ORIGINAL ARTICLE

Prevalence of Tooth Wear among 16-Year-Old Secondary School Children in Kota Bharu Kelantan

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ABSTRACT

Tooth wear is the non-carious loss of tooth tissue due to attrition, erosion and/or abrasion. The amount of wear that accelerates physiological tooth wear is referred as pathological tooth wear. This study aims to determine the prevalence and mean scores according to mouth quadrant of raw tooth wear (RTW) and pathological tooth wear (PTW) and investigate sex association with PTW among 16-year-old secondary school children in Kota Bharu, Kelantan. This cross-sectional study involves 688 participants randomly selected from eight government secondary schools. The Smith and Knight Tooth Wear Index (TWI) was used. Data were analyzed using a simplified Microsoft Excel program developed based on the index to quantify PTW. Bar graphs were plotted to highlight the mean scores according to mouth quadrant. About 44% of participants were male and 56% were female. The prevalence of RTW and PTW among subjects was 100% and 20.1% respectively. It was found that 32.8% of tooth surfaces were affected with RTW and 0.7% of study subjects already had exposed dentine. The most affected quadrant for RTW and PTW was the upper and lower incisal quadrant respectively. Males had 92% more odds of developing tooth wear compared to females. In conclusion, all subjects have some degree of wear. About one-fifth of the study subjects were affected by PTW. The patterns of wear were similar to those encountered in the Western societies. There was statistically significant association between sex and PTW.

Key words: raw tooth wear, pathological tooth wear, secondary schools, prevalence

INTRODUCTION

The loss of tooth tissues can occur due to carious and non-carious phenomena. Tooth wear describes the non-carious loss of tooth tissue as a result from the interaction of three processes which may occur in isolation or in combination; attrition, erosion and abrasion (Langlais & Miller, 1998; Murray, 1996; Ibbetson and Eder, 1999). Attrition is the loss of tooth substance or a restoration caused by mastication or contact between occluding surfaces, while erosion is the progressive loss of hard dental tissues by chemical processes not involving bacterial action. On the other hand abrasion is the pathological loss of tooth substance caused by abnormal and repetitive mechanical wears other than tooth to tooth contact (Langlais and Miller, 1998).

A number of systems for classification and measurement of tooth wear have been presented in the literature such as Parma (1960), Eccles (1979), WHO (1979), Smith and Knight (1984), Carlsson et al. (1985) and Johannson et al. (1996) (cited in Addy et al., 2000). Unlike some other widely used dental measuring systems such as dental caries and gingival index, a universally applicable tooth wear measuring system is still lacking. This makes comparison of results very difficult. There has been a considerable amount of information about tooth wear in other parts of the world. Therefore it is timely to unravel the prevalence of tooth wear in the context of Malaysian population to enable valid comparison among similar age groups. Until recently, there was only one published study in Malaysia (Milosevic & Lo, 1996) involving three distinct ethnic groups in Northern Borneo (Sabah), with a prevalence of 95% and 41% moderate and severe tooth wear respectively. The age groups studied were wide (14-77 years). The authors found that tobacco chewing, crushing and eating of bones in the daily dietary habit gave a distinctive pattern of wear, with more of the occlusal and buccal surfaces of teeth affected.

Therefore the current study aims to determine the prevalence of RTW and PTW, mean scores of RTW and PTW according to mouth quadrant and association between PTW and sex. Such information may highlight the
reality of tooth wear problems and treatment needs. This information will enable professionals and the public health personnel to plan methods of appropriate approach in handling tooth wear problem in this age group.

MATERIALS AND METHODS

This study involved 688 randomly selected sixteen-year-old subjects from eight ‘Sekolah Menengah Kebangsaan’ (SMK) in Kota Bharu, Kelantan. Systematic random sampling was used. Kota Bharu (town area) is one area in Kota Bharu District, which has been chosen for the purpose of the present study. In Kota Bharu there are many types of secondary schools. These were eight ‘SMK’ co-educational schools, one Boy’s school, two Chinese schools and one semi-boarding school (some of the students stayed in the hostel provided). Thus, to get similar characteristics of the subjects, only ‘SMK’ co-educational schools were included in the study.

