



Original Research Article

The impact of orthodontic space closure and subsequent canine substitution of bilateral congenitally absence of maxillary lateral incisors on the oral health-related quality of life

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ABSTRACT

Background: Closure of the space of missing maxillary lateral incisors and canine substitution is probably the first choice to avoid long-term restorative replacements but may produce an inferior aesthetic result which may have adverse effect on oral health.

Aims: To assess the effects of orthodontic space closure (OSC) of bilateral congenitally absence of maxillary lateral incisors (CMMLI) and consequent canine substitution on Oral Health-Related Quality of Life (OHRQL).

Materials and Methods: The impacts of OSC and canine substitution on the OHRQL were assessed using the short-version of the Oral Health Impact Profile (OHIP) and a modified version of the Eastman Esthetic Index (EEI) questionnaires. Answers of the patients' perception to esthetics of the tooth substitution were rated and correlated between gender and compared between the oral health and esthetic perception categories.

Results: Females had higher mean OHIP score in all domains and lower mean EEI score than males. Overall, 76% of patients rated their oral health as satisfactory, more males were satisfied than females. Significantly, 33.3% of females recorded impacts to their oral health compared to 20% of males ($P=0.014$). More males ($p=0.049$) were dissatisfied with the colour, and more females ($p=0.022$) were dissatisfied with the shape. The most common impacts were related to social disability domain in the perception of male patients to colour of teeth ($p=0.00078$) and in Psychological discomfort and disability domains in females with poor perception to the shape and size of teeth, respectively.

Conclusions: One-fourth of patients were associated with impairment in OHRQL, this extent and severity appeared to be expressed by social disability and psychological discomfort.

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1. Introduction

The demand for orthodontic treatment of bilateral CMMLI is high because the condition has an obvious impact on facial aesthetics.^{1,2} There are two major treatment alternatives; orthodontic space closure (OSC), or opening space for prosthetic replacements.³ Closure of the space with canine reshaping/restoration is known as canine

substitution,⁴ it is probably the first choice to avoid long-term restorative replacements but may produce an inferior aesthetic result.⁵

The notion of Oral Health-Related Quality of Life (OHRQL) is defined as “a multi-dimensional construct that reflects people's comfort; self-esteem; and satisfaction with respect to their oral health.”⁶ The Oral Health Impact Profile (OHIP) is the most comprehensive and widely used instrument to measure OHRQL, it was developed by Slade in 1994 and has been validated in cross-sectional population

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studies.⁷

Assessment of dental appearance, involves the six maxillary anterior teeth as they are the most visible ones during communication, speech, functioning and smiling.⁸ The overall dental appearance is generally affected by tooth color, shape, size and position of the anterior teeth.⁹ Several instruments had been used to evaluate the patients perception to dental esthetic, the Eastman Esthetic Index (EEI) was developed by Howitt et al.,¹⁰ in 1967 to consider the aesthetic aspects of malocclusion.

It is hypothesized that patients with bilateral CMMLI who were treated by OSC and canine substitution would not have an adverse effect on the oral health status or a negative impact on the quality of life as a whole. Therefore, this study aims to assess the effects of OSC and canine substitution of the CMMLI on OHRQL among adolescent and young adult Jordanians.

2. Materials and Methods

2.1. Ethical approval

This study was approved by the Head of the Specialty of Orthodontics and The Human Research Ethics Committee (No: 1/20 dated 28th January 2020). All included patients provided verbal and written informed consent of participation. All procedures used were in accordance with the institutional ethical standards of the responsible committee and with the Helsinki Declaration of 1975.

2.2. Participants

The original sample of patients with congenitally missing lateral incisors comprised 67 patients, of these 33 patients who were treated with orthodontic space opening and prosthetic replacement and 9 patients with unilateral CMMLI were excluded from the study. The remaining 25 (15 female, 10 males) patients who had bilateral CMMLI treated with space closure and reshaping of canine tooth, met specific selection criteria and agreed to participate and complete the questionnaire were included in this study.

2.3. Inclusion/exclusion criteria

Patients with bilateral CMMLI, who accepted to participate had not exposed to any orthognathic surgical or extensive restorative procedure; and accepted to answer the questionnaire, and the protocol and provided informed consent were included. Those who did not agree to participate were excluded.

