



Comprehensive assessment of tooth wear in children: A state wide representative survey in Andhra Pradesh, India

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Abstract

Aim: To assess the distribution and severity of tooth wear among children of Andhra Pradesh state, India.

Study design: A descriptive cross sectional study was conducted by trained and calibrated examiner.

Methods: A two stage random sample of 384 children with the age of 12 years were examined for tooth wear using Smith and Knight tooth wear index (1984). Descriptive statistics were applied to the data.

Results: Prevalence of tooth wear amounted to 39.06%. The highest frequency of score 1 and 2 was found for maxillary right central incisors (49.5% and 12.7% respectively). No tooth surfaces had score 3 and 4. Occlusal/incisal surfaces were most commonly affected with tooth wear followed by cervical, lingual surfaces. It also shows that occlusal surfaces of maxillary and mandibular anterior teeth were more commonly affected than the posterior teeth. No tooth wear on the lingual surfaces of posterior teeth of both the arches.

Conclusion: Tooth wear remains a common finding in study population. Furthermore, the question of whether tooth wear is a public health problem remains open for debate.

Keywords: erosion, tooth wear, smith and knight index, risk factors

Introduction

Loss of tooth tissue occurs in a number of ways, dental caries and trauma being the most obvious ones. But tooth wear in its own right now is assuming greater importance^[1]. It occurs by attrition, abrasion and erosion. According to Nunn *et al.*, wear lesions seen on teeth result from the contribution of above mentioned three conditions^[2]. Lussi *et al.* have also reported that two or more types of tooth surfaces loss can coexist and the presence of erosion could make the tooth surface more susceptible to attrition and abrasion as well. This indicates the difficulty in differentiating these types of lesion clinically^[3].

The irreversible and multi factorial aspects of wear on the teeth make it one of the most difficult dental problems to manage and easy diagnosis of pathological forms is therefore important^[4]. For the majority of population, any wear on teeth is often limited to enamel and dentin involvement only occurs in a relatively small population of the population. A study by Dugmore and Rock reported that 59.7% of 1753, 12 year old children had evidence of tooth wear of which 2.7% had exposed dentin, and this rose to 8.9% by the age of 14 years. Another study by Bardsely *et al* reported that 53% of 2385, 14 year old adolescents had exposed dentin. Smith and Ross observed that tooth wear in an adult was an almost universal experience with up to 97% of all ages experiencing some wear on their teeth with the older aged cohorts' dentin exposure became more common^[5].

Measurement of tooth wear has been performed over the years using a large variety of both quantitative and qualitative methods. A number of indices have been developed such as Parma (1960), Eccles (1979), WHO (1979), Carlson *et al.* (1985) and Johannson *et al.* (1996), typically using grading or scoring designed to identify increasing severity or progression of the condition, but traditionally with a focus on only one etiological factor^[6]. There are too many indices proposed and used, with lack of standardization in terminology, there are many epidemiological studies reported but it is difficult to quantify increase in prevalence reported internationally, as results are not easily comparable^[7]. One of the most commonly used indices was developed by Smith and Knight, 1984 index, and it has adapted by many researchers. This index classifies tooth wear on a 5 point scale at 4 sites per tooth, including all the teeth irrespective of the cause. This index is easy to use and is not based on etiology^[4].

Over the past 20 years there have been a number of studies evaluating the prevalence of tooth wear in children. By far the majority of the studies (Bartlett *et al.* 1998, Al-Dlaigan *et al.* 2001, Van Rijkem *et al.* 2002, Bradsley *et al.* 2004, Dugmore and Rock 2004) have been reported on various risk factors for tooth wear. Studies on severity and distribution of tooth wear on the other hand tend to be less common and not comprehensive. Hence, the aim of the study was to assess comprehensively the distribution and severity of tooth wear

among children of Andhra Pradesh, India.

Materials and methods

The present study is a descriptive cross sectional epidemiological survey conducted to assess severity and distribution of tooth wear among children of Andhra Pradesh. The survey population was all the school children who had reached the age of 12 years. The sample of children were randomly selected using a two-stage sampling frame, first by random selection of the districts from a total of 13 districts followed by the selection of schools. A sample size of 384 was estimated considering 95% confidence level and 5% margin of error. All school children gave consent prior to the study. Children with ongoing orthodontic treatment, those with the presence of crowns, bridges or multiple fillings, children with restricted mouth opening and uncooperative individuals were excluded from the study.

Training and calibration of the use of the index was carried out prior to the study. The calculation produced a Kappa value of 0.85 and 0.90 for inter and intra examiner reliability and this was acceptable. The calibrated examiner performed the clinical examinations using WHO probe and plane mouth mirror.

