Tooth cleaning devices, calculus, gingival recession and tooth sensitivity in adult population, Mtwara-Rural, Tanzania

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Abstract
Aim: To determine the type of tooth cleaning devices, presence of calculus, occurrence of gingival recessions and tooth sensitivity. **Study Participants and Methods**: This was a cross-sectional descriptive study conducted among adults in Mtwara-Rural district. Randomly selected 201 participants aged 40 years or more, 113 males and 88 females were interviewed on commonly used tooth cleaning devices and tooth sensitivity using a structured questionnaire. Clinical examination was done to assess gingival recessions (> 3.5 mm) and calculus using the Community Periodontal Index Probe and a mouth mirror. **Results**: Tooth cleaning devices included plastic toothbrush (51.7%), chewing stick (25.9%), both chewing stick and plastic toothbrush (17.4%), and other unspecified devices (5.0%). Prevalence of calculus was 99.5%, gingival recession > 3.5mm was 86.1% and TS was 50.2%. There was no significant difference between males and females for the occurrence of gingival recessions, tooth sensitivity and the type of tooth cleaning devices used. The mean number of sextants having teeth with gingival recessions and tooth sensitivity did not differ among different types of tooth cleaning devices used ($P > 0.05$). The study participants that had no gingival recessions had slightly higher mean number of sextants with calculus (5.79 ± 0.57) than those with gingival recessions (5.50 ± 1.17), ($P = 0.04$, 95% confidence interval: 0.01, 0.57), but the finding was considered to be of no clinical significance. **Conclusion**: Participants of this study mainly used plastic toothbrush and chewing stick as tooth cleaning devices and the prevalence of calculus and gingival recession were very high with substantial reported tooth sensitivity. The relationship between tooth cleaning devices or calculus accumulation and gingival recessions could not be elucidated.

Key Words: Plastic toothbrush; chewing stick; dental calculus; gingival recessions; tooth sensitivity.

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Introduction

Tooth cleaning devices commonly used in Tanzania include mostly plastic toothbrush and chewing stick, while dental floss is very rarely used (1, 2, 3). In adult population, it has been reported that chewing sticks appeared to be equal or even more effective than toothbrush for plaque removal (2, 4). Apart from use of these tooth cleaning devices and a reported high frequency of tooth brushing practice, calculus accumulation has almost been a universal finding in most Tanzanians and other developing countries (5-8). A hypothesis has been advanced that, longstanding calculus is an important determinant factor in the onset of gingival recession in populations deprived of prophylactic dental care (9). The pattern of gingival recession bears close resemblance to the distribution of calculus (7). In Tanzania, gingival recession among adults aged 45 years or above has been reported to be more in rural than urban population (10). Due to increased frequency in tooth brushing, generally, females have been found to have more recession than men (11). Also there some reports showing that gingival recessions are found more in developing countries (7, 12).

Relationship between calculus accumulation and gingival recessions has been reported in young individuals and in adults in some disadvantaged populations (9, 13, 14). Gingival recession also has been found to be associated with gingival inflammation and periodontal disease (14-17). Gingival recession have been reported to be associated with tooth sensitivity particularly on buccal/facial surfaces whereby the most initiating factor includes cold drinks, brushing and sometimes even breathing air (18-20). However, the available information on tooth cleaning devices in relation to the accumulation of dental calculus, occurrence of gingival

recession and tooth sensitivity is limited. Therefore, the aim of this study was to determine the type of tooth cleaning devices, calculus accumulation, occurrence of gingival recession and tooth sensitivity in an adult population in Mtwara, Tanzania.

Study participants and methods

This was a cross-sectional, descriptive study that was conducted in Mtwara Rural district in Mtwara region, south and eastern coast of Tanzania. Mtwara region was sampled conveniently because there was another study that was going on in this region. The design of the study was a cross-sectional descriptive one. The sampling frame consisted of all the four districts in Mtwara region that are Mtwara urban, Mtwara rural, Tandahimba, Newala and Masasi. A simple random sampling was done whereby five small pieces of paper each carrying the name of one district were folded and placed on the table. One among these, which coincidentally carried the name of Mtwara-rural district, was randomly picked. A multistage simple random sampling technique was conducted from ward to village levels whereby five villages were selected to form the study sites. The villages that were studied were Chekereni (Kitere ward), Imekuwa and Majengo (Naumbu ward), Namkuku (Nanyamba ward) and Njengwa (Njengwa ward). The villagers (adults) were gathered together and were informed the purpose of the study in a simple understandable language. The recruited participants were those who gave "informed verbal consent". The inclusion criteria were to be a resident in the sampled village and aged 40 years or more. Exclusion criteria were age less than 40 years and total edentulousness. A total of 201 adults participated. There were 113 (56.2%) males and 88 (43.8%) females, with an age range of 40-95 years and a mean age of 54.98 ± 11.72 years and a median of 53.0 years. A structured questionnaire was used to interview the study participants on tooth cleaning devices they were using and whether they had experienced any tooth sensitivity at the time of study.

