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Oral Hygiene Status and Experience of Orthodontic Appliance Breakage Among Adolescents and Young People Treated at Smiles Dental Clinic, Dar es Salaam, Tanzania

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Abstract
Introduction: Treatment of malocclusion with fixed orthodontic appliances can create some stagnations that harbour plaque with concomitant obstruction to conventional oral hygiene procedures.
Objectives: The purpose of the present study was to assess oral hygiene status, and determine its effect on treatment duration and orthodontic appliance failure among adolescent and young orthodontic clients treated at Smile Dental Clinic.
Methods: A retrospective study covering the period between 2019 and 2022 was conducted at Smile Dental Clinic. A total of 176 dental records of adolescent and young orthodontic clients aged 10 to 24 years were accessed to collect information on oral hygiene status, number of dental visits, missed scheduled appointments, socio-demographics and status of brackets and molar tube breakages.
Results: A high proportion of female (71.4%) and young orthodontic clients aged 20 – 24 years (50.6%) had good oral hygiene. A significantly high proportion of clients in boarding schools (67.8%) and those who frequently missed scheduled appointments (91.9%) had poor oral hygiene status. Treatment duration was longer for clients with poor oral hygiene (30.5 months versus 26.8 months) but those with good oral hygiene made significantly fewer numbers of dental visits (8 versus 10). Clients with poor oral hygiene were 9 and 14 times more likely to experience broken molar tubes and broken brackets respectively.
Conclusion: Oral hygiene of adolescent and young orthodontic clients treated is sub-optimal and affects the rate of orthodontic appliance failure and duration of fixed orthodontic treatment duration. Increased exposure to oral hygiene messages through frequent dental visits may help to motivate clients to maintain good oral hygiene.

Keywords: Oral hygiene, bracket failure, molar tube, orthodontic treatment, Smiles dental clinic, Tanzania.

Introduction

Malocclusion can negatively affect patients' oral health-related quality of life, especially the psychological aspects (Masood et al 2013, Mtaya et al, 2008). To address the consequences of malocclusion, orthodontic treatment is provided to enhance individuals' dental function and aesthetics as well as their social well-being and quality of life (Buthelezi &Madiba, 2021). However, treatment of malocclusion with fixed orthodontic appliances can create some stagnations that harbour plaque which is a harmful layer of bacteria on the teeth that cause permanent damage to

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dental tissues ranging from white spot lesions to dental caries (Kawasar et al, 2017; Attasi & Awartani, 2010; Zachrisson et al, 1971).

treated with multi-bracket appliances (MB) show increased plaque accumulation and increased gingivitis (Klukowska et al, 2011; Heintze et al, 1999; Liu et al 2011). The physiological cleaning mechanism of oral muscles and saliva is restricted by the irregular surface of the MB (Kafle et al, 2020). In addition, studies have shown altered microbial flora in patients with MB (Liu et al, 2011; Freitas et al, 2014; Turkkahraman et al, 2005; Yanez-Vico et al 2015; Naranjo et al, 2006).

Apart from enhancing plaque accumulation, fixed orthodontic appliances components such as brackets, elastic ligature and archwires impede conventional oral hygiene procedures (Arici et al, 2007), therefore placing orthodontic patients with poor oral hygiene control at increased risk of poor treatment outcomes such as bracket failure, and developing gingivitis and periodontitis (Thornberg et al, 2009; Zachrisson et al, 1972).

Adherence to proper oral hygiene practices during orthodontic treatment is critical to maintaining good oral health and achieving successful treatment results. To maintain good oral and periodontal health, orthodontic patients are required to practice optimal oral hygiene measures such as brushing their teeth at least twice a day and using additional tools including interdental aids and mouthwash (Aljohani & Alsaggaf, 2020).

Therefore, maintaining an adequate level of oral hygiene during orthodontic treatment requires commitment from the patient to practice good oral hygiene measures and to develop skills that demand time, effort, and motivation. Whereas some studies reported rapidly declining of clients' adherence to the recommended frequency of tooth brushing after the initial bonding in one study (Jihad, 2018; Lara-Carrillo et al, 2010; Sawai et al, 2019; Pandey et al, 2019; Shah et al, 2018; Eid et al, 2014), others have demonstrated that patients' oral health-related behaviour improved during and after orthodontic treatment (Aljohani & Alsaggaf, 2020; Al-harbi et al 2018; Baheti & Toshniwal, 2015; Alhaija et al 2018; Atassi &Awartan, 2010; Martignon et al, 2010).