The Clinical examination included recording of tooth wear according to Smith and Knight Tooth wear index (1984). The incisal/occlusal (O/I), buccal (B), lingual (L) and cervical surfaces (C) surfaces of all the teeth were examined. The criterion used in this study was as follows:

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

2. Score 1 was given if there was loss of enamel characteristics on B/L/O/I and minimal loss of contour on C.
3. 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.
4. 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.
5. Score 4 was given if there was loss complete loss of enamel or pulp exposure on B/L/O/I and defect more than 2 mm deep on C.

Lower scores were assigned when examiner was unsure as to which code was applicable. Ethical clearance vote was taken from the institutional review Board. Descriptive statistical analysis has been carried out for the collected data. The Statistical software namely IBM SPSS 21.0 was used for the analysis of the data and Microsoft word and Excel have been used to generate graphs and tables.

Results

Out of 384 children, 58.7% were males and 41.3% were females. The prevalence of tooth wear was found to be 39.06%. Tables 1 and 2 shows the severity of tooth wear for maxillary and mandibular arches respectively. The highest frequency of score 1 and score 2 was found for incisal surfaces of maxillary right central incisor (45.9% and 12.7%). None of the maxillary and mandibular teeth surfaces had score 3 and 4.

Table 1: Presentation of severity of tooth wear index scores in maxillary arch.

		17	16	15	14	13	12	11	21	22	23	24	25	26	27
C	0	100	91.4	95.7	94.6	98.3	88.9	96.3	92.3	97.1	57.6	94.4	85.7	72.8	97.6
	1	0	4.7	3.7	4.5	0	0	3.7	7.7	0	2.4	4.2	14.3	16.5	2.4
	2	0	1.8	0.3	0.7	0	0	0	0	0	0	1.3	0	9.5	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	M	0	2.1	0.3	0.2	1.7	11.1	0	0	2.9	0	0	0	1.2	0
	0	100	97.7	99.6	99.8	97.3	88.9	99.1	99.3	97.1	100	99.1	97.9	98.7	100
	1	0	0.2	0.1	0	0	0	0.9	0.7	0	0	0.9	2.1	2.1	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O/I	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M	0	2.1	0.3	0.2	2.7	11.1	0	0	2.9	0	0	0	0.2	0
	0	95.2	84.6	95.2	99.8	98.7	66.8	41.4	58.1	75.1	92.3	96.6	94.3	82.5	94
	1	2.4	9.3	4.5	0	7.7	19.6	45.9	32.4	19.6	7.7	3.2	4.5	10.6	5.8
	2	0	2.7	0	0	0	2.4	12.7	9.5	2.4	0	0	0.5	2.7	0
L	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M	2.4	3.5	0.3	0.2	2.7	11.1	0	0	2.9	0	0.2	0.7	4.2	0.2
	0	100	97.9	99.7	99.8	98.3	94.4	92.3	94.4	92.3	100	100	100	98.8	100
	1	0	0	0	0	0	4.8	7.7	5.6	4.8	0	0	0	0	0
M	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	M	0	2.1	0.3	0.2	1.7	11.1	0	0	2.9	0	0	0	1.2	0

C= cervical, B= buccal, O/I= occlusal/incisal, L= lingual, M=missing

Table 2: Presentation of severity of tooth wear index scores in mandibular arch.

		47	46	45	44	43	42	41	31	32	33	34	35	36	37	
C	0	95	85.9	91.1	89.8	100	94.7	95.2	96.6	97.1	92	93.3	91.3	82.8	97.3	
	1	4.8	9.3	6.4	7.7	0	5.3	4.8	3.4	2.9	7.2	5	6.5	10.3	0	
	2	0.3	2.4	1.6	1.3	0	0	0	0	0	0	0.8	1.1	1.3	4.5	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	0	2.4	1.9	1.2	0	0	0	0	0	0	0	0.6	0.9	2.4	0.7	
B	0	100	97.1	96.7	98.6	100	100	100	100	100	100	99	98.4	96.3	100	
	1	0	2.9	1.2	0.2	0	0	0	0	0	0	0	0	0	0	
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M	0	2.4	1.9	1.2	0	0	0	0	0	0	0	0.6	0.9	2.4	0	
O/I	0	96.3	83	92.2	90.2	94.7	58.4	56	59.2	62.3	94.7	91.6	90.1	88.6	97.3	
	1	3.7	8.8	4	7.2	5.3	36.3	35.8	29.4	32.9	5.3	6.4	6.9	5.6	0	
	2	0	2.9	1.6	0	0	4.8	8.2	11.4	4.8	0	0.8	1.3	0.8	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M	0	5.3	2.3	2.6	0	0	0	0	0	0	0	1.2	1.7	5	2.7	
L	0	100	97.6	98.1	98.8	100	96.8	86.7	86.7	96.8	100	99.4	99.1	97.6	100	
	1	0	0	0	0	0	3.2	13.3	13.3	3.2	0	0	0	0	0	
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M	0	2.4	1.9	1.2	0	0	0	0	0	0	0	0.6	0.9	2.4	0	