The schools provided the name list of students with details such as date of birth etc. These were entered into the computer in groups of boys and girls based on classes in each school. Only those born in 1988 were selected. A total 1506 of sixteen-year-old students was then divided with the sample size of 750, which was calculated earlier based on the result of a pilot study, to get the sampling interval. The calculated sampling interval was about two. To get the starting point for the sampling interval, the author drew lots and eventually got number 2 as the starting point. Therefore, all the even numbers in the name list were selected.

All subjects gave consent prior to the study. Ethical approval was obtained from the Research and Ethics Committee, Universiti Sains Malaysia in June 2004.

Clinical oral examination of study subjects was done in the school premise using a portable dental chair, disposable plane mouth mirrors, dental probes to remove food debris and periodontal probes to measure depth of eroded tooth surface when necessary under the Safari operating light (Dental Inc, Quebec Canada). Subjects were seated on the dental chair, with the operator seated behind and the recorder in front of the subject. To enhance vision in the mouth, the teeth were dried using cotton wool rolls. All permanent teeth were examined for four surfaces, namely cervical (C), buccal (B), occlusal (O) or incisal (I) and palatal (P) or lingual (L) surfaces using Tooth Wear Index (TWI) from Smith and Knight, 1984. The criteria of TWI used in the study were as follows:

(i) Score 0 was given if there was no loss of enamel surface characteristics on B/L/O/I and no change in contour on C.

(ii) Score 1 was given if there was loss of enamel characteristics on B/L/O/I and minimal loss of contour on C.

(iii) Score 2 was given if there was loss of enamel exposing dentine for less than 1/3 of the surface on B/L/O/I and defect less than 1 mm deep on C.

(iv) Score 3 was given if there was loss of enamel exposing dentine for more than 1/3 of the surface on B/L/O/I and defect 1-2 mm deep on C.

(v) Score 4 was given if there was complete loss of enamel or pulp exposure on B/L/O/I and defect more than 2 mm deep on C.

Restored or carious tooth surfaces were excluded from the analysis. The raw data of tooth wear, which was obtained from the charting, was called RTW. After that this data were entered into the Microsoft Excel (Microsoft Corp., USA) to quantify pathological tooth wear (PTW). PTW is the RTW minus physiological tooth wear. Physiological tooth wear is the normal wears that occur due to ageing process. Microsoft Excel programme was already programmed to deduct the physiological tooth wear from RTW, and the result coming out from the computerized programme was PTW score. Subjects with at least one tooth surface score 1 or more (PTW ≥ 1) were categorized as cases and subjects with all tooth surfaces score 0 (PTW=0) were categorized as non-cases. Then, simple logistic regression analysis was used to determine the association between sex and PTW. The SPSS version 11.0 was used for data management and analysis.

Training and calibration of the use of the index was carried out prior to the project. Initial training was conducted by examining dental patients at the dental outpatient clinic in Hospital Universiti Sains Malaysia (HUSM) for two weeks. In the school setting, charting on the first ten subjects was done to familiarize with the TWI again before the reproducibility of the index was confirmed. Following that, 35 subjects were examined orally and charted using the TWI. This was done on two consecutive days on the same 35 subjects by the author. After charting on the first day, each subject was categorized under the highest score of the TWI present among all tooth surfaces charted for each subject starting from 0 to 4. On the following day, similar study subjects
were re-examined and categorized based on the same criteria. The data collected on both days were entered into SPSS version 11.0 and analyzed for intra-examiner reproducibility. The calculation produced a Kappa value of 0.85 and this was acceptable.

RESULTS

This cross-sectional study involved 688 secondary school children in Kota Bharu area. The response rate was 91.7% and the ratio of male to female is 1:1.3. Most of the subjects were Malays with only 0.4% Indians. ‘Sekolah Menengah Kebangsaan’ (SMK) Sultan Ismail had the greatest percentage (19.8%) recruited due to its biggest enrolment. Other schools involved were ‘SMK’ Kota (15.1%), ‘SMK’ Pintu Geng (11.3%), ‘SMK’ Zainab 2 (11.8%), ‘SMK’ Ismail Petra (7.8%), ‘SMK’ Putera (11.3%), ‘SMK’ Kota Bharu (10.3%) and ‘SMK’ Puteri (12.5%). Considering minimal non-response rate, the percentage approximately represents the enrolment of the students from each school.

