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Original Article

Effect of malocclusion severity on oral health-related quality of life and food intake ability in orthodontic patients

ABSTRACT

Introduction: Malocclusion is a social handicap because of its negative physical, psychological and social impact on the people. Apart from the esthetic setback, malocclusion also affects the general health of a person by hampering the quality and quantity of food intake.

Aim: The aim of the study was to evaluate the effects of malocclusion severity on oral health-related quality of life (OHRQoL) and food intake ability (FIA) in orthodontic patients.

Methods: A total of 254 patients were assessed for the severity of malocclusion, OHRQoL, and FIA using standard oral health impact profile questionnaire and FIA questionnaire and their grades of malocclusion were assessed using the Index of Orthodontic Treatment Need- Dental Health Component Index.

Results: Of the quality of life questionnaire, females are more affected in social disability than males ($P < 0.001$). Adolescents responded more positively toward their quality of OHRQoL.

Conclusion: Severe malocclusion caused functional limitation, psychological discomfort, psychological disability, social disability, and physically challenged. The severity of malocclusion did not affect the FIA of the patient.

Keywords: Food intake ability, malocclusion severity, oral health-related quality of life index, oral health-related quality of life

INTRODUCTION

Malocclusion has a negative impact on the lives of people. It affects the social and personal life and has an overall impact on the general quality of life. There is a positive correlation between the orthodontic treatment and improvement in quality of life among different age groups of patients.[1,2]

While assessing the quality of life, unlike the previous indices used for assessing oral health, oral health-related quality of life (OHRQoL) index is a comprehensive index taking the physical, psychological, and social aspects of life. OHRQoL has been defined as "the absence of negative impacts of oral conditions on social life and positive sense of dentofacial self-confidence."[3] The importance of patient-centered outcome measure is increasing compared to the yesteryears, and so the World Health Organization has recommended the inclusion of quality of life measurements in clinical studies, and it is the most appropriate tool to assess the necessity for and the results of orthodontic treatment.

Aneeta Johny, BK Rajkumar, S Nagalakshmi, R Ramesh Kumar, S Vinoth, D Dayanithi

Department of Orthodontics and Dentofacial Orthopeadics, Vivekanandha Dental College for Women, Elayampalayam, Nammakkal, Tamil Nadu, India

Address for correspondence: Dr. Aneeta Johny, Department of Orthodontics and Dentofacial Orthopeadics, Vivekanandha Dental College for Women, Elayampalayam, Nammakkal, Tamil Nadu, India.
E-mail: smilingmyrtles@gmail.com

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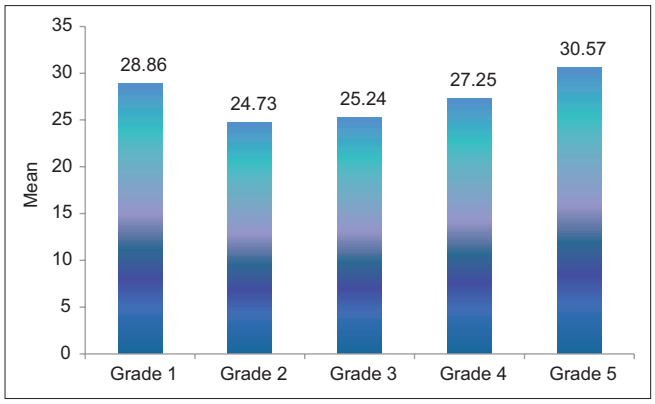


