PREVALENCE AND INTENSITY OF PAIN EXPERIENCED IN THE INITIAL PHASE OF FIXED ORTHODONTIC APPLIANCE TREATMENT IN TANZANIANS

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ABSTRACT

BACKGROUND: In recent times, awareness of malocclusion has increased, and access to treatment has become more widespread. Henceforth, fixed orthodontic appliances (FOAs) have become increasingly popular in many societies. However, orthodontic treatment has often been associated with pain, especially in the initial phase of treatment.

AIM: This study aimed to determine the prevalence and intensity of pain experienced in the initial phase of fixed orthodontic appliance treatment among orthodontic patients attending the Dental Clinic of the Muhimbili University of Health and Allied Sciences (MUHAS) in Dar es Salaam, Tanzania.

MATERIALS AND METHODS: This was a hospital-based longitudinal study involving 178 orthodontic patients attending the MUHAS Dental Clinic. The study participants were conveniently selected and underwent clinical examination prior to the initiation of treatment. Then, they were given questionnaires to fill out at different time stamps. The Modified McGill Pain Questionnaire-Short Form (MMPQ-SF) with Visual Analogue Scale (VAS) and Present Pain (Intensity) Index (PPI) questionnaires were filled by the patients at home, daily, for a week, starting 24 hours after treatment initiation (T1-T7) and at T8 (after one month). The analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software, version 20.0. Univariate analyses included the generation of descriptive statistics. The relationship between the two variables was assessed using bivariate analyses, including the Kruskal-Wallis test, the Mann-Whitney U test, and the Friedman test. The p-value for statistical significance was set at $p < 0.05$.

RESULTS: The majority of subjects were female (56.2%). The age range was 12-39 years, with 73% of participants falling within the 12-19 years age group. Regarding pain experience, the majority of participants (95.5%) reported experiencing orthodontic pain during the data collection period. Considering the nature of the pain, most patients described their pain as 'tight' (89.9%) for the sensory category and 'frustrating' (11.2%) for the affective category. Generally, the prevalence and intensity of pain increased in the first three days. Thereafter, a consistent decrease in pain severity and intensity was experienced. At T8, no participant reported pain.
Regarding the pain severity, 'severe' and 'moderate' pain was experienced over the first three days. The relationship between pain scores and socio-demographic characteristics, facial profiles as well as malocclusion traits was also assessed. The pain scores varied only with malocclusion traits, specifically with the presence of crowding ($p = 0.007$) and rotations ($p = 0.039$), which were associated with higher pain scores. The Friedman test was also used to explore each of the three scales. Overall, there was a progressive decrease in the level of pain over time.

CONCLUSION: Pain experience was reported by most participants during the initial stages of orthodontic treatment. The pain was tight as well as frustrating in nature and was severe at the start of treatment but improved over time. Pain relief measures should be widely considered when initiating orthodontic treatment.

KEYWORDS: Fixed orthodontic appliance, pain experience, malocclusion, Tanzania

INTRODUCTION

Malocclusion affects a sizable proportion of Tanzanian children; the most recent National Oral Health Survey indicated that 61.2% of children aged 5, 12, and 15 years had at least one form of malocclusion. While some forms of malocclusion may not require corrective orthodontic treatment, a substantial number of children are potential orthodontic patients who require care.

Orthodontic pain has been frequently reported to be a sequela of orthodontic treatment. This is due to orthodontic tooth movement causing inflammatory reactions in the periodontium and dental pulp, which stimulate the release of various biochemical mediators responsible for pain sensation[2]. Pain is undoubtedly unpleasant and would negatively influence one's well-being. This pain has been reported to vary in intensity by different publications; however, the greatest severity was frequently reported during the first month of treatment.

Orthodontic treatment is broad; nonetheless, it can be divided into three major categories: preventive, interceptive, and corrective. Orthodontic treatment may be delivered via removable or fixed appliances[7]. Fixed orthodontic appliance treatment involves attaching bonded devices to the teeth that are not removable by the patient, alongside the ligation of a wire to the devices. That appliance imparts the necessary force required for guided tooth movements to treat malocclusion[8].

Previous studies showed that a significant number of patients, especially those in the younger age, have a harder time becoming accustomed to their therapy due to experiencing physical pain[9]. Moreover, these patients often feel uncomfortable with their altered appearances due to wearing fixed orthodontic appliances in their mouths. However, the growing number of cases undergoing orthodontic treatment in recent years has allowed the aesthetic component to be a non-factor. This is because the treatment has continued to be widely accepted and known to be transient.[11] However, the physical symptoms, specifically pain and discomfort, remain a primary concern for both patients and clinicians[11–13].