2.4. Questionnaire

All recruited patients were interviewed and asked to provide information concerning their demographic data including age, gender, occupation and residence, they were required to fill the shortened version of OHIP instrument selected to

measure the OHRQL. The OHIP questionnaire measured seven dimensions, namely functional limitation, pain, psychological discomfort, physical disability, psychological disability, social disability and, handicap. The short-version OHIP of the original questionnaire was used to measure the impact of orthodontic/restorative treatment of bilateral CMMLI on quality of life. Two questions were used to measure each dimension¹¹ (Table 5 Appendix 1).

Subjects were asked how they had experienced negative impacts in these dimensions and their responses to the items were recorded by using a five-point Likert scale (0 = never, 1 = Hardly ever, 2 = occasionally, 3 = fairly often, 4 = very often). The total OHIP score is computed by adding up the ratings of all questionnaire items (additive count method). Higher OHIP scores thus indicate poor oral health status. Frequency of impacts is calculated by summing the reported negative impacts (i.e., fairly often or very often) across the 14 statements. The overall score for the OHIP was obtained by summing all responses and thus ranged from 0 to 56 points.⁷ The original English version of the OHIP-14 was translated to Arabic. The validated and approved Arabic version was used in this study.¹²

The patients' perception of the general dental appearance was assessed using a modified version of the EEI^{3,7} questionnaire in which they were asked five questions, for each question subjects were asked to select one of five answers. (1) How satisfied are you with the tooth appearance? (2) The tooth shape? (3) The tooth colour? (4) The tooth size? and (5) the symmetry of their teeth ? The responses were recorded by using a five-point Likert scale of satisfaction (0 = extremely dissatisfied, 1 = dissatisfied, 2 =no opinion, 3 = fairly satisfied, 4 = very satisfied). Dissatisfaction with tooth shape meant the tooth being too pointed, too thin, too broad, or too big; dissatisfaction with tooth colour indicated that the tooth was too yellow, too dark, or too light; dissatisfaction with the size indicated that the tooth was too small or too large; dissatisfaction with symmetry due to right or left side differences in shape or colour of the teeth or a midline shift. Higher EEI scores indicate more satisfaction and good oral health. The overall score for the EEI was obtained by summing all responses and thus ranged from 0 to 20 points. Frequency of impacts is calculated by summing the reported negative impacts (0 = extremely dissatisfied, 1 = dissatisfied) across the five statements.

2.5. Methods error

Reliability and validity were assessed by examining internal consistency and reproducibility. Spearman's rank correlation coefficients were used to measure inter-item and item-score correlations. Cronbach's alpha was calculated to assess the degree of internal consistency. Reproducibility was assessed by repeating the administration of the OHIP and EEI questionnaires to 5 (20%) subjects after two weeks

(test-retest correlation).

2.6. Statistical analysis

Data were analyzed using SPSS (V. 17) software, (SPSS Corporation, Chicago, IL, USA). Answers which reflect the impacts were rated and correlated with esthetic variable related to the size, shape and shade of reshaped canine. ANOVA and paired sample t-test were used to compare means of OHIP scores in relation to gender. Continuous variables were subjected to t-test to identify any systematic differences between the results. Variables using chi-squared were tested to identify differences in EEI scores between the categories. The association between patient's responses to OHIP items by combined EEI scores was analyzed using the Simple logistic regression analysis. Ninety-five percent confidence about the mean were constructed for differences. Level of significance was set at 0.05.

3. Results

Table 1 Shows the distribution of patients in relation to age and treatment time. The mean age of male patients was higher than that of females, however, their treatment duration was less; but the differences were not significant.

Table 2 Shows gender differences in the mean OHIP score. The highest scores were recorded in *Social disability* domain followed by *Psychological discomfort* and *Psychological disability*. Females had higher mean OHIP score than males in all domains. They significantly ($p=0.010$) recorded higher scores for the *Psychological discomfort* domain.

Table 3 Shows gender differences in the mean scores within the esthetic categories and percentages of impacts recorded by the perception of patients. The mean EEI score was 2.62 ± 0.45 , males had higher mean scores compared to females. Between categories, significantly males recorded impacts in colour ($p=0.049$) and females in shape ($p=0.022$). Overall, 65.4% of subjects were satisfied. More males were satisfied than females (72% and 61%, respectively).