Figure 1: Malocclusion severity among different age groups

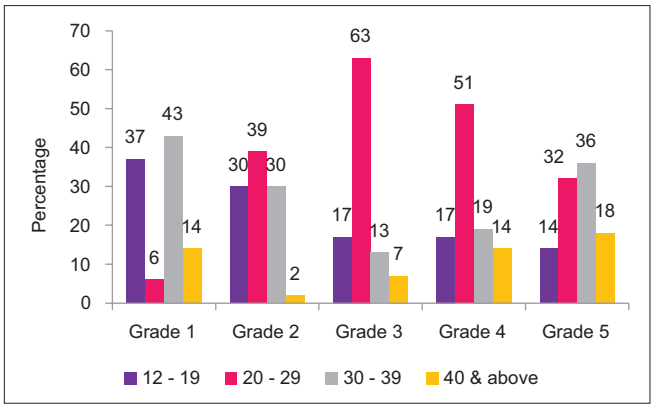


Figure 2: Descriptive statistics for the number of patients in each grade

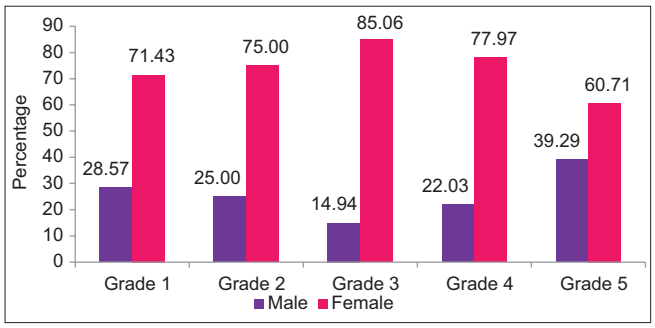


Figure 3: Descriptive statistics showing the male to female proportion of orthodontic patients

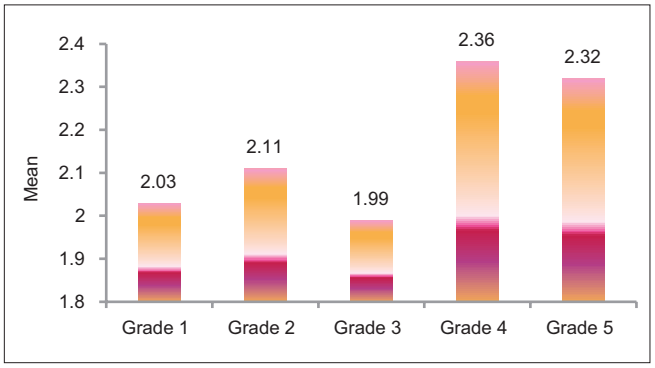


Figure 4: ANOVA showing functional limitation according to different grades of maocclusion

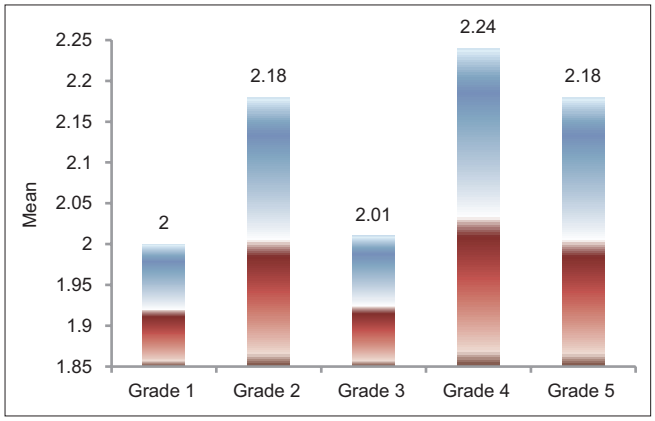


Figure 5: ANOVA showing physical pain and different grades of malocclusion

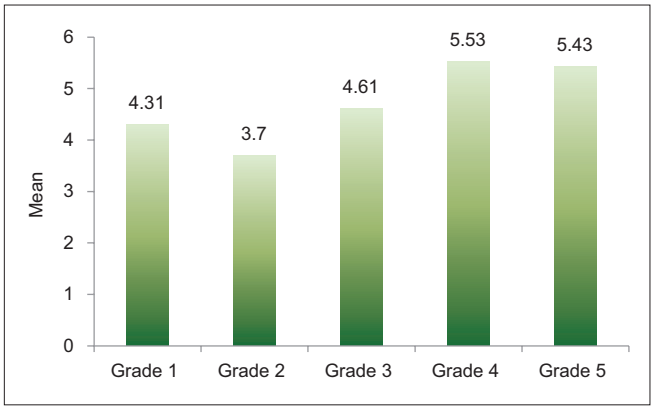


Figure 6: ANOVA showing psychological disconfort and different grades of malocclusion

Despite the amount of malocclusion a person is having, food intake ability (FIA) is according to his perception of the efficiency of his masticatory ability. The masticatory ability of a person can be improved by orthodontic correction of malocclusion.[4] Masticatory function can be evaluated using subjective and objective methods.[5,6] Subjective methods are done using a questionnaire or an interview to determine FIA of various types of food. A clinically developed FIA questionnaire is used to assess the masticatory ability of the patients.

