

ARE DENTAL PATIENTS ABLE TO PERCEIVE EROSIVE TOOTH WEAR? AN INTERNET-BASED SURVEY ASSESSING AWARENESS AND RELATED ACTION

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Abstract

Background. Erosive tooth wear (ETW) is irreversible loss of dental hard tissue. The authors examined patients' ability to recognize ETW relative to sound teeth and teeth with dental caries.

Methods. Using Amazon's crowdsourcing service, the authors recruited participants (N=623) to view standardized images of buccal surfaces of teeth (sound, ETW, or caries). Participants reported whether a dental condition existed (yes/no), likelihood to seek care, and esthetic attractiveness for teeth with no, initial, moderate, or severe signs of ETW/caries.

Results. Dental patients demonstrated poor recognition of cases of ETW, especially compared to sound and caries-affected teeth at each level of severity. Patients were less likely to schedule a dental appointment for care/treatment of teeth with ETW than caries at each level of severity. Patients also found ETW more esthetically attractive than caries at each level of severity and found initial ETW more attractive than sound teeth.

Conclusions. Dental patients struggle recognizing ETW, in general and compared to caries, at each level of severity and particularly for early stages of ETW. These recognition difficulties likely arise, in part, from tooth esthetic attractiveness standards (smooth and shiny teeth look more esthetic), possibly leading to lack of appropriate care-seeking behavior.

Practical Implications. This internet-based tool may be used to assess dental patients' awareness and ability to recognize cases of ETW. Improved patient awareness might lead to seeking professional care to prevent and/or delay ETW progression.

Key Words. Erosive tooth wear, caries, patient perceptions, oral-health, care-seeking behavior.

Introduction

Erosive tooth wear (ETW) is defined as irreversible loss of dental hard tissue, affecting the dental form, function and esthetics.¹⁻⁵ ETW encompasses dental erosive and abrasive processes. Because recent trends are that teeth are likely to stay in the mouth for longer, the harmful effects of ETW present increasingly long-term oral health problems.⁶ ETW prevalence in children and adolescents varies worldwide and has shown to be as high as 46% among teenagers and as high as 80% among adults in the U.S.^{7, 8} By comparison, dental caries is the most prevalent oral disease, affecting 3.58 billion people worldwide⁹ and 94% of U.S. adults.¹⁰

Although ETW and dental caries show from moderate to high prevalence in different populations and age groups, patients are more likely to visit a dentist for dental caries than to ETW care. One possible factor that may influence perceptions of ETW is that this condition is not apparent to most patients. Although the evidence base is sparse, the few studies that have explored dental patients' awareness of ETW suggest that awareness is low. A study of 12-year-olds in the U.K. found that 34.2% of children had heard of ETW, 53.8% acknowledged not knowing what ETW was, and 8.1% could remember discussing ETW with their dentist.¹¹ Dental patients' perceptions appear to be mismatched with the epidemiological and clinical impacts of ETW. For example, 19.8% of patients at a Brazilian dental school were aware of ETW.¹² The lack of patient awareness is concerning because patients' perceptions may not only drive the identification of such dental conditions but also influence the salience of ETW as a clinical issue to be addressed through self-care and professional care.

Therefore, the aim of this study was to examine patients' ability to recognize ETW. We hypothesized that patients would not easily recognize ETW – on its own and in contrast with the more common condition of dental caries. To this end, a web-based survey was used, while also examining whether patients' health-seeking behavior differed for ETW and dental caries.

Methods

Study design and participants. We developed the survey on Qualtrics and used Amazon's crowdsourcing service (Mechanical Turk; MTurk) to recruit participants, henceforth

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referred to as “patients”, since we are assuming that any person participating in our survey is a current or future dental patient. We restricted our survey to patients in the United States during January 2019. Patients were paid a small honorarium for completing the 10-minute survey. Internet sampling services, such as MTurk, have been used for research in various fields such as psychology,^{13, 14} economics,^{15, 16} and sociology.^{17, 18} MTurk participants are more demographically diverse than college and other online samples,¹⁹ and research has found that MTurk-acquired data is as reliable as traditional methods.^{20, 21} We conducted the survey after receiving institutional review board approval from Indiana University – Purdue University-Indianapolis (#1810975503).