Orthodontic pain severity is reported to be most intensely felt during the first two days after force application and gradually deteriorates over week[14]. The researchers further documented that excruciating pain and discomfort during the first month is the reason for most patients deciding to cease treatment[14]. The initial stage of orthodontic treatments significantly influences patients' perceptions of the entire treatment process, as it is the period during which patients must become accustomed to

the new treatment. To improve patient compliance and overall treatment outcomes, pain should be kept to a minimum whenever possible.[15] Prior to the present study, there was no retrievable study that addressed matters pertaining to pain experience in the initial stage of orthodontic treatment in Tanzanian patients. Therefore, based on reports from elsewhere, this study was conducted with a focus on the pain experienced by patients in the initial month of orthodontic treatment.

MATERIALS AND METHODS
This was a longitudinal study involving 178 new orthodontic patients from the MUHAS Dental Clinic, who were conveniently selected. The inclusion criteria allowed orthodontic treatment-seeking patients scheduled to receive fixed orthodontic appliances, aged 12 to 40 years, to participate in the study. Patients who had previously received orthodontic treatment were excluded from the study.
The study obtained ethical clearance from the MUHAS Institutional Review Board (IRB), with the ethical clearance number being DA.282/298/01.C/. Permission for data collection was obtained from the management of the MUHAS Dental Clinic. The patients voluntarily gave written informed consent for their participation in this study. Minors provided assent for participation in the study in addition to the consent form signed by their parents or guardians.

Data Collection and Instruments
Validity and Reliability
The MMPQ-SF, along with the VAS and PPI instruments, was translated into Kiswahili with the assistance of a committee of experts. Thereafter, the instruments were back-translated into English; neither the content nor wording of the scales was modified during the translation and back-translation process. The Kiswahili questionnaire was subsequently pilot-tested prior to the initial data collection time. Malocclusion was assessed in accordance with criteria by al-Emran et al.[16] with slight modifications. The principal investigator was calibrated against an experienced practicing orthodontist in the MUHAS Dental Clinic. Both the principal investigator and the practicing orthodontist performed the clinical examination during the pilot study for calibration purposes. The inter-examiner agreement was almost perfect (Cohen's Kappa value = 0.95).
During the main data collection, the internal reliability, as measured by Cronbach's alpha coefficient, was 0.91 for the MMPQ-SF, 0.94 for the VAS, and 0.91 for the PPI.

Clinical examination
The patients were clinically examined by the principal investigator prior to the initiation of treatment and were given questionnaires to complete at various time points. The clinical examination form was used to record the patients' socio-demographic characteristics and their existing malocclusion traits. Extra-orally, the patient's facial profiles were noted, whether they were straight, convex, or concave. Intra-orally, intra-arch malocclusion traits, such as the presence of space discrepancies or rotations, and inter-arch malocclusion traits, including an increased overjet, as well as the canine and molar relationships, were recorded.
MMPQ-SF with VAS and PPI
The MMPQ-SF, VAS, and PPI questionnaires were completed by the patients at home daily for a week, starting 24 hours after treatment initiation (T1-T7) and at T8. The higher the scores on these scales, the more

severe the patient's pain.[17]
Data analysis
The analysis was done using a Statistical Package for the Social Sciences (SPSS) version 20.0. Univariate analyses included the generation of descriptive statistics. Bivariate analyses were done using Kruskal-Wallis and Mann-Whitney U tests. The MMPQ-SF, VAS, and PPI scores were analyzed as continuous variables, but their frequencies were not normally distributed; hence, the Friedman test was used to compare the repeated measurements of pain intensity across the three scales (MMPQ-SF, VAS, and PPI) over time (T1-T8). The p-value for statistical significance was set at $p < 0.05$.

RESULTS
Socio-demographic distribution of the patients
Eight patients were excluded due to their incomplete questionnaires; hence, the study had a response rate of 96.2% (178 out of 185). Most of the subjects were females (56.2%). The age range was 12-39 years, with 73% of participants falling between 12 and 19 years (Table 1).

Table 1: Socio-demographic distribution of orthodontic patients in the initial phase of treatment, by numbers and percentages (N=178).