Table 4 Shows gender distribution of patients' rating their oral health status in accordance with OHIP and EEI questionnaire. Overall 76% of patients rated their oral health as satisfactory, significantly ($p=0.013$) they responded more satisfactorily to esthetics than oral health questionnaire, in addition, more impacts were recorded in response to OHIP ($p<0.043$). In response to OHIP, males significantly were more satisfied, only 20% recorded impacts to their oral health compared to females (33.3%).

The association between patient's responses to OHIP items by combined patient's perception to dental esthetic parameters was analysed using the Simple logistic regression analysis. The most common impact reported was related to social disability domain. Significant associations ($p=0.00078$) in "a bit irritable with other people" with odds

ratio (OR) 0.3 (95% CI=0.2-0.4), in the perception of male subjects of colour of teeth. In *Psychological discomfort* domains: "self conscious" (OR) 0.4 (95% CI=0.4-1.2, ($p=0.00054$)), and "feeling tense" (OR) 0.5 (95% CI=0.3-0.7, ($p=0.0086$)), were significantly associated related to female subjects with poor perception to the shape of teeth. In *Psychological disability* domain: "Difficulty to relax" and "Embarrassment" were significantly associated with with poor perception of females subjects to the size of teeth ((OR) 0.6 (95% CI=0.5-0.8, ($p=0.0063$)).

Cronbach's alpha was 0.85, indicating high internal consistency of the OHIP. The correlation between OHIP inter-item and the OHIP total score ranged from 0.67 to 0.74. The test-retest correlation coefficient ranged from 0.83 to 0.95 for all individual items and from 0.87 to 0.92 for the subscale scores, indicating that the subscales are reproducible on different occasions.

4. Discussion

This study comprised a sample of dental patients who received orthodontic/restorative treatment for a period of 5 years. All patients were evaluated after the completion of the treatment with a mean duration of 3.5 years, this time was needed to complete the orthodontic treatment which facilitated the restorative reshaping of the canines.

In this study, the females were the majority with a 3:2 ratio. This difference may be explained by a higher demand for orthodontic treatment in females,¹³ or due to a true sex difference in the prevalence of congenitally missing teeth.²

Over 80% of CMMLI were found bilaterally,³ sometimes found unilateral, and where they are missing, it is not unusual to find that the tooth on the opposing side is peg-shaped or dilacerated.¹ In this study, unilateral CMMLI was not included to exclude effects of their loss on midline shift as it is deviated toward that side.¹⁴ In this study, it was reported that the mean age of male patients was higher than that of females, however, age differences were not significant, also there were approximately 33% adolescents under the age of 18 years, so their perception to esthetics was parents/guardians guided.

In this study, the female patients significantly ($p=0.0087$) recorded higher mean OHIP scores compared to males as a whole (29.8 and 24.2; respectively), and in only *Psychological discomfort* domain; which reflects adverse effects to their CMMLI and the combined orthodontic/restorative treatments they had been exposed to during the whole treatment duration. Similar findings were reported previously.¹⁵ In addition, the highest scores were recorded in *Social disability* domain followed by *Psychological discomfort* and *Psychological disability*. These findings might be explained by the increased demand for orthodontic treatment in patients with CMMLI is high because the condition has an obvious impact on facial aesthetics.¹⁶

Table 1: Gender differences of the sample in relation to age and treatment time. (Students t-test)

		Male (n=10)	Female (n=15)	t-test	Total (n=25)
Age	Range	15-21	14-20		14-21
	Mean (SD)	18.1 ±2.08	16.5 ±1.88	0.13	17.2±2.08
Treatment time	Range	2.0-4.0	2.5-4.5		2.0-4.5
	Mean (SD)	3.2±1.8	3.7±2.1	0.33	3.5±1.98

Significant level (p<0.05), SD: standard deviation, n: number;

