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Association between Severity of Tooth Wear and Dentinal Hypersensitivity

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ABSTRACT

Background & Objectives: Tooth wear (attrition, abrasion, erosion, and abfraction) is perceived globally as ever increasing problem. Several outcome of the tooth wear are hypersensitivity, esthetic problems, functional impairment, annoyance to the patient, and fracture of the tooth. Among these, the measurable and more commonly reported outcome is hypersensitivity to stimuli. Although dentin hypersensitivity is a common clinical condition and is generally reported by the patient after experiencing a sharp, short pain caused by one of the several different external stimuli, it is often inadequately understood. None of the scientific literature available till date attempted to establish the relationship between tooth wear and dentin hypersensitivity which could be a key factor in monitoring those patients. The aim of the study was to estimate the association between severity of teeth wear and sensitivity in the patients with reported dentinal hypersensitivity. **Materials & Methods:** Fifty patients with dentin hypersensitivity were investigated for tooth wear. Tooth wear measured using exact tooth wear index and level of sensitivity to stimuli was recorded using a numerical rating scale. **Results:** Enamel wear at cervical region of teeth showed a positive correlation ($p=.010$), similarly, dentin wear at cervical region of teeth showed positive correlation and significant association ($p<.001$) with dentinal hypersensitivity. **Conclusion:** The observation supports a significant association between severities of tooth surface wear and dentinal hypersensitivity.

Key words: Attrition; Abfraction; Abrasion; Dentine Hypersensitivity; Tooth wear; Tooth wear indices

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INTRODUCTION

The increased availability of the dental treatment to the population and awareness regarding preventive regimes have resulted in retaining the natural dentition for longer ages. With the advancing age, the loss of tooth substance and its management is posing a challenge for the clinicians. Apart from the carious destruction of the tooth surface, several mechanical, biological, physiological and chemical processes play role in the loss of tooth substance. Non-carious destruction of tooth substance are commonly associated with dietary patterns, parafunctional habits, periodontal disease, improper brushing habits, the presence of acid reflux and socioeconomic status. Usually more than one etiological factor play combined role in the mechanism of the bio-corrosion (Chemical, Biochemical, Electrochemical Degradation), friction and stress (Occlusion, mastication, static and cyclic fatigue) in the teeth resulting in attrition, abrasion, erosion and abfraction.[1] The aetiology, extent and clinical presentation of this condition vary among different individuals.

The most convenient method to record changes on teeth resulting from wear has been the use of indices, other methods measuring tooth wear are surface profilometry, polarized light microscopy, microhardness, microradiography, digital image analysis, scanning probe microscope. Several indices are used to assess the degree of tooth wear at different site of tooth. The most frequently used index is the Smith and Knight Tooth Wear Index, several other indices are simplified tooth wear index by Bardsley et al (Simplified scoring criteria for

tooth wear index), Eccles index for dental erosion.[2,3] Larsen et al.[4] proposed a new clinical index based on a combination of clinical examination, photographs and study casts with several complicated qualitative and quantitative clinical criteria to score different surfaces. Oilo et al.[5] criticised the use of indices that used a nonlinear scoring method and advocated different type of scoring system, in which the decision of whether treatment is necessary is a basic criterion. These indices didn't consider grading the extent of enamel wear.[6] The relative inaccuracy of these indices at the enamel level may underestimate the severity of enamel wear that may be a predictor of dentin loss with advancing age in an individual. A new index (the Exact Tooth Wear Index), which grades the severity of wear in enamel and dentine separately has been introduced by Fares J. et al.[6] Several studies report the prevalence of tooth wear in different population, sex, age groups or in selected population group such as armed forces, referred patients. The most common presentation and concern for which patients with tooth wear seek dental advice and treatment is the dentin hypersensitivity. The current scientific literature doesn't have any evidence to show whether the severity of tooth wear or the measurement of this by indices influence or correlate the level of dentin hypersensitivity of the population or individual patient. Thus the aims of the present study were to describe the correlation between severity of tooth wear and its association with the level of dentin hypersensitivity using the Exact Tooth Wear Index, to measure its reproducibility in the patients with reported dentin hypersensitivity.