Survey outline. We first examined whether patients were able to recognize the presence of a dental condition when presented with images of teeth with ETW, sound teeth, and teeth with dental caries, at varying levels of severity. We expected patients to have poor recognition of ETW in general and poorer recognition than dental caries at initial, moderate, and severe levels of severity. Next, we examined when patients would be motivated to seek dental care. We expected patients to be less likely to seek dental care for ETW than caries at each level of severity. Lastly, we examined whether perceived esthetic attractiveness differed for teeth with ETW compared to dental caries at each level of severity. In all contrasts, we included images of sound teeth to provide a healthy referent for the comparisons. Briefly, patients viewed fourteen standardized images of buccal surfaces of teeth depicting caries and ETW, two images per level of severity (no condition [sound], initial, moderate, and severe). One specific tooth was circled in each image, and patients answered three questions regarding the selected tooth/surface.

Procedure. We selected images of teeth with ETW, sound teeth, and dental caries from a catalogue maintained by a member of our research team (JCC). We used the Basic Erosive Wear Examination (BEWE) to determine severity of teeth with ETW.²² The BEWE grades ETW on a 0-3 ordinal scale: sound (BEWE 0: no wear), initial (BEWE 1: early surface loss), moderate (BEWE 2: surface loss < 50%), and severe (BEWE 3: surface loss > 50%). The dental caries lesions were classified into the same severity levels to allow a direct comparison between the two conditions as follows: sound (absence of any sign), initial (visual changes in enamel), moderate (localized enamel breakdown with visual signs of small dentinal involvement), and

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severe (distinctive cavity with extensive dentin involvement). Initial testing of 42 images was completed prior to the commencement of the current study wherein three experienced dentists (JCC, ATH, & GM) scored the buccal surfaces of teeth and reached consensus in cases of disagreement. Finally, 14 images considered representative of all conditions under study were selected and a benchmark established.

Materials. For each of the fourteen images described above, patients responded to three questions. First, patients responded “yes” or “no” to the question, “Does the circled tooth look normal?” Patients’ responses were correct when they matched the expert-determined clinical diagnosis (benchmark). This item assessed patients’ perceptions of whether a dental abnormality was present (recognition). Next, patients used a Likert-type scale (ranging from *Extremely unlikely* [1] to *Extremely likely* [6]) to respond to the question, “How likely would you be to schedule a dentist appointment based on the appearance of the circled tooth?” These items assessed patients’ care-seeking tendencies (seeking care). Lastly, patients used a Likert-type scale (ranging from *Extremely unattractive* [1] to *Extremely attractive* [6]) to respond to the question, “How attractive would you rate the circled tooth?” This item assessed patients’ perceptions of tooth attractiveness (attractiveness).

Analyses. After normality checks indicated the residuals were approximately normally distributed, we conducted repeated measures ANOVAs with a Greenhouse-Geisser correction and post hoc tests using the Bonferroni correction to compare patient responses to teeth with ETW, teeth with caries, and sound teeth.²³ For each of the analyses, we combined the responses for each level of severity (14 images in total), and averaged the two responses to create seven variables: sound, initial ETW, moderate ETW, severe ETW, initial caries, moderate caries, and severe caries.

Results

Demographics. The study included 623 patients (295 men; 313 women; 15 did not report sex), ranging in age from 19-75 ($M = 37.09$; $SD = 12.19$). Approximately 9% completed high school or less ($n=59$), 20% reported some college ($n=123$), 51% completed a 2-year or 4-year

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college degree (n=308), and 20% completed an advanced degree (n=120). Approximately 48% reported current income <\$50,000 (n=291), 38% reported \$50,000-\$100,000 (n=234), and 14% reported >\$100,000 (n=85). Pairwise deletion was used to account for the small amount of missingness in the data.

Recognition. We combined the responses for each level of severity and examined the percentage of patients who correctly determined whether a dental condition was present. Eighty-six percent of sound teeth were correctly identified as not having a dental condition present. Mean ratings of recognition significantly differed by severity ($F(4.59, 2852.49) = 638.64, p < .001$; see Figure 1). Patients had poorer recognition for initial ETW (9.6%) than initial caries (76.2%, $p < .001$), poorer recognition for moderate ETW (34.1%) than moderate caries (77.3%, $p < .001$), and poorer recognition for severe ETW (56.3%) than severe caries (86.8%, $p < .001$).