In Tanzania, there is a scarcity of studies which have explored the effect of oral hygiene on orthodontic treatment duration and outcomes. Therefore, the present study assessed oral hygiene status and explored its association with orthodontic treatment duration and appliance breakage among clients at Smile Dental Clinic.

Materials and methods

A retrospective study was conducted to explore the association between oral hygiene and orthodontic treatment duration and outcomes. Information on oral hygiene, appliance breakages, missed dental appointments and sociodemographic was extracted from patients' files. The sample size comprised of all 176 individuals aged 10 – 24 years with malocclusion and treated with fixed orthodontic appliances at Smile Dental Clinic. The oral hygiene of all patients seen at the clinic is assessed by a dental assistant before sending them to either the general dentist or orthodontist. Thus, a practical, easy-to-use Visible Plaque Index (VPI) was used to assess the quality of oral hygiene through clinical observation of the presence of biofilm on dental surfaces using simple categorical definitions of the presence and absence of plaque (Ainamo & Bay, 1975).

During each dental visit, oral hygiene was assessed by examining six teeth in the dentition (16, 21, 24, 36, 41 and 44). If one of these teeth was missing, an adjacent distal tooth or if non-existence, a mesial tooth was examined. Teeth were divided into four areas mesial, lingual, distal and buccal. Using a periodontal probe, each quarter of the tooth was swept approximately 1mm into the sulcus to detect plaque. If visible plaque was apparent on the probe, it was counted as positive. The maximum positive plaque was 24 per examined individual. The individual index value was calculated by dividing the sum of the positive plaque findings by the sum of the assessed surfaces times 100. A score of 25% to 39%

was considered good oral hygiene and a score of 40% to 100% was rated as poor oral hygiene. To get an average score for all the dental visits made, the sum of oral hygiene per cent scores for each individual's visits was divided by the total number of individual visits.
Collected data was analysed using SPSS version 23.0 (IBM Corp, Armonk, NY, 2015). The chi-square test was used to measure the association between oral hygiene status and independent variables such as age, sex, health insurance status and school type. T-test was used to compare mean treatment duration, frequency of orthodontic appliance breakages, and mean number of dental visits between clients with poor and good oral hygiene status. The level of significance was set at $P<.05$.

Results

From January 2019 to December 2022 a total of 11,912 teeth surfaces of 176 adolescents and young orthodontic clients were examined to assess oral hygiene status. On average a client made 10 dental visits throughout treatment with those with good oral hygiene having made fewer dental visits (8 versus 10). Less than half (48.3%) of the studied orthodontic patients had health insurance and more than half were in boarding school (57.4%) and had poor oral hygiene (56.2%). Poor oral hygiene varied with sex, age, school type and adherence to scheduled dental appointments. A high proportion of female orthodontic clients (71.4%) and those aged 20 – 24 years (50.6%) had good oral hygiene compared to their counterparts. Those in boarding schools (67.8%) and who missed dental appointments (91.9%) had poor oral hygiene compared to their counterparts. A significantly high proportion of those who experienced breakage of orthodontic appliances (broken bracket 89.9% and broken molar tube 91.9%) had poor oral hygiene (Table 1).

Table 1. Profile of Orthodontic Patients (N = 176)

	Poor oral health % (n)	Good oral health % (n)	P value
Sex			
Males	42 (42.4)	22 (28.6)	0.041
Females	57 (57.6)	55 (71.4)	
Age			
10 – 14 years	34 (34.3)	19 (24.8)	0.023
15 – 19 years	35 (35.4)	19 (24.8)	
20 – 24 years	30 (30.3)	39 (50.6)	
Health insurance			
Insured	50 (50.5)	35 (45.4)	0.506
Not insured	49 (49.5)	42 (54.6)	
School type			
Boarding	67 (67.8)	34 (44.2)	0.002
Day	32 (32.3)	43 (55.8)	
Broken brackets			
Yes	89 (89.9)	42 (54.5)	0.000
No	10 (10.1)	35 (45.5)	
Broken molar tube			
Yes	95 (96.0)	34 (44.2)	0.000
No	4 (4.0)	43 (55.8)	
Missed appointments			
Yes	91 (91.9)	58 (75.3)	0.000
No	8 (8.1)	19 (24.7)	