C= cervical, B= buccal, O/I= occlusal/incisal, L= lingual, M=missing

Graphs 1 and 2 represent the surface distribution of tooth wear on maxillary and mandibular arches respectively. It shows that occlusal surfaces were most commonly affected with tooth wear when compared to buccal, lingual and cervical surfaces. It also shows that incisal surfaces of maxillary and mandibular teeth were more commonly affected than occlusal surfaces of

posterior teeth. No tooth wear on the lingual surfaces of posterior teeth of both the arches. It was observed only on the lingual surfaces of anterior teeth. Cervical surfaces of first molars were more frequently affected when compared to other surfaces of molars.

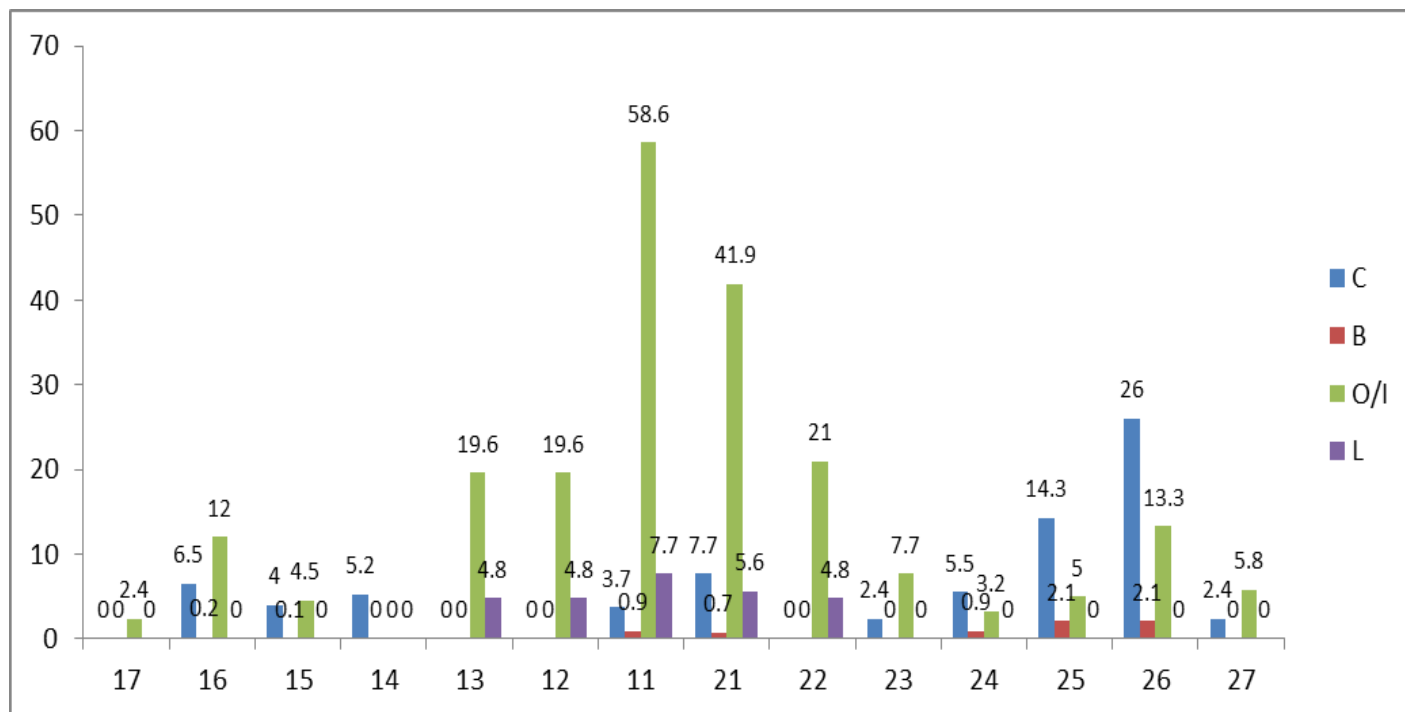


Fig 1: Presentation of surface distribution of tooth wear for maxillary teeth

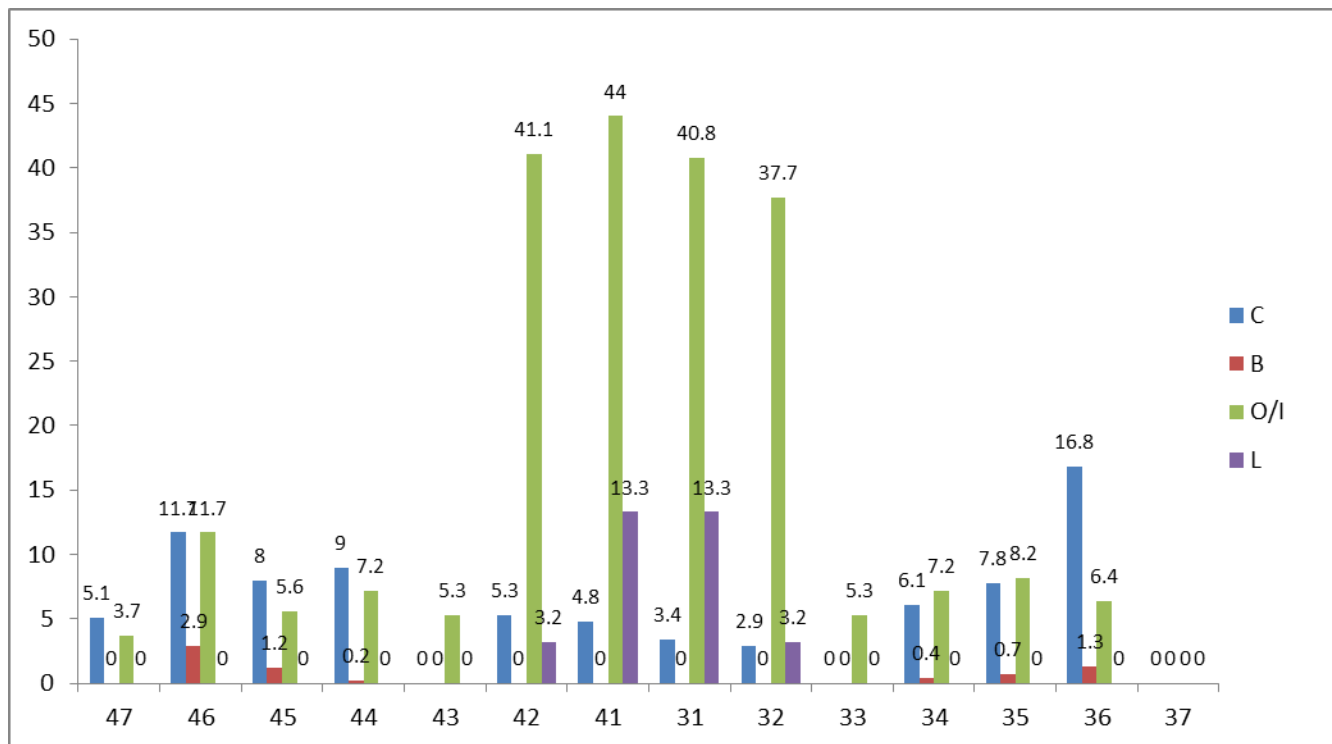


Fig 2: Presentation of surface distribution of tooth wear for mandibular teeth

Discussion

The present study is unique in its way of assessing the tooth wear in a most comprehensive way in the dental literature. The results revealed the prevalence of tooth wear among the study population was 39.06%. Findings from recent studies indicate that the prevalence of tooth wear ranged between 27% and 40% [8, 9, 10]. Variations in prevalence rates observed between the studies could be due to differences in the burden of tooth wear as well as due to methodological differences. The later include the use of different indices to record tooth wear, the differences in the types of teeth considered for recording tooth wear, variations in the terminology used to report tooth surface loss and differences in the age groups considered [11].