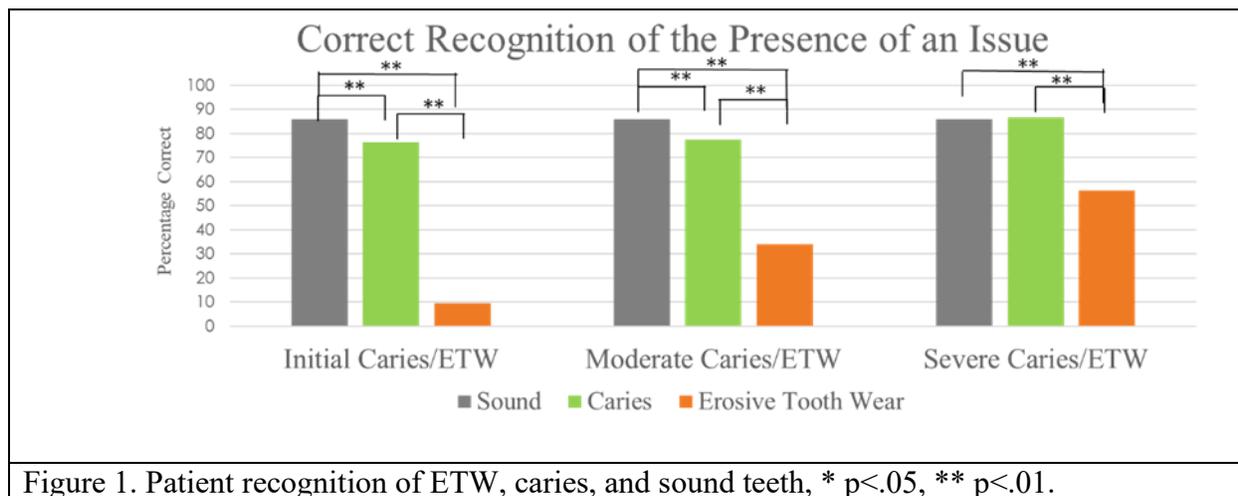
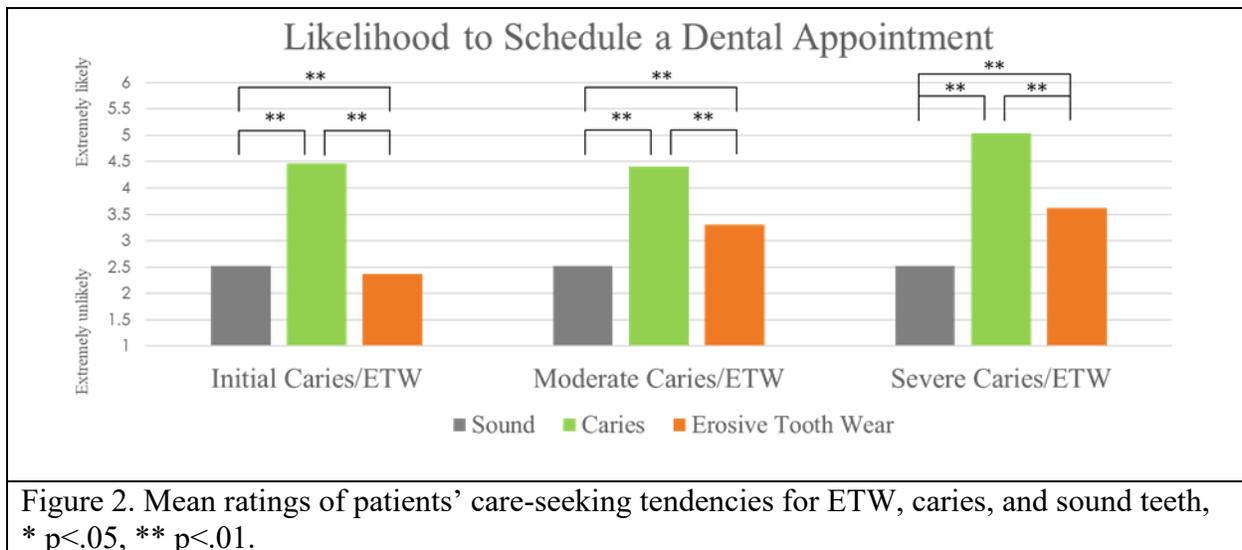


Figure 1. Patient recognition of ETW, caries, and sound teeth, * $p < .05$, ** $p < .01$.