There is a positive correlation between the malocclusion severity and its effects in OHRQoL,[7] but the perception of patients regarding their dental problems, especially those related to culture and concept of beauty are different in different communities. Hence, the present study aims to evaluate the effects of malocclusion severity on OHRQoL and masticatory ability in orthodontic patients.

MATERIALS AND METHODS

This study was a cross-sectional evaluation of 254 patients aged between 13 and 45 years who visited the orthodontic

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Table 1: Malocclusion severity among different age groups

	Age						
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	Upper bound		
Grade 1	35	28.86	11.01	1.86	25.08	3.13	3.13	0.015*
Grade 2	44	24.73	7.27	1.10	22.52	26.94		
Grade 3	87	25.24	7.69	0.82	23.60	26.88		
Grade 4	59	27.25	9.72	1.27	24.72	29.79		
Grade 5	28	30.57	8.60	1.63	27.24	33.91		
Total	253	26.71	8.89	0.56	25.61	27.81		

**P* value is significant. SD: Standard deviation, *n*: Number of patients, SE: Standard error

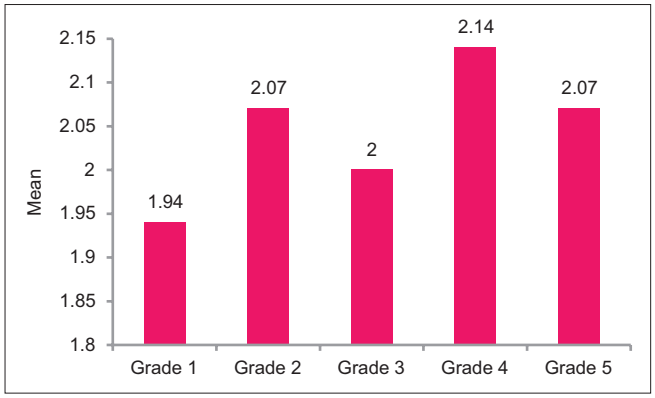


Figure 7: ANOVA showing physical disability and different grades of malocclusion

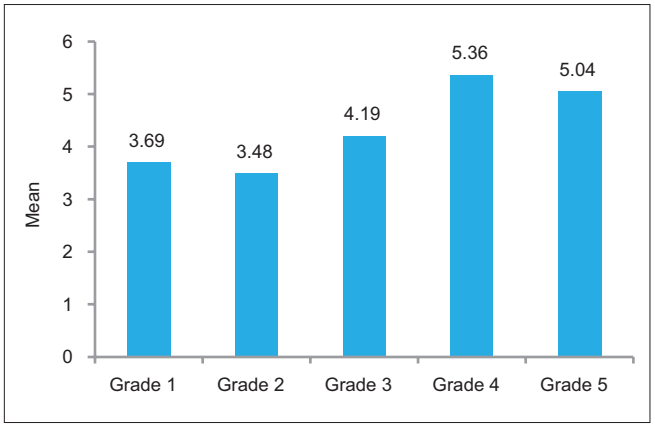


Figure 8: ANOVA showing psycological disability and different grades of malocclusion

