The Impact on Oral Health Related Quality of Life of Orthodontic Patients with Missing Teeth Substituted with Acrylic Teeth During Orthodontic Treatment

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ABSTRACT

Objective: *This research aims to assess the impact on the Oral Health-Related Quality of Life (OHRQoL) in patients who had the missing teeth substituted with acrylic teeth during orthodontic treatment.* **Materials and Methods:** *Eighteen orthodontic patients aged between 18 and 35 years who had at least one missing tooth, and required prosthesis, were recruited. All patients were undergoing orthodontic treatment with fixed appliance for space opening and idealisation. Patient were randomly allocated into Group 1: Transbond XT adhesive only; Group 2: Transbond XT adhesive with surface sandblasting; Group 3: Transbond XT adhesive with surface abrasion; and Group 4: Triad Gel adhesive only. Upon achieving adequate space intraorally, the acrylic tooth was adjusted to required dimension. Subsequently, the corresponding metal bracket was attached to the labial surface using the different surface preparation prior to archwire ligation. The short version of Oral Health Impact Profile (S-OHIP-14) was used to measure the difference in OHRQoL between pre- (T_0) and 6 months post-attachment (T_1) of acrylic teeth. The patients were monitored monthly for six months.* **Results**: *The S-OHIP-14 for simple count (SC) and additive (ADD) scores method showed 28.3% and 40.4% improvement, respectively, although only the ADD method showed significance. Among all the domains, only the handicap domain showed the highest improvement (54.0%) which was statistically significant (p=0.001).* **Conclusion**: *There was an overall*

improvement in the orthodontic treatment outcome measure on the OHRQoL scores after six-months of having missing teeth substituted with acrylic teeth.

Keywords: *Oral health-related quality of life, Acrylic teeth, Missing teeth*

INTRODUCTION

Oral-health-related quality of life (OHRQoL) has been defined as the significant impact in terms of severity, frequency, or duration of oral problems in daily life that is pertinent to patients leading to changes in their perception of life altogether (Locker & Allen, 2007). There are four main areas of OHRQoL: Oral Function, Orofacial Pain, Orofacial Appearance, and Psychosocial Impact (Schierz & Baba, 2021). Understanding the impact on quality of life (QoL) provides an insight into conditions of patients, management and allocation of resources (Schierz & Baba, 2021)**.**

In term of psychosocial impact, missing teeth were commonly associated with unpleasant spacing which can significantly impact an individual's self-esteem and oral-health-related quality of life (OHRQoL) (Anweigi et al., 2013). A recent study had concluded that missing teeth were associated with deteriorations in OHRQoL (Naorungroj & Thitasomakul, 2020). A previous study stated that tooth loss might profoundly affect patients' psychosocial well-being, resulting in lowered self-confidence, altered self-image, dislike of appearance, concern about dignity, altered behaviour in socializing, and premature ageing (Davis et al., 2000).

In term of functional impact, the absence of permanent maxillary lateral incisors may result in several aesthetic problems, such as spacing between the front teeth, median diastema, and drifting or rotation of the adjacent teeth (Savarrio & McIntyre, 2005).

There are two main orthodontic approaches in managing missing teeth, either closing the space or opening the space for prostheses (Josefsson & Lindsten, 2018). In the space opening method, closed-coil spring or acrylic teeth attached to the orthodontic archwire via a bonded bracket were used to act as a space maintainer. Apart from improving the aesthetics, the cost of this procedure is low and can be performed at chairside (Savarrio & McIntyre, 2005).

Although several studies related to prevalence, aetiology, and management of missing teeth have been done, few studies have investigated the aspects of functional, social, and behavioural implications on OHRQoL. Therefore, this clinical study aimed to assess the impact on OHRQoL of orthodontic patients with missing teeth substituted with acrylic teeth for a temporary period during the orthodontic treatment. The questionnaires were administered prior placement of the acrylic teeth (T_0) and at the end of 6 months post placement of acrylic teeth (T_1)

MATERIALS AND METHODS

Study Design

This study was a prospective clinical study consisting of 18 patients (a total of 37 missing teeth) from the Orthodontic Postgraduate Dental Clinic, Faculty of Dentistry Universiti Teknologi MARA (UiTM). Ethical approval was obtained from the Research Ethics Committee UiTM (600-IRMI (5/1/6)). This study was conducted between September 2018 and December 2020. Informed consent was obtained, and a written study information sheet was given to all participants.