Seeking care. We combined the responses for each level of severity and examined patients' likelihood to seek dental care for a specific tooth. Mean ratings of likelihood significantly differed by severity ($F(2.08, 1285.34) = 624.92, p < .001$; see Figure 2). Patients were less likely to schedule a dentist appointment for initial ETW ($M = 2.37, SE = .05$) than initial caries ($M = 4.47, SE = .05, p < .001$). Patients were also less likely to schedule an

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appointment for moderate ETW ($M = 3.31, SE = .05$) than moderate caries ($M = 4.40, SE = .04, p < .001$), and for severe ETW ($M = 3.62, SE = .04$) than severe caries ($M = 5.04, SE = .05, p < .001$).



Esthetic attractiveness. We combined the responses for each level of severity and examined how attractive patients found a specific tooth. Mean ratings of attractiveness significantly differed by severity ($F(2.76, 1688.57) = 1339.53, p < .001$; see Figure 3). Patients rated initial ETW ($M = 4.58, SE = .04$) more esthetically attractive than initial caries ($M = 2.27, SE = .04, p < .001$), moderate ETW ($M = 3.07, SE = .03$) as more esthetically attractive than moderate caries ($M = 2.29, SE = .04, p < .001$), and severe ETW ($M = 3.05, SE = .04$) as more esthetically attractive than severe caries ($M = 1.74, SE = .04, p < .001$). Patients rated initial ETW as more esthetically attractive than sound teeth ($M = 4.32, SE = .04, p < .001$).

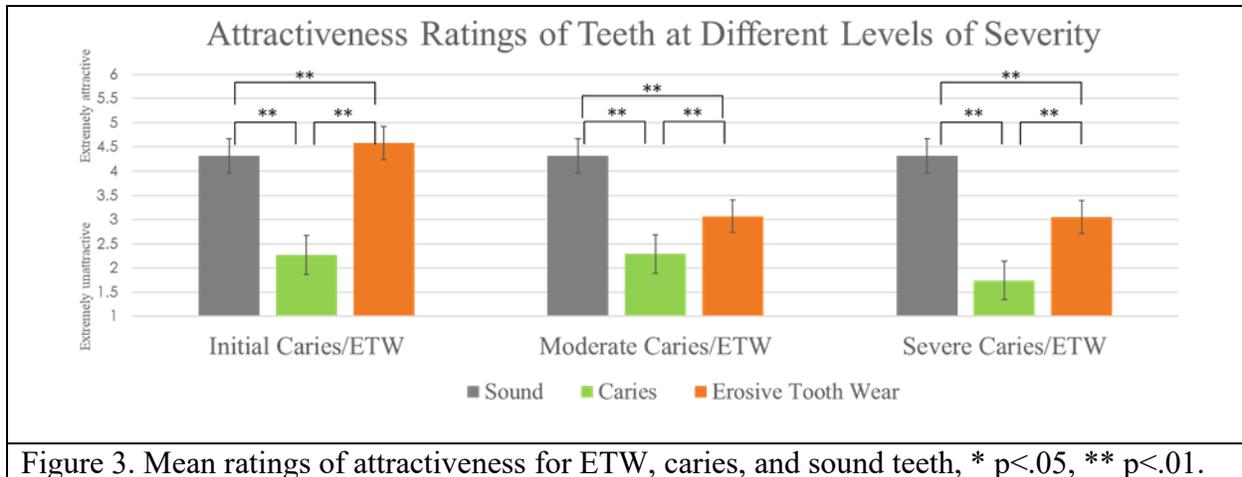


Figure 3. Mean ratings of attractiveness for ETW, caries, and sound teeth, * $p < .05$, ** $p < .01$.