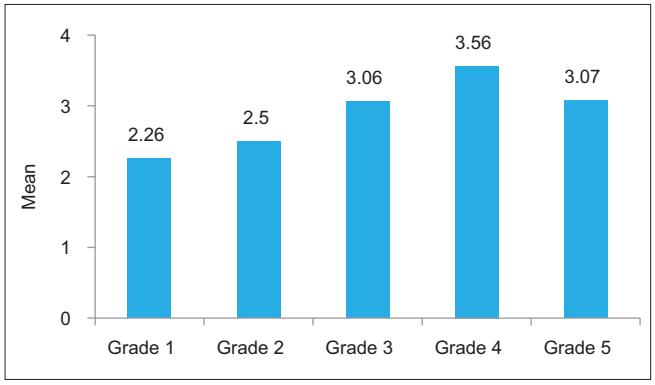


Figure 9: ANOVA showing social disability and different grades of malocclusion

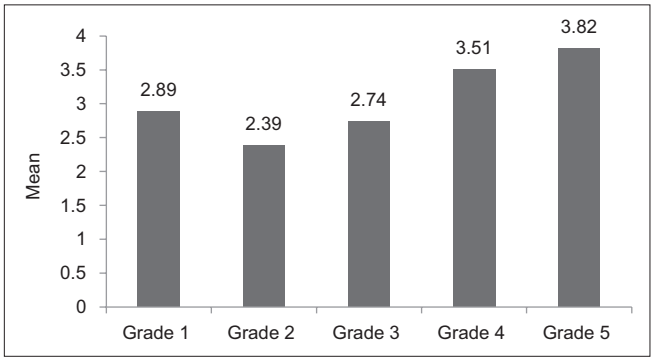


Figure 10: ANOVA showing handicapp and different grades of malocclusion

department, for 6 months. The ethical clearance of the study was obtained from the Institutional Ethical Committee.

Patients with severe dentofacial anomalies including cleft lip and palate, patients taking medication or are having serious medical conditions for which they were hospitalized, current or past history of orthodontic treatment or orthognathic surgery were excluded from the study for the homogeneity of the sample. The study was done in only those patients who were willing to participate.

Data were collected from direct interviews with all the patients. Age and sex of the patients were noted during the interviews. Oral health impact profile-14 (OHIP-14) questionnaire was given to each patient for assessing their OHRQoL. OHIP-14 questionnaire consists of 14 questions, which cover the seven domains of oral health: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and physically challenged. A Likert type scale was used to record the responses, which is coded as follows 0 - never, 1 - hardly ever, 2 - occasionally, 3 - fairly often, and 4 - very often. The total score was then calculated by summing up the responses, generating scores from 0 to 56, highest of which indicated poor OHRQoL.

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The subjective masticatory ability of the patient was evaluated using a clinically developed FIA questionnaire. The self-assessed questionnaire requested the patients' masticatory ability of five food items (raw carrots, peanuts, cake, caramel, and cabbage). The responses were recorded in a 5-point Likert type scale coded as 1 - cannot chew at all, 2 - difficult to chew, 3 - cannot say either way, 4 - can chew some, and 5 - can chew well. The total score was from 0 to 25, higher of which indicated good chewing ability. Lower scores indicated lower chewing ability.

Nine malocclusion traits were assessed to find the dental health component of the index of orthodontic treatment need: overjet, reverse overbite, open bite, cross bite, crowding, impeded eruption, Class II and Class III buccal occlusion, and hypodontia. Those cases which do not require treatment or need minimal treatment belong to Grade 1 and Grade 2. Those cases which belong to borderline treatment need belong to Grade 3. Grade 4 and Grade 5 describe conditions that require treatment.

Table 2: Descriptive statistics for the number of patients in each grade

Grade	Frequency (%)
Grade 1	35 (13.83)
Grade 2	44 (17.39)
Grade 3	87 (34.39)
Grade 4	59 (23.32)
Grade 5	28 (11.07)
Total	253 (100)

Table 3: Descriptive statistics showing the male to female proportion of orthodontic patients

Grade	Sex		Total
	Male, *n* (%)	Female, *n* (%)	
Grade 1	10 (29)	25 (71)	35
Grade 2	11 (25)	33 (75)	44
Grade 3	13 (15)	74 (85)	87
Grade 4	13 (22)	46 (78)	59
Grade 5	11 (39)	17 (61)	28
Total	58 (23)	195 (77)	253

All the examinations were done by a single examiner.

Statistical analysis

All statistical analysis was performed with IBM SPSS statistics for windows (version 16).

Descriptive analysis was performed in respect to grade, sex, and age. ANOVA test was done to evaluate the response in different grades according to age, functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and physically challenged and FIA with a statistical significance level at $P < 0.05$. All the eight parameters according to the age and gender were evaluated using *t*-test with statistical significance at $P < 0.05$. Linear regression analysis was done to assess the relationship between age and FIA.

RESULTS

The present study shows that there is a positive correlation between the age of the patient and the malocclusion severity [Table 1 and Figure 1].

Descriptive statistics showed that most patients who seek orthodontic treatment belonged to Grade 3 [Table 2 and Figure 2]. Forty-five percent of the total orthodontic patients belonged to the age group of 20–29 [Table 3 and Figure 3].