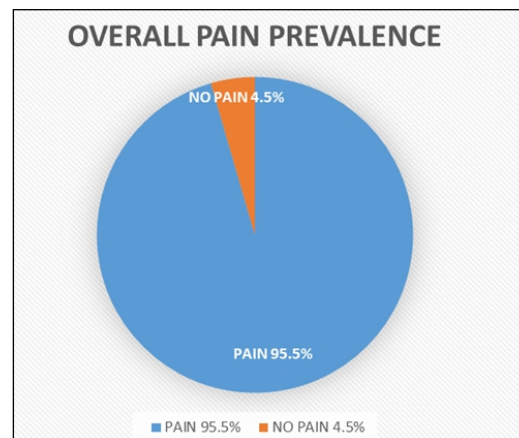| Variable	Category	Number	Percentage
Age	*12-19*	130	73.0
	20-39	48	27.0
Sex	*Male*	78	43.8
	Female	100	56.2

MMPQ with VAS and PPI

Figure 1: Overall pain prevalence among orthodontic patients in the initial phase of treatment (T1-T8) at the MUHAS Dental Clinic (N=178).

Regarding pain experience, the majority of participants (95.5%) reported experiencing orthodontic pain during the data collection period (T1-T8) (Figure 1).
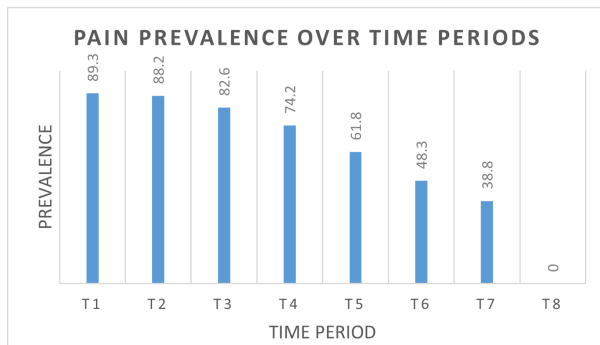
Figure 2: Prevalence of pain experience at T1-T7 and T8 among orthodontic patients in the initial phase of treatment (N=178).

Figure 2 illustrates the prevalence of pain at various periods, where T1-T7 represents the first seven days after treatment initiation, and T8 denotes one month after treatment initiation. The figure shows that most of the patients experienced pain on the first day after treatment. The pain prevalence ranged from a high score of 89.3 at T1 to 38.8 at T7. There was a steady decline thereafter, and by the end of the month, no patient reported experiencing pain.
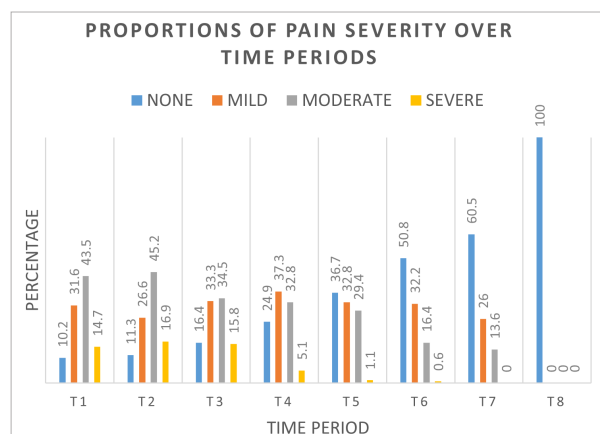

Figure 3: Frequency distribution of orthodontic patients by their levels of pain severity during the initial phase of treatment (N=178).

Figure 3 shows the frequency distribution of pain severity as reported by orthodontic patients at each period. A trend shows that 'severe' and 'moderate' pain were experienced during the first three days. Meanwhile, a percentage of those who reported 'none' increased in each subsequent time of measurement.

Table 2: Percentage distribution of the patients by the nature of pain they experienced in the initial phase of orthodontic treatment (N=178).

Category	Nature of Pain	Number	Percentage (%)
Sensory	Pressure	12	6.7
	Sore	-	-
	Aching	2	1.1
	Throbbing	2	1.1
	Tight	160	89.9
	Cutting	2	1.1
	Burning	-	-
	Tingling	1	0.6
	Pulling	5	2.8
	Dull	-	-
	Uncomfortable	6	3.4
Affective	Strange	4	2.2
	Frustrating	20	11.2
	Annoying	6	3.4

Table 2 shows that most patients described their pain as 'tight' (89.9%) for the sensory category and 'frustrating' (11.2%) for the affective category.

Table 2: Percentage distribution of the patients by the nature of pain they experienced in the initial phase of orthodontic treatment (N=178).