Discussion

Our findings supported the hypotheses and suggest that patients' perceptions of dental conditions differ for ETW and caries. We found that our panel of dental patients demonstrated poor recognition of cases of ETW, especially compared to sound teeth, and compared to teeth with caries at each level of severity. Patients were less likely to schedule a dental appointment for teeth with ETW than caries at each level of severity and, perhaps even more interesting, were less likely to schedule a dental appointment for teeth with initial ETW than sound teeth. Patients also found ETW more esthetically attractive than caries at each level of severity and found initial ETW more esthetically attractive than sound teeth.

The poor ability for dental patients to recognize ETW (33% recognition, collapsing across each level of severity) is problematic given that ETW prevalence is as high as 80% among adults in the U.S.⁸ Meanwhile, patients were better able to recognize caries (80.1% recognition, collapsing across each level of severity), which affects 94% of U.S. adults.¹⁰ These differences in recognition accuracy were especially prominent at early stages of the two dental conditions (9.6% recognition for initial ETW vs. 76.2% recognition for initial caries). One possible explanation for why dental patients struggle to recognize ETW is the perceptions of the physical appearance of the tooth. Early stages of ETW were rated as more esthetically attractive (mean rating = 4.58 on a 6-point scale) – more esthetically attractive, in fact, than sound teeth (mean rating = 4.32) – which likely contributed to patients' poorer recognition of this condition, as well

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as their low likelihood of seeking dental care for it. Initial ETW physically changes the enamel surface texture and results in polishing of the surface, which makes the tooth look shinier than sound enamel without affecting its form or exposing the underlying dentin.²⁴ Highly polished surfaces remove superficial defects (e.g. light fluorosis or uneven coloring), resulting in a more esthetically pleasing tooth.²⁵ The smooth and shiny appearance of early ETW lesions make it difficult for patients to detect them.²⁶ The esthetic attractiveness findings are consistent with related research showing that patients find teeth with early levels of fluorosis as more attractive than sound teeth.²⁷⁻²⁹ All in all, these findings suggest that the general public considers esthetically attractive teeth to be indicative of healthy teeth. A better understanding of the progressing stages of ETW would help patients recognize early symptoms and manage the condition before it reaches moderate and severe levels.

The current finding that patients especially struggled to recognize initial levels of ETW has significant implications given the importance of early detection in terms of dental self-management and seeking professional dental care.³⁰ Indeed, a study published over a decade ago found that dental patients have difficulty detecting initial ETW and often fail to seek treatment until the condition reaches an advanced stage or impairs the esthetics of the tooth.²⁶ Initial erosive lesions that go undetected can potentially progress to more serious problems that require restorative therapy – increasing patients' recognition of these initial stages may allow for the use of less invasive and costly measures that prevent further progression.^{31, 32} Increased recognition of early ETW may also initiate professional care-seeking behavior and the implementation of non-operative management strategies.³³ Our findings support this claim, such that patients were less likely to make an appointment for early cases of ETW and only considered seeking care for severe cases.

The limited existing research on dental patients' awareness of ETW typically assesses familiarity with the concept of ETW and recollection of any discussion with their dentist about the topic. The current research explored a more naturalistic approach to how patients make dental health-care decisions. We examined the extent patients could visually recognize a dental condition when presented with an image of a tooth. This methodology more closely represents how patients examine their own teeth in a mirror to determine how to improve or maintain oral

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health. As such, the current research sets the groundwork for developing and testing interventions to increase patient awareness of ETW. These advantages notwithstanding, a potential limitation of this work is that it was conducted with an online sampling service. MTurk respondents have greater internet access, are better educated, and have higher socioeconomic status than the average U.S. citizen³⁴ – this was also true for the current sample. Therefore, one might assume that MTurk respondents are better informed about oral health, yet our findings still show these patients struggle to recognize ETW. We also restricted the scope of the current research to focus solely on patients' perceptions of ETW and did not factor in dentists' perceptions. Ongoing research is similarly exploring dentists' ability to recognize ETW compared to sound and caries-affected teeth.³⁵

Conclusion

Dental patients struggle recognizing ETW, in general and compared to caries, at each level of severity and particularly for early stages of ETW. These recognition difficulties likely arise, in part, from tooth esthetic attractiveness standards (smooth and shiny teeth look more esthetic), possibly leading to lack of appropriate care-seeking behavior. Improved patient awareness might lead to seeking professional care to prevent and/or delay ETW progression.

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