Sample Size Calculation

Sample size calculation was performed using G Power software (G*Power Version 3.1.9.4, Germany). A total of 18 patients were decided for an alpha (α) of 0.05, 80% power and an effect size of 0.8, taking into consideration a 10% dropout

Patient Selection

Subjects who fulfilled the inclusion and exclusion criteria were included in this study. The inclusion criteria for the subjects were healthy patients aged between 18 and 35 years with good oral hygiene, missing at least one tooth (due to hypodontia, trauma, extraction due to caries or periodontal disease) and required space opening for prosthesis replacement. Any patients who presented with active periodontal disease, bruxism, complex medical problems, or impacted teeth were excluded. The subjects were randomised into four different groups based on the surface preparation of acrylic teeth.

Preparation of Acrylic Teeth and Clinical Examination

A clinical examination was performed on each patient to obtain the number, location, and cause of the missing teeth. An impression was taken once the space was idealised for working model fabrication. It was used for the preparation of acrylic teeth (shape and alignment with adjacent teeth) in the laboratory prior to attachment to the archwire intraorally. The shade of acrylic teeth was taken using VITA classical A1-D4® shade guides in comparison to the adjacent teeth.

A pilot hole was drilled following the marker, to a depth of 1 mm using a rose-head diamond bur to create a mechanical undercut on the labial surface of the acrylic teeth. In group 2, the acrylic's labial surface was sandblasted with 50 μm aluminium oxide particles and in group 3, the surface was abraded with a tungsten carbide bur. There was no surface preparation carried out in Groups 1 and 4. In groups 1,2, and 3, a small amount of Transbond™ XT adhesive (3M Unitek) was condensed into the pilot hole and bracket base then attached to the labial surface of acrylic teeth and light-cured for 30 seconds. However, in Group 4, the same protocol was applied for the orthodontic metal bracket's attachment onto acrylic tooth but using Triad® Gel (Dentsply Sirona Prosthetics, York) material as an adhesive material instead of Transbond XT.

All patients were treated with conventional stainless-steel fixed appliances (Aria™ Ortho Organizers, MBT prescription, and 0.022″ x 0.028″ slot). Once the space was adequate, the prepared acrylic tooth was ligated to the arch-wire. The patients were reviewed in a monthly interval, and the attachment between the tooth and metal bracket was monitored for six months. Any dislodgement episode was recorded in terms of attachment days, and newly prepared acrylic teeth were replaced and attached back to the archwire. This study's outcome measure was the changes in patient's OHRQoL after receiving the acrylic teeth.

Oral Health-Related Quality of Life Questionnaire

The following demographic details were included in the questionnaire: age, gender, and educational level. All the subjects were asked to complete a modified shorter version of questionnaire S-OHIP-14 (M) (Saub et al.2005) twice. First, before the acrylic tooth attached to the archwire (T_0) and second, was after six months post-attachment (T_1). The scoring was based on a Likert-type scale and coded 0 = "never", 1 = "hardly ever", 2 = "occasionally", 3 = "fairly often", 4 = "very often".

There were two different methods to score the S-OHIP-14 questionnaire. First, the "simple count method" (SC), in which the total score was calculated by counting the number of items reported as occurring 'very often' (code 4) and 'fairly often' (code 3). The SC score ranged from 0 to 14. The second method was the "additive method" (ADD), in which the total score was calculated by summing up the item codes for the fourteen questions, with the total score ranging from 0 and 56. The higher the value of the score, the worse the oral health status.

Statistical Analysis

Data analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 25 software. Descriptive statistics was presented based on the types and distribution of the data. Categorical data were shown as frequency and percentage, while numerical data were shown as means and standard deviations. The paired t-test was used to compare T_0 and T_1 reading of the S-OHIP-14 scores for each of the domains and statistical significance was set at less than 0.05 (p<0.05).

RESULTS

Sample Profile

Table 1 shows the distribution of demographic features. A total of 18 patients consisting of 10 males (55.6%) and 8 females (44.4%) patients were recruited. A total of 37 acrylic teeth were placed and of which 21 acrylic teeth were placed on male patients (56.8%) and 16 acrylic teeth were placed on female patients (42.3%) with the ratio M: F was 1:0.77. The mean age was 23.11 (SD 5.0), ranging from 18 years to 35 years old, and the majority (88.9%) of patients had university level education. All the patients (100.0%) were from the Malay population. There were five reported major causes for a missing tooth due to environmental factors or congenital factors.as stated in Table 2. The "others" included failed root canal treatment (RCT), dilacerated tooth, and impacted teeth

Higher percentage of acrylic teeth were attached on the upper arch (75.7%) compared to the lower arch (24.3%). In terms of the position of missing teeth, anterior teeth (67.6%) were more apparent compared to posterior teeth (32.4%). The acrylic teeth were placed on the patients with Class I malocclusion (48.6%) followed by Class III (27.0%) and Class II division 1 (21.6%). Subjects with Class II division 2 malocclusion were the least with 2.7%. The acrylic teeth that were used in this study included all except second molar. Lateral incisors were the most common teeth to be replaced (32.4%), and first molars were the least (2.7%) (Table 1).