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Table 2. Mean Treatment Duration, Number of Dental Visits and Frequency of Broken Orthodontic Appliances

	Poor oral hygiene (n = 99)	Good oral hygiene (n = 77)	All N = 176
The mean number of broken brackets	2.4 (1.4)**	0.7 (0.5)	1.6 (1.4)
Mean number of broken molar tubes	1.3 (0.5)**	0.5 (0.4)	0.9 (0.8)
The mean number of dental visits	10	8**	10
Mean treatment duration (months)	30.5**	26.8	28.8

**P>0.0001; *P>0.005

Orthodontic patients with poor oral hygiene frequently experienced broken orthodontic appliances, had longer treatment duration (30.5 months versus 26.8 months) and made more dental visits (10 versus 8) compared to their counterparts with good oral hygiene (Table 2).

Table 3. Association of Oral Hygiene with Dental Visits, Broken Orthodontic Appliances and Treatment Duration (Adjusted for Insurance, Dental Visits, Sex and Age).

	Adjusted Odd Ratio	95% Confidence Interval
Girls	0.6	0.3 – 1.3
10 – 14 years	**1**	
15 – 19 years	0.4	0.2 – 1.3
20+ years	**0.3**	**0.1 – 0.9**
Day scholars	0.7	0.3 – 1.8
Health insured patients	1.4	0.1 – 3.1
Broken molar tube	**9.1**	**3.5 – 23.5**
Broken bracket	**13.5**	**3.9 – 47.1**
Dental visits	1.5	0.6 – 3.4

Orthodontic patients with broken brackets and broken molar tubes were more likely to have poor oral hygiene. However, those aged 20 – 24 years were less likely to have poor oral hygiene (Table 3).

Discussion

Good oral hygiene during orthodontic treatment is essential for achieving optimum results in a short duration of treatment (Kafle et al, 2020). Results of this study showed that more than 50% of patients had poor oral hygiene which varied with the sociodemographic characteristics of the studied clients. In line with other studies (Jakavice et al, 2023; Jihad, 2018; Aikins & Ututu, 2017; Mtaya et al, 2009) we demonstrated that female and young orthodontic clients have optimal oral hygiene compared to male and adolescent orthodontic clients. However, our findings are in disagreement with a study which did not find differences in the oral hygiene status of male and female, and adolescent and young orthodontic clients (Buthelezi, 2021)

Orthodontic clients studying in boarding schools demonstrated poor oral hygiene, this may be due to limited exposure to oral hygiene messages because of less contact with orthodontists stemming from few dental visits and frequently missed dental appointments. Other studies indicated

that adherence to orthodontic treatment follow-up visits strongly correlates with improved oral hygiene status of patients Yan et al, 2022; Hussein & Ismail, 2023; Atassi & Awartan, 2010). Results of our study point to a similar direction, that is high proportion of orthodontic patients with poor oral hygiene had missed more dental appointments and made very few dental visits.

The orthodontic treatment duration of the studied adolescents and young people was longer than the required less than 2 years to complete comprehensive orthodontic treatment (Tsichlaki et al, 2016). In the current study, more than half of the clients had poor oral hygiene which substantially contributed to orthodontic appliance failure (clients with poor oral hygiene were more likely to experience broken molar tubes and brackets). Several other studies have also shown that poor oral hygiene is significantly associated with broken orthodontic appliances (Jakavice et al, 2023; Li et al, 2022; Buthelezi, 2021; Kafle et al, 2020; Al-Duliamy, 2018; Jihad, 2018).

The Visible Plaque Index was proposed by Ainamo and Bay (1975) and was used to assess the quality of oral hygiene through clinical observation of the presence of biofilm on dental surfaces using simple categorical definitions (presence or absence of plaque). The index is very simple and practical but prone to subjectivity. Nevertheless, the use of one dentist who assessed and recorded the oral hygiene status of all adolescent and young orthodontic clients to inform clinical decisions may have minimized the subjectivity. Nevertheless, the results should be interpreted with caution as some of the clinical information concerning the plaque values might have been lost in the process of quantifying the index.

Conclusion

Oral hygiene of adolescent and young orthodontic clients treated is sub-optimal to the extent it increases the rate of orthodontic appliance failure and affects the duration of fixed orthodontic treatment duration. Increased exposure to oral hygiene messages through frequent dental visits may help to motivate clients to maintain good oral hygiene.

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