Clinical examination was done indoors with the study participants seated on an ordinary chair facing an open window to capture daylight. Clinical examination involved all teeth including third molars for the assessment of dental calculus (present or absent) and the extent of gingival recessions (0-3.5mm, 3.5-5.5mm and > 5.5mm) using the Community Periodontal Index (CPI) epidemiological probe (5,6) and a normal non-magnifying mouth mirror. The mouth was divided into sextants (sextant 1, 2, 3, 4, 5, and 6), defined by tooth code numbers: 18-14, 13-23, 24-28, 38-34, 33-43 and 44-48, respectively (21). Three calibrated examiners did clinical assessment, whereby the chance corrected proportional agreement (Cohen's Kappa-statistics) for each of the six sextants examined ranged from 0.4 to 1.0, which indicated a moderate to perfect agreement (22, 23). Ethical clearance was obtained from the Ethical Committee of the Muhimbili University College of Health Sciences (MUCHS).

The data was entered into a computer and analyzed using Statistical Package for Social Sciences (SPSS) 10.0 for Windows (SPSS Inc., Chicago, IL., USA). Frequency and cross-tabulations for age groups, gender and sextants with gingival recession and calculus accumulation, and respondents with tooth sensitivity were generated. Statistical tests applied were Pearson's Chi-square (X^2) test for all categorical data and the Student's t-test to compare the mean number of sextants that had calculus and gingival recession. The level of statistical significance test was set at $P < 0.05$.

Results

Among the 201 study participants that were recruited, the proportion of females (43.8%) and males (56.2%) as well as their distributions in different age groups were not statistically significant (Table 1). Out of 201 study participants, those who had full intact dentition (32 teeth) were 9 (4.5%) and those who were partially edentate were 95.5%. A total of 4,483 teeth (mean 22.3 ± 7.4 (sd)) and 1,132 (mean 5.6 ± 1.01 (sd) sextants were examined. The differences in the mean number of examined teeth in males (23.03 ±7.61) and females (21.37 ± 7.06) as well as sextants in males (5.58 ±1.109) and females (5.69 ± 0.89) were respectively not statistically significant (P = 0.117 and 0.447).

The prevalence of calculus was 99.5%. Prevalence for the different age groups studied was 100% for (40-49, 50-59, and 70 years or more), whereas for the 60-69 years it was 97.8%, but the differences were not statistically significant (P = 0.323). However, in the median split age (53 years), participants aged less than 53 years had significantly higher mean number of sextants that had calculus (5.8 ± 0.5) as compared to (5.2 ±1.5) for those aged above 53 yrs (P < 0.001, 95% CI: 0.31, 0.91). The

prevalence of gingival recession and tooth sensitivity was 86.1% and 50.2%, respectively. The proportion of study participants that had gingival recessions was significantly higher in older as compared to the middle age groups: 40-49 years (74.0%), 50-59 years (90.6%), 60-69 years (95.6%) and 70+ years (96.2%), (P=0.001). On the other hand, the reported experience in tooth sensitivity in each age group, 40-49 years (50.6%), 50-59 years (62.3%), 60-69 years (42.2%) and 70+ years (38.5%), was not statistically significant (P = 0.129). Using a cut-off point at 60 years of age, about 60% of the participants aged 60+ years had experienced tooth sensitivity (P = 0.049).

Table 1: Distribution of study participants in percentages by gender and age groups

Age group (years)	Males (n=113)	Females (n=88)	Total (n=201)
40-49	34.5	43.2	38.3
50-59	26.5	26.1	26.4
60-69	23.0	21.6	22.4
70+	15.9	9.1	12.9
Total	56.2	43.8	100.0

X^2 value = 2.807, df = 3, P = 0.422 (not significant).

The types of tooth cleaning devices used by this study population included plastic toothbrush (51.7%), chewing stick (35.9%), both plastic toothbrush and chewing stick (17.4%) and other non-specific devices (5.0%). Among those who commonly used chewing stick, 75% were more than 53 years of age while most of the plastic toothbrush users (64.4%) were less than 53 years of age and this. The difference between middle and older age groups in the use of different types of tooth cleaning devices was statistically significant (P < 0.001) (Table 2).