MATERIALS AND METHODS

Fifty adult patients (18- 60 years, 30 female and 20 male) attending department of conservative dentistry and endodontics with chief complaint of dentin hypersensitivity from January to June 2016 were invited to take part in the study. Inclusion criteria: a) Permanent teeth, b) vital teeth. Exclusion criteria: a) Tooth with carious lesion, b) moderate to severe periodontal disease, c) periapical pathosis, d) traumatic injury to tooth, e) malaligned tooth, f) atypical tooth morphology, g) developmental disorders affecting teeth and/or oral structures, h) current desensitizing therapy, i) medical (including psychiatric) and pharmacotherapeutic histories that may compromise the protocol including the chronic use of anti-inflammatory, j) analgesic and mind-altering drugs, k) periodontal surgery in the preceding three months, l) orthodontic appliance treatment within previous three months, m) teeth or supporting structures with any other painful pathology or defects, n) teeth restored in the preceding three months, o) extensively restored teeth and those with restorations extending into the test area.

Following informed consent and information about the study, the oral examination was conducted. Clinical oral examination of the patients was performed in an outpatient dental clinic using a dental front surface mirror, explorer and gauzes, under standard illumination from a dental operating light. All patients were examined intraorally by the same practitioner. The most sensitive tooth among or for which he/she seek dental advice as reported by patient was selected for further investigation.

Clinical examination:

The buccal, cervical, incisal/occlusal, palatal/ lingual surface of the selected teeth were scored according to the criteria shown in Table 1. Scores of 0–4 for the enamel and 0-5 for the dentine were assigned to the teeth, according to the severity of wear. Patients were educated to understand the numerical rating scale (NRS) with score 0 to 10 (labelled at the extremes with "no pain," at the zero end of the scale, and "severe pain," at the end of the scale) along with facial expression printed on the plain sheet. Dental explorer was used to elicit tactile stimuli over the wear site followed by air blast from a standard air/water syringe directed towards the sensitive portion of tooth, perpendicular to long axis of the tooth at a distance of 0.5 to 1 cm applied for one second with a pressure of 45psi to 65 psi.[7] Patients were asked to rate the sensitivity in the standard numerical rating scale.

Statistical method:

Patients were evaluated and data entered in data collection sheet. Collected data were entered in Microsoft Excel 2013 and coded accordingly. The statistical analysis was performed by Statistical Package for the Social Sciences (IBM SPSS, Inc. Chicago, IL, USA version 20). For Inferential statistics, Spearman's rank correlation coefficient was applied to measure the strength of association between variables. Statistically significant levels were set at $p < 0.05$.

RESULTS

Total 50 patients, thirty females and twenty male patients with established dentinal hypersensitivity gave informed consent to participate in the study.

Table 1: The Exact Tooth Wear Index [Fares J et. al.][6]

Exact Tooth Wear Index for Enamel
0: No tooth wear: no loss of enamel characteristics or change in contour
1: Loss of enamel affecting less than 10% of the scored surface
2: Enamel loss affecting between 10% and one third of the scored surface
3: Enamel loss affecting at least one third but less than two thirds of the scored surface
4: Enamel loss affecting two thirds or more of the scored surface
Exact Tooth Wear Index for Dentine
0: No dentinal tooth wear: no loss of dentine
1: Loss of dentine affecting less than 10% of the scored surface
2: Dentine loss affecting between 10% and one third of the scored surface
3: Dentine loss affecting at least one third but less than two thirds of the scored surface
4: Dentine loss affecting two thirds or more of the scored surface, no pulpal exposure
5: Exposure of secondary dentine formation or pulpal exposure

No significant difference in sensitivity was observed with the gender variation. Distribution of pain scale score according to teeth morphology shows that higher score was observed with premolar followed by anterior teeth and then molar teeth (Table 2). Correlation between tooth wear index and pain scale (NRS) showed a positive correlation with the teeth wear (Table 3). A significant positive correlation exists between teeth wear in cervical region with enamel and dentin wear. Correlation between enamel wear and dentin wear shows that there exists a positive and significant association between them according to the teeth surface involved (Table 4).

Table 2: Distribution of pain scores according to teeth morphology

PAIN SCALE (NRS) SCORE	%	TEETH		
		Anterior	Premolar	Molar
2	34.0%	6.0%	12.0%	16.0%
3	50.0%	14.0%	30.0%	6.0%
4	10.0%	4.0%	4.0%	2.0%
5	6.0%	-	6.0%	-
TOTAL	**100%**	**24.0%**	**52.0%**	**24.0%**

Table 3: Correlation between tooth wear index and pain scale (NRS)

	Pain Scale (NRS)	
Tooth surface	**Correlation Coefficient**	**p- Value (†Significant, p< 0.05)**
Enamel Buccal	0.056	.699
Enamel Cervical	0.359*	0.010†
Enamel Incisal/ Occlusal	0.177	0.220
Enamel Palatal/ Lingual	0.217	0.131
Dentin Buccal	0.191	0.184
Dentin Cervical	0.533**	<.001†
Dentin Incisal/ Occlusal	0.055	0.703
Dentin Palatal/ Lingual	0.068	0.640