Time Period	Pain scale	Median	Interquartile Range
T1	MMPQ	2	1-2
	VAS	5	2-6
	PPI	2	1-2
T2	MMPQ	2	1-2.25
	VAS	4	2-6
	PPI	2	1-2
T3	MMPQ	2	1-2
	VAS	3.5	1-6
	PPI	2	1-2
T4	MMPQ	1	0-2
	VAS	2	0-5
	PPI	1	0-2
T5	MMPQ	1	0-2
	VAS	2	0-4
	PPI	1	0-2
T6	MMPQ	0	0-1
	VAS	0	0-3
	PPI	0	0-1
T7	MMPQ	0	0-1
	VAS	0	0-2
	PPI	0	0-1
T8	MMPQ	0	0-0
	VAS	0	0-0
	PPI	0	0-0

Table 3 presents the median scores of pain across the periods, as measured by the MMPQ-SF, VAS, and PPI scales. There was a decreasing trend in pain scores over time; whereby, the highest scores were at T1 and T2, and the lowest were at T8, meaning that the pain severity diminished with time. This was constant across all the pain measuring instruments.

Table 4: Mean ranks of patients' pain scores by the malocclusion traits at T1 (N=178). (Mann-Whitney U test). *p<0.05

Malocclusion trait	Category	Mean rank	p-value
Crowding	Yes	95.37	0.007*
	No	71.07	
Spacing	Yes	76.82	0.075
	No	93.17	
Rotations	Yes	94.91	0.039*
	No	78.01	
Increased overjet (>4mm)	Yes	89.78	0.950
	No	89.30	
Anterior crossbite	Yes	87.18	0.744
	No	90.17	
Deep bite	Yes	85.18	0.590
	No	90.48	
Open bite	Yes	69.02	0.050
	No	92.24	
Scissor bite	Yes	89.54	0.998
	No	89.50	
Posterior crossbite	Yes	94.00	0.693
	No	88.99	
Midline shift	Yes	84.70	0.395
	No	91.70	

Mann-Whitney U test was done to determine the relationship between pain scores and specific malocclusion traits. Only at T1 were statistically significant differences observed in pain scores between patients with and without crowding (p = 0.007) and with and without rotations (p = 0.039); specifically, the presence of crowding and rotations was associated with higher pain scores.

Furthermore, the relationship between pain scores and socio-demographic factors, facial profiles, and molar and canine relationships was explored. At all times of measurement, the Mann-Whitney U test showed no variation in pain by sex or age. Moreover, the Kruskal-Wallis test showed no variation in pain by different types of facial profiles, molar or canine relationships.

Table 5: Mean ranks of the patients' pain scores across different time periods and pain measuring instruments (N=178). (Friedman test).

Time period	Mean rank			p-value
	MMPQ-SF	VAS	PPI	
T1	6.13	6.31	6.08	
T2	6.52	6.63	6.45	
T3	5.92	6.17	5.94	
T4	4.93	4.99	4.95	0.000
T5	4.17	4.10	4.22	
T6	3.29	3.04	3.32	
T7	2.96	2.68	2.98	
T8	2.08	2.07	2.06	

The Friedman test was also used to explore each of the three scales measuring pain. The results indicated a statistically significant difference in pain scores across different measurement times (T1-T8) in each scale. For the MMPQ-SF instrument, $X2(7, n=178) =776.376$, $p<0.005$). For VAS, $X2(7, n=178) =838.644$, $p<0.005$). For PPI, $X2(7, n=178) =758.285$, $p<0.005$). Overall, there was a progressive decrease of the level of pain over time.

DISCUSSION

This study assessed the prevalence and intensity of pain experience in the initial phase of fixed orthodontic appliance treatment among patients attending the MUHAS Dental Clinic in Dar es salaam, Tanzania. It is the first study in Tanzania that have assessed orthodontic treatment in that light. The patients involved ranged in age from 12 to 39 years, with the 12–19-year-olds being the most numerous. This age distribution is similar to what was observed in other studies, indicating that adolescents are more likely to seek orthodontic treatment than adults [18,19]. The finding can further be linked to increased parental concern about their children's aesthetics, the increased availability of orthodontic care, and the presence of health insurance schemes in Tanzania.

Additionally, this may reflect higher self-consciousness regarding aesthetics in the younger age group. Regarding sex, slightly more than half of the participants were females (56.2%). This distribution is common among orthodontic care-seeking patients in many parts of the world, including China, India, Malaysia, the United States, and Nigeria.[8, 19-21] Possibly, such findings are due to the higher perceived aesthetic needs in females compared to males.