The prevalence of raw tooth wear (RTW) in all subjects was 100% with 23.5% had exposed dentine (score 2, 3 and 4) (Table 1). Specifically, when tooth surfaces were considered, out of 76412 surfaces examined, 25044 surfaces had RTW, therefore the prevalence of RTW was 32.8%. Of these surfaces with RTW, 24545 surfaces (98.0%) occurred in enamel (score 1), 451 surfaces (1.8%) in shallow dentine (score 2), 14 surfaces (1.0%) occurred in deeper dentine (score 3) and 34 surfaces (1.0%) had pulpal involvement (score 4). The prevalence of PTW by subject was found to be 20.1% (Table 2).

<table>
<thead>
<tr>
<th>Table 1. Distribution of raw tooth wear (RTW) by sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTW</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Distribution and sex association with PTW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
DISCUSSION

The prevalence of RTW in all subjects was 100% but most of the wear only occurs in enamel (76.5% with score 1). The proportion of wear that occurs in shallow dentine (score 2) was 21.5%, in deeper dentine (score 3) was 1.3% and only 0.7% had pulpal involvement (score 4). This finding is similar with Milosevic & Lo (1996), who found that all study subjects have some degree of wear on their tooth surfaces. However, the mean (SD) age group in their study was 33 (14.1) years whereas the present study concentrates among the 16-year-olds. In their study, 95% of the subjects were found to have wears in shallow dentine and 41% in deeper dentine. The proportion of tooth wear in their study was higher compared to the present study. This could be due to the wider interval age group (14 to 77 years) and it is also agreed by other authors that as age increased tooth wear becomes more pronounced.

In another study, among 14-year-old school children in Liverpool (Milosevic et al., 1994), it was also found that all the children exhibited some degree of tooth wear. From this particular study, 30% and 7.6% of the subject had exposed dentine (score 2 and 3) on the incisal and occlusal surfaces respectively. Bartlett et al. (1998) in their study among 11 to 14-year-old school children revealed 57% of subjects had tooth wear on more than ten teeth with 2% or less surfaces having exposed dentine.

In a more recent study by Bardsley et al. (2004) among 14-year-old children comparing tooth wear in fluoridated and non-fluoridated areas, it was found that 53% of subjects in their study had exposed dentine. In fluoridated areas, significantly fewer children had exposed dentine on the labial and palatal surfaces but no difference was found for incisal and occlusal surfaces. In the present study the proportion of subjects having exposed dentine was considered low compared to other studies (Milosevic et al., 1994; Milosevic & Lo, 1996; Bartlett et al., 1998).
Considering dental erosion per se, several studies have revealed the prevalence of erosion among children and adolescents (Al-Dlaigan et al., 2001; Al-Majed et al., 2002; Dugmore and Rock 2004). The age groups studied varied from 11 to 15 years. The proportion of subjects with exposed dentine ranged from 1% to 3% except in the study by Al-Dlaigan et al. (2001) who found that 48%, 51% and 1% of the subjects had low, moderate and severe erosion respectively. In their study (Al-Dlaigan et al., 2001) the Smith and Knight Tooth Wear Index used was modified by Millward et al. (1994). Low erosion was scores 0 and 1, moderate erosion scores 2 (dentine exposed) and severe erosion scores 3 and 4 (dentine exposed and pulpal involvement).

Another way of presenting prevalence is as number and proportion of tooth surfaces affected by wear. This was done in several studies (Al-Majed et al., 2002; Oginni and Olusile, 2002). The present study found 32.8% of tooth surfaces affected by wear, with less than 1% of tooth surfaces having exposed dentine (score 2, 3 and 4). Al-Majed et al. (2002) in their study among 12-14 year-old boys in Saudi Arabia only considered permanent maxillary incisors, and the prevalence was displayed as labial, palatal and occlusal surfaces. On the labial surfaces, the proportion was 99% and 1% for wears in enamel only and wears in enamel and dentine respectively. This is similarly presented for palatal surfaces (86% and 14%) and occlusal surfaces (88% and 12%). Whereas Oginni and Olusile (2002) in their study among adults aged more than 16 years, examined 15,480 tooth surfaces and revealed an overall proportion of wear surfaces as 14.4% (2,229 surfaces). The wide age gap of the study subjects makes comparison difficult and unsuitable.