The findings of the present study showed almost a symmetrical distribution of tooth wear in both maxillary and mandibular arches. In both the arches, first molars and incisors were the most frequently affected teeth as they could be exposed to risk factors associated with tooth wear for a considerable period of time. These findings are in agreement with other studies conducted by Ogunyinka *et al*, 2001; Bradsley *et al*, 2004 [12, 13]. On the other hand, in studies conducted by Milosevic *et al*, 1993; Barlett *et al*, 1998 reported that premolars and molars had little wear compared to the incisors suggesting that etiological factors responsible for causing tooth wear are different for different populations [14, 15]. Lussi *et al*. found more lesions on maxillary teeth, mainly on the canines and premolars. It should be pointed out that they examined only erosive lesions whose frequency was greater in the upper jaw [16]. Zipkin and Mc Clure obtained similar results with 27% of the people affected by tooth wear situated in the maxilla on the evaluating wear in children and young adults at age 3, 5, 10, 15 and 20 years, only 63% of the

3 year olds, 19% of the 5 year olds had tooth wear and for the 10, 15, and 20 years olds the corresponding data were 78%, 51% and 35% representing the prevalence of tooth wear decreases with increasing the age [17]. Bergstorm and Eliasson reported more lesions on the left side and Radentz *et al*. reported more on the right side [18, 19]

The site of tooth wear can be used to some extent to suggest the source of the etiological factor. In the present study, it was found that the occlusal/incisal surfaces were most frequently affected followed by cervical and lingual surfaces. In agreement with other studies (Bardsley *et al*, 2004; Nilantha Ratnayake *et al*, 2010), it was found that the occlusal surface was the most frequently affected tooth surface, palatal surface was the least affected and palatal lesions were only seen in the anterior teeth. Labial surfaces of anterior teeth were most frequently affected by tooth wear than the buccal surfaces of the posterior teeth [20, 21]. In a study conducted by S.H.C. Sales-Peres *et al*, 2011; it was found that the mean tooth wear across all participants was 16% with the incisal/occlusal surfaces most frequently affected by tooth wear in primary and permanent dentition (92.4% and 15% respectively) [22]. In contrast, a similar study conducted by Ganss C Klimek *et al*, 2001 revealed that 10% of the children had erosive lesions of the buccal and 19% of the palatal surfaces of their incisors were affected [23].

An important factor in measuring tooth wear is the extent of damage. If dentin is exposed on the incisal edges of the maxillary anterior teeth in a 12 year old and the situation remains relatively stable for the next 40 years it is unlikely to be a significant problem. However, if the wear continues and ultimately compromises the appearance and function of the teeth there is a problem. Most of the studies on the prevalence of erosion, attrition, or tooth wear report that early wear is

common and severe wear, by comparison, is not ^[24]. In this study, majority of the population had score 1 involving only the enamel surface mostly and few surfaces had score 2. The index score levels 3 and 4 were absent. In another study, among 14-year-old School children in Liverpool (Milosevic *et al.*, 1994), it was 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 ^[25]. 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 ¹⁵. 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 ^[20]. In the present study the proportion of subjects having exposed dentine was considered low compared to other studies (Milosevic *et al.*, 1994) ^[26].

Limitations

It is important to consider the limitations of the study. The very first one is related to the tooth wear index. Most early tooth wear indices were developed in an attempt to match treatment need to severity and as such, are biased toward the more severe levels. The Smith and Knight index has 5 levels, from 0 to 4, with wear on enamel denoted by level 1 and early dentin being exposed denoted by level 2. Therefore, the Smith and Knight index is biased toward moderate (level 3) and severe (level 4) levels of tooth wear. The comparison of data between studies was possible at levels 3 and 4 but not possible at those that were less severe. This index does not indicate the whether the tooth wear lesion is due to attrition or abrasion or erosion.

Recommendations and future studies

- A main perspective for future work is the initiation of a consensus process in the scientific community, aimed at avoiding the further proliferation of indices. This process should lead to the development of an internationally accepted, standardized and validated index. A reasonable appraisal of the various forms of tooth wear as oral disease is needed to avoid overestimating its importance for oral health. We support the idea of adopting a widely held and used tooth wear index. It is unlikely that a single index will ever be fully adopted by all researchers, but it might be possible to use a skeleton index which can be adaptable to others, both in collection and presentation of data.
- A further topic for the research agenda is the initiation of data collection on the prevalence of tooth wear on a population based level, preferably integrated in caries prevalence surveys when applicable. For improving the validity of diagnostic criteria and to facilitate the differential diagnosis of sub forms of tooth wear, a database providing clinical photos may help with training sessions and calibration.
- Considering analytical epidemiological studies, for instance identifying risk factors from life style and diet, or

general health conditions, the development of a validated questionnaire needs to be initiated. In addition, future research into the roles of saliva and medical conditions in the pathogenesis of the tooth wear lesions may help further the understanding of this complex condition.

- The management of TW is a major challenge to the dental profession. Improved measures of prevention and therapy of tooth wear lesions still need to be determined. Failure to eliminate the cause may compromise the long-term survival of restorations and further deterioration of the dentition.

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