Table 2: Gender differences in the mean OHIP score according to domains

	Male (n=10)			Female (n=15)			Male mean	Female mean	t-test	Total score	Mean score
	Q1	Q2	Total	Q1	Q2	Total					
Functional limitation	13	25	38	14	47	61	3.8	4.1	0.13	99	3.96
Physical pain	15	12	27	27	18	45	2.7	3.0	0.14	72	2.88
Psychological discomfort	32	34	29	56	48	104	2.9	6.9	0.010*	133	5.32
Physical disability	7	6	13	12	10	22	1.3	1.5	0.21	35	1.4
Psychological disability	18	28	46	32	45	77	4.6	5.1	0.082	123	4.92
Social disability	37	34	71	56	53	109	7.1	7.3	0.23	180	7.2
Handicap	10	8	18	17	12	29	1.8	1.9	0.41	46	1.84
Sum	132	147	242	247	200	447					
Mean	13.2	14.7	24.2	16.5	13.3	29.8	24.2	29.8	0.0087*	688	27.5

* (p<0.05) Significant; n: number; Q: question.

Table 3: Gender differences in the mean EEI score and percentages of impacts according to the perception of patients to the general dental appearance questionnaire.

	Males (n=10)			Females (n=15)			Total (n=25)		
	Sum	Mean	Impacts	Sum	Mean	Impacts	Sum	Mean	Impacts
Appearance	30	3.0	0	40	2.67	0	70	2.80	0
Shape	31	3.1	0	23	1.53 ^b	3 ^b	54	2.16	3
Color	19	1.9 ^a	2 ^a	37	2.47	0	56	2.24	2
Size	31	3.1	0	41	2.73	0	72	2.88	0
Symmetry	33	3.3	0	42	2.80	0	75	3.00	0
Total	144	14.4	2	183	12.20	3	327	13.08	5
Mean	72%	2.88	20%	61%	2.44	20%	65.4%	2.62	20%

^a: P=0.049; ^b P=0.022: denotes significant level (p<0.05).

Table 4: Gender differences of patients rating their oral health in relation to OHIP-14 and EEI questionnaires (chi square test).

Rating	OHIP			EEI			Overall	Chi square test
	Males (n=10)	Females (n=15)	Total (n=30)	Males (n=10)	Females (n=15)	Total (n=30)		
Excellent	3 (30.0)	3 (20.0)	6 (24.0)	4 (40.0)	3 (20.0)	7 (28.0)	13 (26.0)	P=0.013*
Very good	2 (20.0)	3 (20.0)	5 (20.0)	3 (30.0)	4 (26.7)	7 (28.2)	12 (24.0)	
Good	3 (30.0)	4 (26.7)	7 (28.0)	1 (10.0)	5 (33.3)	6 (24.0)	13 (26.0)	
Satisfaction	80%	66.7%	72%	80%	80%	80%	76%	
	P=0.037*			P=0.20				
Fair	2 (20.0)	2 (13.3)	4 (16.0)	1 (10.0)	1 (6.7)	2 (8.0)	6 (12.0)	p=0.043*
Poor	0 (0.0)	3 (20.0)	3 (12.0)	1 (10.0)	2 (13.3)	3 (12.0)	6 (12.0)	
Negative impact	20.0%	33.3%	28.0%	20.0%	20.0%	20.0%	24.0%	
	P=0.014*			P=0.20				

* p<0.05 Significant

Regarding the esthetic perception, the results showed that approximately 65% of patients were satisfied with esthetic parameters; in general the males were more satisfied than females. The gender differences to the esthetic perception were found to be represented as males' dissatisfaction in the colour and females' dissatisfaction in the shape. Shade balance between the canine and the incisors must be considered prior to space closure, greatly improves aesthetics.¹⁷ In this study, approximately 15% of subjects had no opinion on the appearance and symmetry of the maxillary anterior teeth and the size of reshaped canines. The patients, males in particular, disagreed about whether the colour of the tooth next to the central incisor was satisfactory; their main complaint was that the canine replacing the CMMLI looked too dark compared with central incisors. However, the female patients who were not satisfied with the shape of the canines closed the space of the lateral incisors because the tooth looks too large than it should be. It was suggested that special care of female patients, who are more aesthetically criticized than males should be considered.^{2,13}