**Correlation is significant at the 0.01 level

*Correlation is significant at the 0.05 level

Table 4: Correlation between enamel wear and dentin wear

Correlation Matrix					
Tooth surface		**Dentin Buccal**	**Dentin Cervical**	**Dentin Incisal/ Occlusal**	**Dentin Palatal/ Lingual**
Enamel Buccal	Correlation Coefficient	.409**	.293*	-	-
	p-Value	.003†	.039†	-	-
Enamel Cervical	Correlation Coefficient	-	.613**	-	-
	p-Value	-	<0.001†	-	-
Enamel Incisal/ Occlusal	Correlation Coefficient	-	-	.673**	-
	p-Value	-	-	<0.001†	-
Enamel Palatal/ Lingual	Correlation Coefficient	-	-	-	.556**
	p-Value	-	-	-	<0.001†

**Correlation is significant at the 0.01 level *Correlation is significant at the 0.05 level

p- Value (†Significant, p< 0.05)

DISCUSSION

Perception of pain is a subjective sign and this is strongly dependent on the cultural, individual and economic background of the patient.[8]The usefulness of the indices will only be established if they support the clinical outcome such as dentine hypersensitivity or possibly influence the treatment plan, also if they may be helpful in predicting the future tooth surface loss.

Results of this study suggest that severity of dentinal hypersensitivity as scored by NRS is associated with surface wear in the cervical region of teeth. Enamel and dentin wear measured separately in the cervical region of teeth as scored by exact tooth wear index show a positive correlation with the dentine hypersensitivity. Stanford et. al.[9] showed that enamel in the cervical region has a 30% lower compressive strength. It has also been shown that the crystal structure is barely definable in this region,[10] and there are fewer areas of gnarled enamel, where the enamel rods intertwine, which leads to greater fracture resistance. Studies revealed that excessive cyclic and nonaxial loading resulted in cusp flexure and more stress concentration in the cervical region of the teeth.[1]

Higher incidence of pain in premolar teeth could be explained because the dentin thickness in the cervical region is less in these teeth and also due to the anatomical location of the premolars as they are subject to compressive, tensile and shearing stress. Studies revealed that the teeth that had cyclic fatigue stress demonstrated more biocorrosion than the unstressed teeth.[1] Wear in buccal, incisal/ occlusal, lingual/palatal regions didn't show significant correlation with the severity of dentine hypersensitivity, probably it may be due to lower scores of wear in these sites as recorded during the investigation. Results demonstrate a strong correlation between cervical enamel loss and cervical dentin loss, thus the pattern of enamel wear (usually due to crack production, by tensile loading) and dentine (usually as a result of plastic deformation, by shear stress)[11] may be helpful in predicting future dentin loss.

We considered only one most sensitive tooth of an individual patient so as not to unduly sensitise patient and also it may influence sensitivity score. Increased consumption of carbonated beverages implies that exposure of teeth to an acid environment is increasing, which will obviously have an effect on the wear of teeth. Experimental studies has shown that there is decrease in the hardness and elastic modulus of enamel with increasing acidity (decreasing pH).[12,13] Cuy et al.[14]observed the enamel surface hardness (H) > 6GPa and modulus of elasticity (E) > 115GPa, while enamel at the enamel-dentine junction H < 3GPa and E < 70GPa. These variations were shown to correspond to changes in the chemistry, microstructure and prism alignment. More the depth of tooth wear, higher possibility of accelerated loss of deeper surfaces will be there. Thus, the pattern of enamel wear may be considered as predictor for dentin wear. Early identification of the aetiology and appropriate strategies can be recommended for

the prevention of the tooth wear leading to dentinal hypersensitivity.

It is often difficult for patients to identify and localize the painful situation in teeth and thus there is risk for false positive.[15] The results of this study may be used as possible relationship between the tooth wear and dentin hypersensitivity but generalization of these association may still be incomplete since dentin hypersensitivity is of multifactorial etiology which is often incompletely explained and characterized and several variables may contribute to the differences in perception of the patient. An understanding of the mechanisms and controlling factors in tooth enamel/ dentin wear is therefore clinically important. Multifactorial model analysis using several contributing factors responsible for the perception of painful sensation in the patients may be recommended with a larger sample.

CONCLUSION

Based on these findings, the answer to the clinical research question underlying this investigation is that there exists a positive and significant correlation between severity of tooth wear in the cervical region of teeth and dentine hypersensitivity perceived by the patients.

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