontic appliance therapy: an 18-month prospective longitudinal study. *Am J Orthod Dentofacial Orthop.* 2011;139:214–219.
- Zhang M, McGrath C, Hägg U. Changes in oral health related quality of life during fixed orthodontic appliance therapy. *Am J Orthod Dentofacial Orthop.* 2008;133:25–29.
- Othaman SA, Mansor N, Saub R. Randomized controlled clinical trial of oral health-related quality of life patients wearing conventional and self-ligating brackets. *Korean J Orthod.* 2014;44:168–176.
- Gordis L. *Epidemiology.* 4th ed. Philadelphia, Pa:Saunders Elsevier; 2009.
- IBGE (Brazilian Geography and Statistics Institute), Available at: <http://www.ibge.com.br/>. Accessed February 3, 2014.
- Torres CS, Paiva SM, Vale MP, et al. Psychometric properties of the Brazilian version of the Child Perceptions Questionnaire (CPQ11–14) – short forms. *Health Qual Life Outcomes.* 2009;7:43.
- Jokovic A, Locker D, Stephens M, Kenny D, Tompson B, Guyatt G. Validity and reliability of a questionnaire for measuring child oral-health-related quality of life. *J Dent Res.* 2002;81:459–463.
- Jokovic A, Locker D, Guyatt G. Short forms of Child Perceptions Questionnaire for 11–14-year-old children (CPQ 11–14): development and initial evaluation. *Health Qual Life Outcomes.* 2006;4:4.
- Cons NC, Jenny J, Kohout FJ, Freer TJ, Eismann D. Perceptions of occlusal conditions in Australia, the German Democratic Republic and the United States of America. *Int Dent J.* 1983;33:200–206.
- Soriano EP, Caldas Ade F Jr, Diniz De Carvalho MV, Amorim Filho Hde A. Prevalence and risk factors related to traumatic dental injuries in Brazilian schoolchildren. *Dent Traumatol.* 2007;23:232–240.
- Piovesan C, Pádua MC, Ardenghi TM, Mendes FM, Bonini GC. Can type of school be used as an alternative indicator of socioeconomic status in dental caries studies? A cross-sectional study. *BMC Med Res Methodol.* 2011;11:37.
- Abreu LG, Melgaço CA, Lages EM, Abreu MH, Paiva SM. Effect of year one orthodontic treatment on the quality of life of adolescents, assessed by the short form of the Child Perceptions Questionnaire. *Eur Arch Paediatr Dent.* 2014; 15:435–441.
- Locker D. Measuring oral health: a conceptual framework. *Community Dent Health.* 1988;5:3–18.
- Bernabé E, Sheiham A, Tsakos G, de Oliveira CM. The impact of orthodontic treatment on the quality of life in adolescents: a case-control study. *Eur J Orthod.* 2008;30: 515–520.
- Marques LS, Filogônio CA, Filogônio CB, et al. Aesthetic impact of malocclusion in the daily living of Brazilian adolescents. *J Orthod.* 2009;36:152–159.