In the domains of oral health, functional limitation was found to be having a positive correlation with the grades of malocclusion severity, and Grade 4 has got the highest effect in functional limitation [Table 4 and Figure 4]. There was no positive association between physical pain and malocclusion severity [Table 5 and Figure 5]. Malocclusion severity has a positive toll on the psychological discomfort and found to be greatest in Grade 4 [Table 6 and Figure 6]. Physical disability and malocclusion severity were not having an association [Table 7 and Figure 7]. Psychological disability was found to be affected more in Grade 4 and found to be strongly

Table 4: ANOVA showing functional limitation according to different grades of malocclusion

	Functional limitation							
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	Upper bound		
Grade 1	35	2.03	0.45	0.08	1.87	2.18	3.07	0.017*
Grade 2	44	2.11	0.99	0.15	1.81	2.42		
Grade 3	87	1.99	0.36	0.04	1.91	2.06		
Grade 4	59	2.36	0.96	0.13	2.11	2.61		
Grade 5	28	2.32	0.61	0.12	2.08	2.56		
Total	253	2.14	0.72	0.05	2.05	2.23		

*Significant *P* value. SD: Standard deviation, *n*: Number of patients, CI: Confidence interval, SE: Standard error, *P* value at <0.05

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Table 5: ANOVA showing physical pain and different grades of malocclusion

	Physical pain							
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	Upper bound		
Grade 1	35	2.00	0.42	0.07	1.86	2.14	1.73	0.143
Grade 2	44	2.18	0.97	0.15	1.89	2.48		
Grade 3	87	2.01	0.47	0.05	1.91	2.11		
Grade 4	59	2.24	0.63	0.08	2.07	2.40		
Grade 5	28	2.18	0.39	0.07	2.03	2.33		
Total	253	2.11	0.61	0.04	2.03	2.19		

SD: Standard deviation, CI: Confidence interval, SE: Standard error, *P* value significant at <0.05

Table 6: ANOVA showing psychological discomfort and different grades of malocclusion

	Psychological discomfort							
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	Upper bound		
Grade 1	35	4.31	1.39	0.23	3.84	4.79	9.12	<0.001**
Grade 2	44	3.70	1.82	0.28	3.15	4.26		
Grade 3	87	4.61	1.64	0.18	4.26	4.96		
Grade 4	59	5.53	2.00	0.26	5.00	6.05		
Grade 5	28	5.43	1.17	0.22	4.98	5.88		
Total	253	4.72	1.80	0.11	4.49	4.94		

**High significance. *n*: Number of patients, SD: Standard deviation, CI: Confidence interval, SE: Standard error, *P* value significant <0.05

Table 7: ANOVA showing physical disability and different grades of malocclusion

	Physical disability							
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	Upper bound		
Grade 1	35	1.94	0.34	0.06	1.83	2.06	0.76	0.554
Grade 2	44	2.07	0.85	0.13	1.81	2.33		
Grade 3	87	2.00	0.59	0.06	1.87	2.13		
Grade 4	59	2.14	0.60	0.08	1.98	2.29		
Grade 5	28	2.07	0.26	0.05	1.97	2.17		
Total	253	2.04	0.59	0.04	1.97	2.12		

SD: Standard deviation, CI: Confidence interval, SE: Standard error, *P* value significant at <0.05

Table 8: ANOVA showing psychological disability and different grades of malocclusion

	Psychological disability							
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	upper bound		
Grade 1	35	3.69	1.23	0.21	3.26	4.11	9.75	<0.001**
Grade 2	44	3.48	1.92	0.29	2.89	4.06		
Grade 3	87	4.19	1.79	0.19	3.80	4.57		
Grade 4	59	5.36	2.09	0.27	4.81	5.90		
Grade 5	28	5.04	1.37	0.26	4.50	5.57		
Total	253	4.36	1.90	0.12	4.12	4.60		

**Highly significant. SD: Standard deviation, CI: Confidence interval, SE: Standard error, , *P* value significant at <0.05

associated with the severity levels of malocclusion [Table 8 and Figure 8]. Social disability and malocclusion severity are also associated and found to be highest in Grade 4 [Table 9 and Figure 9]. Malocclusion severity and handicap found to be strongly associated and have a greatest toll in Grade 5 malocclusion [Table 10 and Figure 10].

FIA, although it was found to be worsening in older age groups, statistically the association was not found to be significant [Tables 11, 11.5 and Figure 11].