This study reported an overall prevalence of pain of 95.5% during the first month of orthodontic treatment. The first three days had more than three quarters of participants reporting pain from various categories. The presence of pain during the initial period of orthodontic treatment has been widely reported[2,6,22,23]. However, in the literature that could be retrieved, gaps and variations were noted with respect to the prevalence, nature, intensity, and duration of pain. In this study, it was found that the prevalence of pain decreased daily over the course of the first week. Whereby, on the first day following treatment initiation, the prevalence was 89.3% and by the seventh day it was 38.8%. The finding is supported by earlier studies, which showed that orthodontic pain is mainly concentrated within the first two days of force application and tends to deteriorate over the first week. [14,24] Presently, after a month, no participant reported pain. In a study conducted by Banerjee et al., a similar pain experience pattern was reported by the majority of their participants. Conversely, a study by Brown and Moerenhout reported lower values [3]. Generally, it is worth noting that pain is a subjective phenomenon; therefore, it may be influenced by an individual patient's perception. Moreover, cultural differences may be a factor that affects the pain perception of certain populations.[2]

The MMPQ-SF, as it uses descriptor terms, helped to identify the nature of pain the patients felt in the present study. More than 80% of the patients referred to their pain as being 'tight' and 11.2% reported it to be 'frustrating'. This implies that the sensory (physical) pain dimension was more negatively felt than the affective (psychological/ emotional) pain dimension.

Pertaining to orthodontic pain severity, an earlier researcher showed that this can vary with age, sex, personal pain tolerance ability, treatment force magnitude, emotional state and stress, cultural differences and

previous pain experiences [2]. Nonetheless, it should be noted that orthodontic pain is a sequel of an inflammatory reaction, which causes changes in blood flow, following the activation of fixed orthodontic appliances. Thus, patients in the current study reported the highest pain scores in the first days of treatment. Furthermore, these were the days where the frequencies for moderate and severe pain were the highest. The findings are similar to those reported in previous studies [14,24]. In literature, it is indicated that orthodontic force activation creates tension and compression zones in the periodontal ligament space. This may cause patients to experience some pain and discomfort [25].

Across malocclusion traits, there were statistically significant differences in the pain intensities during the first day. This was with respect to the patients with crowded and rotated teeth, whereby the presence of crowded and rotated teeth was associated with higher levels of pain. Some studies, however, reported no relationships between the tooth positions, applied forces, and the pain experienced by the study participants. [4,25] Possibly, the differences observed could be due to the different pain thresholds of the individuals [26].

This study found no statistically significant differences related to pain experiences across age groups or sex. This contrasts with the findings of Koritsánszky and Madlena, who found that orthodontic pain is influenced by factors such as the age and gender of the patients. [25] Correspondingly, an earlier study which was done by Scheurer et al. found a significant gender difference. In the study, females were reported to have experienced more severe and frequent pain than males, with the participants' age being statistically insignificant related to pain experience[23].

Pain is highly unpleasant; unfortunately, it is a common experience during orthodontic treatment. Consequently, pain experience in orthodontics has been reported in several past studies [3,5,10,22,27-29]. Likewise, in the present study, during the first three days of appliance placement, about 60% of our patients reported having felt 'moderate' to 'severe' pain. This may be the basis for painkillers' recommendation to orthodontic patients in the first three days of treatment initiation. The medications can help them to relieve pain to make their treatment experiences tolerable [30,31].

Study limitations

The data collection tools were questionnaires; these are subject to a response bias. Whereby the study participants might have provided limited responses based on the survey questions rather than being able to elaborate their own thoughts [32]. Additionally, as the principal investigator reminded the study participants to fill in the questionnaires at each time interval, there was a risk of social desirability bias. In which the participants might have responded in a way that they believed would make them look good, concealing their true experiences [32].

Given the limited time available for the study, the researcher did not do probability sampling; instead, a convenient sample of patients was taken. Additionally, there was a loss to follow-up as data collection was performed at eight different time intervals over the course of a month. To minimize biases, the researcher kept a close follow-up with daily reminders to the participants during the data collection period. Eventually, it was possible to obtain enough samples for the present study.

CONCLUSION

Pain experience was expressed by the overwhelming majority of the participants during the initial stages of orthodontic treatment. The pain was tight as well as frustrating in nature and was severe at the start of treatment but improved over time.

RECOMMENDATIONS

1.   To develop new evidence-based standard operating procedures for the treatment of new orthodontic patients, where clinicians can prescribe painkillers to the patients in the first three days. In order to reduce treatment morbidity and enhance treatment compliance.

2.   More studies among Tanzanians should be planned to assess the pain experience in orthodontics on a larger scale.

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