Table 1: Socio- Demographic Data

Variable		Frequency (n)	Percentage (%)
Gender	Male	10	55.6
	Female	8	44.4
Educational level	Secondary	2	11.1
	Tertiary	16	88.9
Subject with acrylic teeth	Male	21	56.8
	Female	16	43.2
Cause for missing teeth	Hypodontia	15	40.5
	Caries	6	16.2
	Peridontal Disease	1	2.7
	Trauma	11	29.7
	Others	4	10.8
Type of arch	Maxilla	28	75.7
	Mandible	9	24.3
Position of missing teeth	Anterior	25	67.6
	Posterior	12	32.4
Type of teeth	Central incisor	9	24.3
	Lateral incisor	12	32.4
	Canine	4	10.8
	First premolar	7	18.9
	Second premolar	4	10.8
	First molar	1	2.7

Table 2: Causes of Missing Teeth in Relation to the Position and Arch

Cause for missing teeth	Details (n)			
	Maxilla	**Mandible**	**Anterior**	**Posterior**
Hypodontia	8	7	9	6
Dental caries	4	2	2	4
Dental trauma	11	0	11	0
Periodontal disease	0	1	0	1
Others	4	0	4	0

OHRQoL Using S-OHIP-14 Questionnaires

All 18 patients completed the questionnaire at T_0 and T_1. Two scoring methods (SC and ADD) were computed. The SC score (1.28) had a higher percentage of mean difference than the ADD score (5.72) which gave 40.4% and 28.3% of improvement, respectively. However, only the ADD score method showed statistical significance (p=0.032) (Table 3).

Overall, there was an improvement in the OHRQoL of the subjects in this study. The handicap domain showed the highest percentage of changes (54.0%), followed by the psychological discomfort (29.3%), physical disability (26.5%), social disability (19.8%), physical pain (16.9%), functional limitation (10.7%), and psychological disability (10.1%). The effect of acrylic tooth placement only showed statistically significant improvements in the psychological discomfort, physical disability, and handicap domains. (Table 4).

Table 3: Comparison of Overall Mean S-OHIP-14 Score Using Simple Count (SC) Scores Method and Additive (ADD) Scores Method

Variable	T_0 (SD)	T_1 (SD)	Mean difference (95% CI)	t-statistics (df)	p-value
SC Score Method	3.17 (2.60)	1.89 (3.07)	1.28 (-0.07 -2.63)	1.99 (17)	0.062
ADD Scores method	20.22 (10.35)	14.50 (11.16)	5.72 (0.54-10.91)	2.33 (17)	0.032

Table 4: Summary of the Mean S-OHIP-14 Score for All Domain

Variable	T_0 (SD)	T_1 (SD)	Mean difference (95% CI)	t-statistics (df)	p-value
Functional Limitation	2.06 (1.48)	1.83 (1.38)	0.22 (-0.59-1.03)	0.58 (17)	0.570
Physical Pain	2.61 (1.98)	2.17 (1.79)	0.44 (-0.34-1.23)	1.19 (17)	0.249
Psychological Discomfort	4.00 (1.85)	2.83 (2.04)	1.17 (0.71-2.26)	2.25 (17)	0.038
Physical Disability	4.00 (2.11)	2.94 (2.31)	1.06 (0.99-2.01)	2.33 (17)	0.033
Psychological Disability	2.17 (2.12)	1.94 (2.13)	0.22 (-0.80-1.24)	0.46 (17)	0.651
Social Disability	1.67 (2.11)	1.33 (1.82)	0.33 (-0.89-1.6)	0.57 (17)	0.575
Handicap	3.39 (1.91)	1.56 (1.65)	1.83 (0.84-2.83)	3.88 (17)	0.001

DISCUSSIONS

Demographic Data

The ratio of males to females (M: F) with missing teeth in this study was 1:0.77. This was in contrast to the systematic review findings of M:F ratio being 1:1.17 (A. Rakhshan, 2016), which may be associated with biological differences such as small arch among females patients (V. Rakhshan, 2014). Another study also stated a higher ratio of females to males was due to increased concern regarding appearance and aesthetics among females compared to males (Varela et al., 2009).