In between the two genders, there was no association between grades and functional limitation, physical pain, psychological

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Table 9: ANOVA showing social disability and different grades of malocclusion

	Social disability						
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	Upper bound		
Grade 1	35	2.26	0.74	0.13	2.00	2.51	8.05	<0.001**
Grade 2	44	2.50	1.21	0.18	2.13	2.87		
Grade 3	87	3.06	1.32	0.14	2.78	3.34		
Grade 4	59	3.56	1.43	0.19	3.19	3.93		
Grade 5	28	3.07	0.98	0.18	2.69	3.45		
Total	253	2.97	1.30	0.08	2.81	3.13		

**High significance. SD: Standard deviation, CI: Confidence interval, SE: Standard error

Table 10: ANOVA showing handicap and different grades of malocclusion

	Handicap						
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	Upper bound		
Grade 1	35	2.89	1.13	0.19	2.50	3.27	11.61	<0.001**
Grade 2	44	2.39	1.06	0.16	2.06	2.71		
Grade 3	87	2.74	0.95	0.10	2.53	2.94		
Grade 4	59	3.51	1.41	0.18	3.14	3.88		
Grade 5	28	3.82	0.90	0.17	3.47	4.17		
Total	253	3.00	1.20	0.08	2.85	3.14		

**High significance. SD: Standard deviation, CI: Confidence interval, SE: Standard error, *P* value significant at <0.05

Table 11: ANOVA showing food intake ability and different grades of malocclusion

	FIA						
	n	Mean	SD	SE	95 CI for mean		ANOVA	*P*
					Lower bound	Upper bound		
Grade 1	35	24.26	1.50	0.25	23.74	24.77	2.06	0.087
Grade 2	44	23.45	2.60	0.39	22.66	24.25		
Grade 3	87	23.87	1.75	0.19	23.50	24.25		
Grade 4	59	23.22	1.89	0.25	22.73	23.71		
Grade 5	28	23.36	2.20	0.42	22.50	24.21		
Total	253	23.64	1.99	0.13	23.40	23.89		

SD: Standard deviation, CI: Confidence interval, SE: Standard error, FIA: Food intake ability, *P* value significant at <0.05

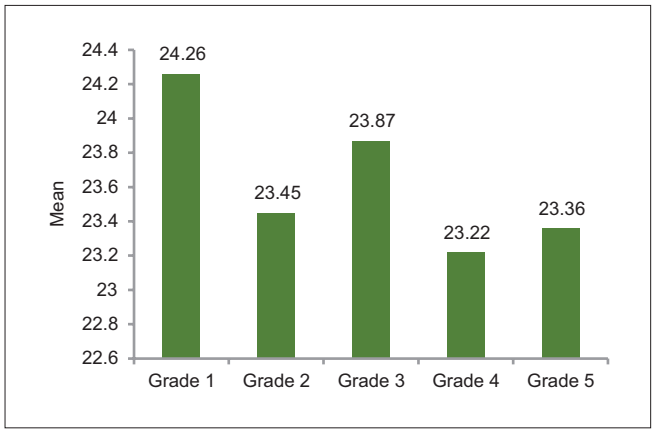


Figure 11: Regression analysis showing relation between food intake ability and grades of malocclusion

discomfort, physical disability, psychological disability, physically challenged, and FIA [Table 12]. Females found to be affected more in Grade 5 in regarding the social disability [Table 13].

There found to be positive association between different age groups and physical pain, psychological discomfort, physical disability, psychological disability, social disability, and physically challenged [Table 14].

Physical pain, physical disability, and handicap were found to be affected mostly by 30–39 years of age group whereas psychological discomfort, psychological disability, and social disability were found mostly in 20–29 years of age group.

DISCUSSION

The desire to have a happy and healthy living is there in everybody. As a dentist is concerned, it is his duty to ensure, his patients are satisfied with the treatment and their OHRQoL has been improved. The present study was aimed at assessing the severity of malocclusion and its effect on the OHRQoL and FIA in orthodontic patients visiting the orthodontic department.