Although most of the above studies used the Smith and Knight TWI (1984), results were presented in different ways such as selection of tooth surfaces. When tooth were considered, the selection of tooth for charting was also not similar. When presenting prevalence using tooth surfaces, results were combined as less or more than 10 or 50 surfaces or mean number of tooth surfaces, etc. (Milosevic and Lo, 1996; Smith and Robb, 1996; Oginni and Olusile, 2002). Therefore comparability between studies is difficult. The summary of the prevalence studies of tooth wear or dental erosion is shown in Table 3.
Table 3. Summary of prevalence studies of tooth wear or dental erosion

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Country</th>
<th>Age (years)</th>
<th>Erosion/Wear</th>
<th>Teeth examined</th>
<th>Surfaces examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milosevic et al.</td>
<td>1994</td>
<td>UK</td>
<td>14</td>
<td>Wear</td>
<td>All permanent</td>
<td>C, B, I/O, P/L</td>
</tr>
<tr>
<td>Milosevic &amp; Lo</td>
<td>1996</td>
<td>Malaysia</td>
<td>14-77</td>
<td>Wear</td>
<td>All permanent</td>
<td>C, B, I/O, P/L</td>
</tr>
<tr>
<td>Smith &amp; Robb</td>
<td>1996</td>
<td>UK</td>
<td>&gt;12</td>
<td>Wear</td>
<td>All permanent</td>
<td>C, B, I/O, P/L</td>
</tr>
<tr>
<td>Bartlett et al.</td>
<td>1998</td>
<td>England</td>
<td>11-14</td>
<td>Wear</td>
<td>All permanent</td>
<td>C, B, I/O, P/L</td>
</tr>
<tr>
<td>Al-Dlaigan et al.</td>
<td>2001</td>
<td>UK</td>
<td>14</td>
<td>Erosion</td>
<td>All permanent</td>
<td>C, B, I/O, P/L</td>
</tr>
<tr>
<td>Oginni &amp; Olusile</td>
<td>2002</td>
<td>Nigeria</td>
<td>&gt;16</td>
<td>Wear</td>
<td>All permanent</td>
<td>C, B, I/O, P/L</td>
</tr>
<tr>
<td>Al-Majed et al.</td>
<td>2002</td>
<td>Saudi Arabia</td>
<td>12-14</td>
<td>Erosion</td>
<td>Maxillary incisor Maxillary 1st molar</td>
<td>Lab, P</td>
</tr>
<tr>
<td>Bardsly et al.</td>
<td>2004</td>
<td>England</td>
<td>14</td>
<td>Wear</td>
<td>Upper &amp; lower anterior All first molar</td>
<td>Lab, I, P/L</td>
</tr>
<tr>
<td>Dugmore &amp; Rock</td>
<td>2004</td>
<td>England</td>
<td>12</td>
<td>Erosion</td>
<td>Upper &amp; lower incisor All first molar</td>
<td>L/P</td>
</tr>
<tr>
<td>This study</td>
<td>2005</td>
<td>Malaysia</td>
<td>16</td>
<td>Wear</td>
<td>All permanent</td>
<td>C, B, I/O, P/L</td>
</tr>
</tbody>
</table>

C=Cervical, B/Lab=Buccal/labial, I/O=Incisal/occlusal, P/l=Palatal/lingual

In the present study, pathological or unacceptable level of tooth wear was determined after entering the charted data of Raw Tooth Wear (RTW) into the Microsoft Excel. This software quantifies the amount of wear to be categorized as pathological or non-pathological. It was found that the proportion of subjects with PTW was 20.1%. Not many studies have revealed results in this way. In the study by Smith & Robb (1996) of the total sample of 1,007 subjects aged more than 12 years, 78% have less than 10% of tooth surfaces with PTW and 22% have more than 10% of tooth surfaces with PTW. Although they revealed higher proportion of PTW, the result is not quite comparable due to the difference in the age group being studied. Our study concentrated among 16-year-old school children.