Different populations and ethnicities also affect the pattern of missing teeth (Goya et al., 2008). In the Caucasian population, hypodontia commonly affected maxillary lateral incisors (Fekonja, 2017), while in the Asian population, hypodontia more commonly affects the lower second premolar (Goya et al., 2008). A study among orthodontic patients in Singapore had reported that the lower second premolar was the most commonly missing tooth among the Chinese and Malay populations, whereas the Indian population had upper lateral incisors as the most common missing teeth (Qian et al., 2017). However, a study among Malaysian population found that lateral incisors were commonly missing (28%) (Hasyiqin et al., 2019), which was similar with the present study (46.7%). The difference between these two studies with the other study could be due to majority of the subjects were Malay.

A study of hypodontia under genetic influence found that specific genes has been identified in missing specific teeth: PAX9 (paired box gene 9) associated with missing maxillary lateral incisor, while MSX1 (muscle segment homeobox 1) associated with missing second premolars and lower central incisors (Al-Ani et al., 2017). In the present study, there were almost equal percentage of hypodontia between maxilla and mandible, with 53.3% and 46.7%, respectively. These findings were consistent with previous study where maxilla and mandible showed almost similar percentage of hypodontia between maxilla and mandible with 54.7% and 45.3%, respectively (Hasyiqin et al., 2019).

Dental trauma was second highest aetiology of missing teeth which commonly affected the maxillary incisors and more frequently occurred in a younger population who live a relatively physically active lifestyle (Taiwo et al., 2017). A study among Malaysian population revealed 78.0% of dental trauma involved maxillary central incisors (Nik-Hussein 2001) . The aetiology of traumatic injuries was commonly

due to falls (71%), followed by bicycle accidents (11%), collisions (9%), violence (7%), and bike accidents (2%) (Gojanur et al., 2015) Predisposing factors of dental trauma could be related to individual malocclusion and features such as increased overjet, inadequate lip coverage of upper incisor (Traebert et al., 2006).

The majority of cases in this present study were Class I malocclusion (48.6%), which were ideal for managing space openings or space distribution to maintain Class I occlusion (Caterini et al., 2017). Orthodontic space opening is indicated in Class 1 malocclusion to establish or maintain normal buccal occlusion and to distribute the available space. Moreover, it helps to achieve favourable functional and occlusal outcomes by maintenance of the canine position and lip support, as well as preserving the ideal intercuspation. In Class III malocclusion, this method improved upper lip support and maintaining buccopalatal dimension of alveolar bone (Pini et al., 2014). Furthermore, the space opening procedure also involved minimal dental reshaping on sound-adjacent teeth compared to space closure. In comparison, adjunctive restorative treatment is required to mimic the ideal shape and colour of the lateral incisor in space closure method (Caterini et al., 2017).

In general, Class II division 1 malocclusion patients presented with convex profile. They would benefit from space closure in the maxillary arch (Caterini et., 2017). However, patients with Class II division 1 malocclusion will benefit from the space creation in the mandibular arch. This was observed in the present study where 21.6% of patients were treated with space opening to improve the profile of the patient and minimize the appearance of retrognathic mandible and weak chin in Class 2 skeletal pattern.

Orthodontic Treatment Outcome Measure (OHIP)

The assessment of orthodontic treatment outcomes is traditionally carried out using clinical indices without considering the subjective measures involving patient's perceptions from an aesthetic, functional or psychological point of view (Kotecha et al., 2013). The QoL measures the patient perception and should be considered as important as clinical indices when evaluating the overall consequences of disease and treatment outcomes (Kotecha et al., 2013) The systematic review have shown that there is a positive association between OHRQoL and orthodontic treatment in adolescent patients (Ferrando-Magraner et al. 2019)

The present study utilized the S-OHIP-14 questionnaire to evaluate the impact towards the OHRQoL of orthodontic patient after receiving the acrylic teeth to maintain the space of the missing tooth and act as a temporary prosthesis.

Our findings showed improvement in the average score for both the ADD and SC method with 5.72 (28.3%) and 1.28 (40.3%) mean difference between T_0 and T_1, respectively. Comparing the present study with a previous study by Andiappan et al. (2015), the mean difference in the SC score were almost same with 1.28 and 1.29, respectively. However, the percentage of mean difference was higher in previous study (67.2%) compared with the present study with 40.3% (SC method) and 28.3% (ADD method). These differences could be due to the difference of the subject's age, type of orthodontic treatment, and severity of malocclusion. Moreover, findings from present study are also consistent with other study which have shown that OHIP-14 scores were lower after receiving orthodontic treatment, indicating that the quality of life has improved.