The mean number of sextants with calculus, gingival recessions, and sensitive teeth among males and females is shown in Table 3. Male participants in this study had a slightly higher mean number of sextants that had calculus accumulation as well as gingival recession; however, the differences were not statistically significant. On the other hand, the mean number of teeth that had sensitivity was slightly higher in females (5.07 ± 8.57) than males (3.15 ± 6.20), but it did not reach a level that was statistically significant (P = 0.079). At a sextant level, the relationship between gingival recession and dental calculus was not linear and was not statistically significant (Pearson Correlation coefficient = 0.046, P = 0.514).

The mean number of sextants with calculus, gingival recession and sensitive teeth in relation to type of tooth cleaning devices used is shown in Table 4. The mean number of sextants that had calculus was significantly higher in those who commonly used plastic toothbrush and both types of toothbrushes (plastic toothbrush and chewing stick) than in those who used other non-specific tooth cleaning devices (P = 0.021 and P = 0.026, respectively). The study participants who commonly used chewing sticks did not differ much in the mean number of sextants that had calculus when compared to those who used other unspecified devices of tooth cleaning (P = 0.051). There were no statistically significant differences in the mean number of sextants that had teeth with gingival recessions (Table 4) between chewing stick versus plastic toothbrush (P = 0.205), both types of tooth cleaning devices (P= 0.089) and other unspecified devices of tooth cleaning (P = 0.155); as well as plastic tooth brush versus both types of tooth cleaning devices (P= 0.424) and other unspecified devices of tooth cleaning (P = 0.386). Also when users of both chewing stick and plastic toothbrush were compared with the group of participants using other unspecified means of tooth cleaning, the differences were not statistically significant (P = 0.686).

Table 2: The age group factor and type of tooth cleaning device used

Type of tooth cleaning device used	Age group (years)	Number of study participants and percentages (%)
Chewing stick (CS)	≤ 53 yrs	13 (25.0)
	>53 yrs	39 (75.0)
	All	52 (25.9)
Plastic tooth brush (PB)	≤ 53 yrs	67 (64.4)
	>53 yrs	37 (35.6)
	All	104 (51.7)
Both types: CS and PB	≤ 53 yrs	20 (57.1)
	>53 yrs	15 (42.9)
	All	35 (17.4)
Other means	≤ 53 yrs	3 (30.0)
	>53 yrs	7 (70.0)
	All	10 (5.0)

X^2 value =23.86, df=3, P < 0.001

Chewing stick users had almost the same mean number of sensitive teeth (4.13 ± 7.31) as the plastic toothbrush users (4.15 ± 7.19), (P = 0.988), and comparison with all other means of tooth cleaning (2.70 ± 6.49) did not show any statistically significant differences (P = 0.566). The study participants who had no gingival recession had slightly higher mean number of sextants with calculus ((5.79 ± 0.57) than those with gingival recession (5.50 ± 1.17). This difference was statistically significant (P = 0.042, 95% confidence interval: 0.01, 0.57).

Discussion

The main etiologic factors for gingival recession have been documented to include among others, faulty toothbrushing technique, brushing with hard bristles, gingival inflammation and periodontal disease (12, 24, 25). In this study population, there were differences in gingival recession amongst participants using different types of tooth cleaning devises including the plastic toothbrush as well as the chewing stick. The reason for this was not established, as the hardness of bristles was not studied. It is speculated that a horizontal tooth brushing method might have contributed to the recession that was observed in all groups examined, since this is the most common method practiced by other Tanzanians (26).

The relationship between gingival recession and dental calculus in this study population was not a linear one. Possibly that is why unexpectedly, the participants having no gingival recession had higher mean number of sextants with calculus compared to those with gingival recessions of 3.5 mm or more. Another explanation could be that, the index used to score gingival recessions might has not been sensitive enough because it encompassed 0-3.5mm of gingival recession as "no gingival recession", while in actual fact values like 1mm, 2mm, 3mm and 3.5 mm should be considered as true gingival recession rather than "no" gingival recession at all. A methodological problem with this proposed approach is that reproducibility for such single unit measurements rather than a range might be reduced.

Table 3: Mean number of sextants with calculus, gingival recessions, and *teeth with sensitivity by gender

Condition	Gender (no. of study participants)	Mean number of sextants or *teeth ± Standard deviation	Student's T-Test (P-value)
Calculus accumulation	Males (n=113)	5.55 ± 1.13	0.87
	Females (n=88)	5.52 ± 1.08	
	All (n=201)	5.54 ± 1.11	N/A
Gingival recession	Males (n=113)	2.32 ± 1.67	0.198
	Females (n=88)	2.02 ± 1.54	
	All (n=201)	2.19 ± 1.61	N/A
*Tooth sensitivity	Males (n=113)	*3.15 ± 6.20	0.079
	Females (n=88)	*5.07 ± 8.57	
	All (n=201)	*3.99 ± 7.37	N/A