Figure 1 showed the mean RTW score of tooth surfaces that were affected by wear according to mouth quadrant. The bar graph showed that most of the wear occur on the upper and lower anterior quadrant compared to the posterior quadrant. This finding was supported by a few other studies (Milosevic et al., 1994; Smith and Robb, 1996). This was again emphasized in figure 2 where the maximum mean score of PTW was also higher in the lower anterior quadrant. This can be explained by the fact that the threshold level of 1 (score 1) was considered normal for the incisal surface of the lower canine; instead of the threshold level of 2 (score 2) was considered normal for incisal surface of upper canine. When the threshold level of the entire upper canine is subtracted with the acceptable score, these teeth will have a score zero compared to the lower canine which will have a score of one. This fact has managed to reveal that the lower anterior quadrant showed more PTW compared to the upper quadrant. These normal threshold levels that were computerized in the Microsoft Excel were based on the findings of the study conducted by Smith and Knight (1984).
However some authors (Milosevic and Lo, 1996) did not agree to use these threshold values in other than Western populations. They argued that these threshold values might be different in other populations. Although there is some truth in Milosevic’s argument, the current authors of this study have agreed to use the threshold values by Smith and Knight (1984) to enable valid comparisons. Furthermore there has never been any study to establish threshold values in the Eastern or Asia Pacific populations. Perhaps in the case of tooth wear, there should be a standard set, such as the criteria of charting for dental caries by World Health Organization (WHO). Such standards have enabled possible comparisons worldwide. Probing deeper into the problem of tooth wear or tooth surface losses has made many authors realize the need to consolidate methods of recording, interpretation and age group to further quantify accurately the severity of tooth wear.

When tooth surfaces are considered, the present study revealed that from 76,412 tooth surfaces that had been examined, the mean pathological tooth wear (PTW) score or unacceptable tooth wear computed by the software was shown to be 2.1%. Smith and Robb (1996) examined 93,500 tooth surfaces and found 5.1% pathological (>12 year-old) tooth wear. However, in their study for the age group below 26 years 21,362 tooth surfaces were examined and 5.3% tooth wear was considered pathological whereas in the 56-65 years age group and over 65 years age group the tooth surfaces affected by PTW were 8.2% and 8.8% respectively. Results from the current study revealed lesser mean PTW scores in the study sample compared to Western data. This was due in the present study; the age groups being studied were younger. Since tooth wear is accumulative process, in the younger age group the wear were less prominent.

More males (56.5%) have PTW compared to females (Table 2) and this difference was statistically significant. Males had 92% more odds of developing PTW compared to females. Most studies have also found similar findings (Milosevic et al., 1994; Smith and Robb, 1996; Oginni and Olusile, 2002; Dugmore and Rock, 2004). This could be due to males having a higher bite force compared to females (van der Glass et al., 1996) and different dietary patterns between males and females (Harnack et al., 1999). A study by Harnack et al. (1999) revealed that adolescent boys were more likely to consume 12 oz or more soft drinks per day compared to adolescent girls (age of 13 to 18 years). Studies of tooth wear among adults revealed that tooth wear is also significantly more prominent in man than women (Smith and Robb, 1996; Oginni and Olusile, 2002). These findings supports the view that the trend of tooth wears established in adolescents will probably continue into adulthood.

The proportion of study subjects having tooth wear in the present study is considered low. This matter may appear unimportant but dental professionals are worried of the consequences. Although it might not seem very significant now, the thought that subjects were not aware that this condition could worsen, prevention programmes need to be emphasized to increase awareness and reduce the future burden of oral diseases. Tooth wear which is a preventable and treatable condition can be easily handled without creating much discomfort to patients or incur high cost of treatment to the country if it is done in the early stage of the problem.

CONCLUSION

In conclusion, findings from this study showed that all 16-year-old school children in the sample have some degree of wear with one-fifth of them were already affected by PTW. The patterns of wear were no different from those encountered in the Western cultures. The greatest wears were on the upper and lower incisal quadrant for RTW and PTW respectively. Males had approximately twice likely of developing PTW compared to females. Since quite high proportion of subjects already affected by PTW, oral health promotion needs to emphasize on this matter since early age. Further investigation is required to identify the risk factors of tooth wear.
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