A recent study by Poudel et al. (2020[)] concluded that most studies on the impact of orthodontic treatment in OHRQoL had shown compromised overall OHRQoL. (Poudel et al., 2020). The OHRQoL mean total score for the present study using SC method was 5.72, which was lower than the previous study (12.71 ± 7.27) (Poudel et al., 2020). It could be due to the shorter duration of monitoring the impact of orthodontic procedure to OHRQoL i.e., one-month post-procedure compared to the six months post-procedure in the present study. The impact was usually higher during the initial stages of treatment, and tapered down thereafter as physiological adaption occurred with time (Poudel et al., 2020).

A study among Brazilian children had compared the impact of orthodontic appliance therapy on OHRQoL between orthodontic-treated groups and orthodontic-non-treated groups. It was concluded that orthodontic treatment resulted in significant improvement in OHRQoL (Feu et al., 2013). Another study

among Brazilian adolescents concluded that adolescents who had completed orthodontic treatment had better oral health-related quality of life than those under treatment or those who never had treatment (Oliveira & Sheiham, 2004). This significant increase in OHIP-14 scores in the non-treated group occurred because children with malocclusion have greater aesthetic impairment and experienced teasing by their peers at school and in their daily lives (Feu et al., 2010). Moreover, the previous study stated that adults had a significantly more psychological impact compared to adolescents as they noticed an earlier adaptation for fixed appliance treatment (Jana Alqefari et., 2019).

The used of acrylic pontic teeth as an aesthetic aid during orthodontic treatment proved to improve patient's aesthetic and smile (Rahul et al.,2016). The finding from previous study also stated that acrylic pontic teeth can improved psychosocial status of the patients. (Sharma, 2013). This was supported by Anweigi et al. (2013[)] who had shown that adults who completed orthodontic treatment with tooth spaces restored using resin-bonded bridgework (RBB) showed a statistically significant difference in the improvement of the median OHIP summary scores post-treatment (p = 0.01). Therefore, it was possible to determine the impact of prosthesis both clinically and on OHRQoL (Anweigi et al., 2013). The findings from the present study also showed a significant improvement between T_0 and T_1 (p = 0.032) in ADD scores which showed that patients were satisfied to have acrylic teeth replace their missing teeth as well as a temporary measure for better function and aesthetic. Hence, it can be recommended that provision of the prosthesis is vital to have a positive impact on the OHRQoL of patients with missing teeth.

Furthermore, psychological discomfort and physical disability were the most affected domains at the start (T_0) with 4.00 mean score in the present study. In comparison, previous study found that functional limitation and social disability were the most prevalent domains of OHRQoL among the patients with tooth loss (Anbarserri et al., 2020). The difference could be due to the severity of tooth loss. When there was more tooth loss, there was higher OHIP-14 score which indicated higher oral health impairments.

The present study also showed that psychological discomfort of eating and embarrassment significantly reduced (p=0.038) after the six months intervention. It showed that patients were able to eat well and felt less shy at T_1. This is similar to findings in other studies, which showed that patients suffered less psychological discomfort after one month of orthodontic treatment (Lai et al., 2017). The physical disability also improved significantly (p=0.033) after six months, possibly because they were able to eat well and smiled more confidently. This is in contrast with findings of previous studies reporting that missing teeth did not affect children's psychosocial status (Laing et al., 2010). These findings could be because children were not really concerned with the spacing between their teeth as it is a common developmental malocclusion for their age group (Feu et al., 2013)

There was also a significant improvement (p=0.001) of the handicap component which showed that replacement with acrylic teeth, immensely improved patients' OHRQoL in general and more specifically, the patients' confidence (Anweigi et al., 2013). However, other OHRQoL domains in this present study, such as functional limitation, physical pain, psychological disability, and social disability, showed no statistically significant difference at the end of six months of the study. The different improvements in some domains could be attributed to the different demographic features of patients in the present study.

Limitation of This Study

The sample size of this present study was small and limited to a single centre. It is suggested that future study could involve a larger sample from multicentre to assess the impact of OHRQoL on patients who require temporary prosthesis for their missing teeth during orthodontic treatment.

CONCLUSION

1. There was significant difference in the overall improvement of OHRQoL scores six months after attachment of the acrylic teeth (ADD score p=0.032).
2. The handicap domain showed the highest percentage of change (54.0%) with a statistically significant

difference (p=0.001) of mean scores six months after attachment of acrylic teeth.

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CONFLICT OF INTEREST
The authors declares that there is no conflict of interest in this study

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