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Table 11.5: Regression analysis

	Unstandardized Coefficients	SE	*t*	*P*	95% CI for B	
					Lower bound	Upper bound
Constant	27.628	4.006	6.897	<0.001**	19.738	35.518
Age	0.058	0.037	1.564	0.119	−0.015	0.130
FIA	−0.331	0.164	−2.020	0.044	−0.654	−0.008
Dependent variable: OHIP-14						

**Significant if *P* value is <0.001. ANOVA showing statistically nonsignificant association between masticatory ability and malocclusion severity. Regression analysis showing food intake ability is not found to be affected by the age of the patient, but there is a deterioration of masticatory ability with increasing age. FIA: Food intake ability, SE: Standard error, CI: Confidence interval, OHIP: Oral health impact profile

Table 12: ANOVA showing gender variation in different domains of oral health-related quality of life

	Gender	*n*	Mean	SD	*t*	*P*
Functional limitation	Male	58	2.172	0.425	0.411	0.682
	Female	195	2.128	0.786		
Physical pain	Male	58	2.086	0.339	0.345	0.730
	Female	195	2.118	0.675		
Psychological discomfort	Male	58	5.052	1.721	1.63	0.105
	Female	195	4.615	1.814		
Physical disability	Male	58	2.000	0.375	0.736	0.463
	Female	195	2.067	0.659		
Psychological disability	Male	58	4.638	1.962	1.16	0.247
	Female	194	4.309	1.874		
Social disability	Male	58	2.828	1.011	0.939	0.348
	Female	195	3.010	1.373		
Physically challenged	Male	58	3.345	1.236	2.61	0.010
	Female	195	2.882	1.172		
FIA	Male	58	24.000	1.686	1.66	0.099
	Female	195	23.508	2.069		

There is no significant difference between the genders in different domain of oral health-related quality of life, n: Number of patients, SD: standard deviation, *P* significant at <0.05

Table 13: ANOVA showing gender variation in different grades of malocclusion in various social disability domain of oral health-related quality of life

Grade	Gender	*n*	Social disability		*t*	*P*
			Mean	SD		
Grade 1	Male	10	2.40	0.70	0.72	0.479
	Female	25	2.20	0.76		
Grade 2	Male	11	2.36	0.50	0.43	0.671
	Female	33	2.55	1.37		
Grade 3	Male	13	2.92	0.95	0.39	0.694
	Female	74	3.08	1.38		
Grade 4	Male	13	3.85	1.21	0.82	0.417
	Female	46	3.48	1.49		
Grade 5	Male	11	2.36	0.50	3.75	0.001**
	Female	17	3.53	0.94		

**Highly significant. In grade 5, females are found to be affected in social disability domain. SD: Standard deviation, n: number of patients. *P* value significant <0.05

In the present study, the number of female patients turned up for the treatment was far more than the males.

There was no gender difference found between different malocclusion grades and OHRQoL domains except in social disability domain in Grade 5 malocclusion which showed a greater effect in female population. When overall OHRQoL was examined, the only gender difference was evident in males in physically challenged domain.

According to the another study in the Indian population by Acharya,[8] females perceived a higher sense of "social handicap" and "handicap" due to their oral status than males which in the present study showed females are affected in social disability domain, that too in the higher grades of malocclusion severity.

Masticatory function was found to be unaffected by the difference in gender. this observation is similar to the study results of Choi *et al*.[7] whose study stated that little anatomical

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Table 14: ANOVA showing the age groups and its effect on various domains of oral health-related quality of life

	n	Mean	SD	ANOVA	*P*
Functional limitation					
12-19 (teens)	55	2.13	1.07	1.83	0.142
20-29	113	2.07	0.37		
30-39	60	2.15	0.55		
40 and above	25	2.44	1.16		
Total	253	2.14	0.72		
Physical pain					
12-19 (teens)	55	1.89	0.79	3.61	0.014*
20-29	113	2.18	0.60		
30-39	60	2.22	0.49		
40 and above	25	2.04	0.35		
Total	253	2.11	0.61		
Psychological discomfort					
12-19 (teens)	55	4.09	1.83	3.69	0.013*
20-29	113	5.04	1.82		
30-39	60	4.78	1.62		
40 and above	25	4.48	1.78		
Total	253	4.72	1.80		
Physical disability					
12-19 (teens)	55	1.84	0.83	3.35	0.020*
20-29	113	2.10	0.50		
30-39	60	2.17	0.62		
40 and above	25	2.04	0.20		
Total	253	2.05	0.61		
Psychological disability					
12-19 (teens)	55	3.42	1.75	8.85	0.000*
20-29	113	4.88	1.83		
30-39	60	4.53	1.86		
40 and above	24	3.88	1.73		
Total	252	4.38	1.90		
Social disability					
12-19 (teens)	55	2.62	1.31	4.90	0.002*
20-29	113	3.30	1.32		
30-39	60	2.70	1.09		
40 and above	25	2.88	1.36		
Total	253	2.97	1.30		
Handicap					
12-19 (teens)	55	2.45	1.20	6.14	0.000*
20-29	113	3.06	1.16		
30-39	60	3.37	1.19		
40 and above	25	2.92	1.04		
Total	253	2.99	1.20		
FIA					
12-19 (teens)	55	23.80	1.99	0.71	0.548
20-29	113	23.48	2.16		
30-39	60	23.83	1.70		
40 and above	25	23.36	1.93		
Total	253	23.62	2.00		