** The unit is teeth and not sextants.*

In this study population, the mean number of sextants with sensitive teeth was higher than the corresponding sextants with teeth that had gingival recessions. One would expect that those sextants exhibiting gingival recessions would also have teeth sensitivity. However, this was not the case. The possible explanation is that, other factors that normally contribute to the occurrence of tooth sensitivity such as dental caries, cervical abrasion, and tooth mutilation by chipping part of teeth as practiced by Makonde tribe in the area might have contributed to the observed situation (27). Looking at sextants with calculus in relation to different types of cleaning devices, it was found that there were fewer sextants in the other unspecified devices group compared to all others (chewing stick, plastic toothbrush and both types). The possible explanation is that, this other unspecified device category had a significantly higher number of tooth extractions,

thus, leaving behind fewer sextants that had intact teeth that were eligible for examination (3).

Although participants using chewing stick alone had higher mean number of sextants with gingival recessions, comparison with all other tooth cleaning devices were not statistically significant. However, other report shows that hard toothbrushes for example are among factors that cause gingival recession (24). The study participants that had no gingival recession had significantly slightly higher mean number of sextants with calculus than those with gingival recession, but this was considered to be of no clinical significance. The method of partial versus full mouth examination and recording might have contributed to this discrepancy. Therefore, it might be that the use of sextant with a maximum of six units per individual rather than tooth surfaces as a unit count with a maximum of four or six sites per tooth (128 or 192 sites per person, respectively) might be insensitive to capture adequate number of teeth with gingival recession versus calculus accumulation sites. Also, other causes of gingival recession might have accounted in obscuring of the differences. A positive association between calculus and gingival recession had previously been reported in Tanzanian adult population in Zanzibar, Morogoro and Ilala, Dar-es-Salaam (7, 9, 28). It seems that at an advanced age (40 years or more) the effect of calculus to gingival recession is obscured by the effect of other factors such as gingival inflammation and periodontal disease.

Table 4: Mean number of sextants with calculus in relation to type of tooth cleaning device used

Type of tooth cleaning device used and number of study participants in parenthesis	Mean number of sextants or *teeth that had specified condition ± Standard deviation		
	Calculus accumulation	Gingival recessions	*Tooth sensitivity
Chewing stick (n = 52)	5.40 ± 1.21	2.52 ± 1.69	4.13 ± 7.32
Plastic toothbrush (n = 104)	5.71 ± 0.82	2.16 ± 1.63	4.15 ± 7.19
Both plastic toothbrush and chewing stick (n = 35)	5.66 ± 1.08	1.91 ± 1.48	3.66 ± 8.41
Other means of tooth cleaning (n = 10)	4.00 ± 1.94	1.70 ± 1.42	2.70 ± 6.50

* *The unit is teeth and not sextants*

The limitations of this study include the fact that the age of 40 years or more seemed to present an asymmetrical or skewed findings in relation to gingival recession and tooth sensitivity. Furthermore, the indices used to assess the presence of calculus and gingival recession in all the teeth (5 to 6 teeth in one sextant) and yet record only one reading for a sextant might have obscured the actual relationship between the factors being studied. It is also apparent that the presence of cervical abrasions as another possible cause of tooth sensitivity was not studied. Lastly, other factors of tooth sensitivity such as use of sugary foods, acidic juices/fruits, hot and cold drinks were not within the scope of this study thus limiting the possibility for instituting dietary counseling.

Conclusion: Tooth cleaning devices were mainly plastic toothbrush and chewing stick, whereas the prevalence of calculus and gingival recession were very high with substantial self-reported tooth sensitivity in this study population. The relationship between tooth cleaning devices or calculus accumulation and gingival recessions could not be elucidated.

Recommendations

The high prevalence of calculus is unacceptable and therefore a strategy on oral health promotion that would encompass oral health education as well as proper and effective use of tooth cleaning devices is recommended to appropriate all the associated benefits. Further research on factors responsible for gingival recessions in this study population is necessary and the readings as well as recording should be tooth sites in a full mouth rather than a sextant that is used for partial examination and recordings.

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Once a scientist making a study on a frog, was cutting its leg one by one and each time asking it to jump, which it could do. The scientist recorded till three legs were cut in turns, that the" frogs can jump with only one leg! "In end he removed the last of the frog's legs, and asked it to jump. But alas the frog did not leap, and he yelled JUMP! JUMP! Several times. Seeing no response from the frog, the scientist recorded, "Frogs, when deprived of all legs, become dead,"

Lawyer (cross-examining a witness): Doctor, did you check the victim's pulse?"
Doctor: No.
Lawyer: So how can you be so sure that the victim is dead?
Doctor: His brains are lying in a jar on my table.
Lawyer (Persisting): But isn't it possible that a man may be alive even after losing his brains?
Doctor: It's possible – I know of at least one such lawyer practicing in Mumbai.