In this study, the patients did not express impacts in satisfaction with their appearance, the size and symmetry, however, 20% of impacts were due to the shape ($P=0.022$) and colour ($P=0.049$) of the reshaped canines. The reasons for the less satisfaction might arise from the general impression of reshaped canines were not the original teeth that should be in this place in comparison with natural lateral incisor teeth, or there might be due to a fairly high dissatisfaction with the colour of the canines replacing the laterals. Similar findings were reported previously.^{3,9} On the contrary, it was stated that a canine-central incisor colour discrepancy may be more acceptable in males than in females and is less apparent in individuals with a darker complexion.¹⁸

In this study, most of the subjects were adolescents and relatively young adults with no significant gender differences in the mean age, in contrast with a previous study which focused on subjects older than 21 years.¹⁹

When comparing the oral health rating to the OSC treatment, the majority of patients were satisfied and reported positive responses to esthetics than oral health. The main finding of the study was that approximately 24% of patients reported one or more physical, functional and psycho-social impacts as a result of OSC fairly often or very often. As expected, there were significant differences in prevalence of negative impacts to their oral health between males (20%) and females (33.3%) respondents. However, no gender differences in response to esthetics, this could be explained by their understanding the question and thus affect their responses.

Wide differences in individual items of OHIP domains reflected the variations in esthetic perception between genders. Examination of prevalence rates and scores for

individual items indicated that the most common impacts were those related to "social disability" more impacts were reported by subjects in "a bit irritable with other people" item, in the perception of colour of teeth. While poor perception to the size of teeth was associated with *Psychological discomfort* particularly in female patients who also recorded impacts in *Psychological disability* domain as a result of "Embarrassment" associated with the size of teeth. Previous researches reported negative social and psychological impacts on the quality of life.^{20,21}

The present study provides information concerning the impact of OSC in both genders from own patient's perception to esthetics demonstrates a baseline knowledge of oral health in Jordan in this dimension and supports the null hypothesis. Although many studies were performed to study the effect of malocclusion on OHRQL, but it was difficult to compare their results with ours due to variations in the variables incorporated.^{22,23}

One of the limitations of this study was small sample size and low participation rate, basically this is due to low prevalence of CMMLI in Jordan.²⁴ Further research is still needed to overcome the limitations of this study. It is recommended that a more careful pre-treatment examination of colour, size, shape and symmetry compatibility should be carried out to minimize the disharmonies and that gender differences should be considered since female patients are more likely to seek treatment and having higher esthetic need.

5. Conclusion

The highest level of OHRQL dissatisfaction was observed in the *Social disability* subscale. Females significantly reported more negative psychological and social impacts on their OHRQL compared to males who were more satisfied with esthetics, although they were significantly less satisfied with the colour, however, more females were dissatisfied with the shape of the reshaped canines.

Approximately, 24% of patients rated their oral health as unsatisfactory. Significantly, fewer males recorded impacts to their oral health compared to females (20% and 33.3%, respectively). Females were "Self conscious" and "Feeling tense" caused by their with poor perception to the shape, besides, having "Difficulty to relax" and "Embarrassment" as a result of poor perception to the size of teeth, oppositely males were "A bit irritable with other people" as a result of their poor perception of the colour of teeth.

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Table 5: APPENDIX 1 : The shortened version of the Oral Health Impact Profile (OHIP-14) questionnaire used in the study.

The questionnaire contains 7 domains (each is followed by 2 questions). A total of 14 questions and each is followed by 5 responses: Very often [score=4], Fairly often [score=3], Occasionally [score=2], Hardly ever [score=1], Never [score=0].

Functional limitation Q1. Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures? Q2. Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?

Physical pain Q3. Have you had painful aching in your mouth? Q4. Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?

Psychological discomfort Q5. Have you been self conscious because of your teeth, mouth or dentures? Q6. Have you felt tense because of problems with your teeth, mouth or dentures?

Physical disability Q7. Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures? Q8. Have you had to interrupt meals because of problems with your teeth, mouth or dentures?

Psychological disability Q9. Have you found it difficult to relax because of problems with your teeth, mouth or dentures? Q10. Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?

Social disability Q11. Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures? Q12. Have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?

Handicap Q13. Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures? Q14. Have you been totally unable to function because of problems with your teeth, mouth or dentures?

8. Conflict of Interests

The author declares that they do not have any conflict of interests.

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