*Significant. There found to be positive association between different age groups and physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. SD: Standard deviation, FIA: Food intake ability, n: number of patients. *P* value significant at <0.05

or physical reasons exist for taking up of orthodontic treatment by females.

Masticatory function was found to be unaffected by the severity of malocclusion. There was no association between

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FIA and severity of malocclusion and between the sexes. This result is similar to the study by Feu *et al*.[9]

In the present study, although the age factor is not shown to be statistically significant in hampering the masticatory ability, there is a decrease in masticatory ability with advancing age.

Teens responded positively toward questions of health-related quality of life irrespective of gender. This is in contrast to findings by Peres[10] who stated that adolescent girls expressed stronger dissatisfaction regarding their appearance due to malocclusion.

The present study shows severe malocclusion affects the functional limitation, psychological discomfort, psychological disability, social disability, and handicap.

Physical pain, physical disability, and handicap were reported by patients in 30–39 years of age group showing a more physical effect of malocclusion on their quality of life. Psychological discomfort, psychological disability, and social disability were significantly affected for patients in 20–29 years of age group showing more esthetic concern than functional disability. This result is similar to the study results by Choi *et al*.[7] who stated that most patients seek orthodontic treatment for esthetic correction than functional improvement.

CONCLUSION

A person's negative perception regarding the OHRQoL is increasing with age. Masticatory ability of a person is not associated with the severity of his malocclusion. Elder persons have more of functional difficulties due to malocclusion whereas younger participants are more concerned of esthetics and social acceptance.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Silvola AS, Varimo M, Tolvanen M, Rusanen J, Lahti S, Pirttiniemi P, *et al*. Dental esthetics and quality of life in adults with severe malocclusion before and after treatment. Angle Orthod 2014;84:594-9.
2. Jung MH. Evaluation of the effects of malocclusion and orthodontic treatment on self-esteem in an adolescent population. Am J Orthod Dentofacial Orthop 2010;138:160-6.
3. Slade GD. Assessment of oral health-related quality of life. In: Inglehart MR, Bagramian RA, editors. Oral Health-Related Quality of Life. Chicago: Quintessence; 2002. p. 29-46.
4. Mongini F, Schmid W, Tempia G. Improvement of masticatory function after orthodontic treatment. Two case reports. Am J Orthod Dentofacial Orthop 1994;105:297-303.
5. Hilasaca-Mamani M, Barbosa Tde S, Fegadolli C, Castelo PM. Validity and reliability of the quality of masticatory function questionnaire applied in Brazilian adolescents. Codas 2016;28:149-54.
6. Kim BI, Jeong SH, Chung KH, Cho YK, Kwon HK, Choi CH, *et al.* Subjective food intake ability in relation to maximal bite force among Korean adults. J Oral Rehabil 2009;36:168-75.
7. Choi SH, Kim JS, Cha JY, Hwang CJ. Effect of malocclusion severity on oral health-related quality of life and food intake ability in a Korean population. Am J Orthod Dentofacial Orthop 2016;149:384-90.
8. Acharya S. Oral health-related quality of life and its associated factors in an Indian adult population. Oral Health Prev Dent 2008;6:175-84.
9. Feu D, de Oliveira BH, de Oliveira Almeida MA, Kiyak HA, Miguel JA. Oral health-related quality of life and orthodontic treatment seeking. Am J Orthod Dentofacial Orthop 2010;138:152-9.
10. Peres KG, Barros AJ, Anselmi L, Peres MA, Barros FC. Does malocclusion influence the adolescent's satisfaction with appearance? A cross-sectional study nested in a Brazilian birth cohort. Community Dent Oral Epidemiol 2008;36:137-43.