When patients present with an extensively worn dentition, the dentist must have an understanding of what is causing the wear to be successful in treatment. Tooth wear can be caused by a number of factors, but usually one factor may predominate. Communication between the dentist and patient is essential in establishing an etiology of the wear. Usually patients are aware of a problem and must be informed on how to prevent further damage and what treatment options are available. This article will review the etiology of gastroesophageal reflux disease (GERD) and a conservative, aesthetic treatment solution.

The first time a patient is examined, it is difficult for the dentist to determine if the rate of wear is excessive. The only way to tell is if the patient has been a patient of record for a number of years. What constitutes “normal” wear rates? Various published articles have conflicting values. One study reports a normal loss of enamel between 20 microns and 38 microns per year. Another study reports a wear of 65 microns in 6 months. Non-carious tooth wear is a normal physiologic process that occurs in many patients throughout life. If the rate of wear is such that it is the source of concern to the patient, or if it is likely to prejudice the survival of the teeth, then the rate is considered to be pathological, and action must be taken to minimize the damage.

Erosion is defined as “the progressive loss of tooth substance by chemical processes that do not involve bacterial action”. Acid reflux appears as one of the most common causes of dental erosion. Erosion can be divided into extrinsic and intrinsic factors. The extrinsic factors include acid from beverages and foods, vigorous tooth brushing and some oral medications. Intrinsic erosion is often caused by vomiting, gastric reflux, pregnancy, quality and quantity of saliva, and alcoholism. It was reported that patients with low unstimulated flow rates of saliva were found to have an increased risk for development of cervical lesions. Since saliva rinses away and buffers acids on tooth surfaces, low salivary flow rates may be an initiating factor in dental erosion. It has also been reported that anorexics and bulimics develop xerostomia and their saliva may have a lower buffering and remineralizing capacity.

Most individuals experience gastroesophageal reflux at some time in their lives. GERD, however, is a clinical condition that occurs when the reflux of stomach acid into the esophagus is severe enough to impact the patient’s life and/or damage the esophagus. A relationship between GERD and dental erosion has been described in a number of publications. In most patients, GERD is due to a transient relaxation of the sphincter that keeps the lower end of the esophagus closed when he or she is not swall...
lowing food or liquids, which allows acid and food particles to reflux into the esophagus. GERD is characterized by the chronic, intermittent, unrestricted movement of stomach acids into the esophagus. This is defined as regurgitation and should be distinguished from vomiting since it involves a passive or effortless return of the stomach contents into the mouth versus a physiological response to a stimulus controlled by the autonomic nervous system.1,2 The four major symptoms of GERD are heartburn (uncomfortable, rising, burning sensation behind the breast bone); epigastric and retrosternal (non-cardiac) pain; regurgitation of gastric acid or “sour stomach” contents into the mouth; and difficult and/or painful swallowing.3,4 GERD can be effectively managed with medication or lifestyle changes. Surgery is an option in severe cases.

The frequent regurgitation of stomach acids into the mouth results in continuous undesired contact of these acids with the teeth in the oral cavity. This can lead to dental erosion. Dentists need to familiarize themselves with the consequences of GERD and know how to treat it. Erosion is different from abrasion in cause and appearance. As stated previously, erosion is a non-bacterial, chemical dissolution of hard tooth surfaces, whereas abrasion is caused by mechanical wear of tooth structure by external agents. The appearance of these lesions is different; the enamel is not affected by erosion as it is a spoon-shaped appearance, while abrasive lesions appear sharp, flat and angular. Moreover, since erosion does not affect metal or plastic dental restorations as does abrasion, these remain as prominent elevated plateaus.5,6

Dental erosion can be the result of various systemic conditions, which often makes the etiology difficult to identify. These conditions include upper gastrointestinal disorders with an acid diet (43%); eating disorders (6%); and upper gastrointestinal disorders (25%); an erosive esophageal condition. These medications produce a reduction of salivary secretion rates that contributes to dental erosion.7 While other investigators have emphasized the role of the stomach contents into the mouth regurgitation and pH while the patient slept, a final diagnosis of GERD was reached which included the monitoring of acid reflux. Prior to proceeding with treatment, the patient was referred to a gastroenterologist for a full diagnostic exam. Following the diagnostic exam, which included the monitoring of acid reflux, the patient was treated with a gastro enteric suppressor medication (Prolisoc) that inhibits the hydrogen/potassium ATPase enzyme system in the gastric parietal cells of the lining of the stomach. It is considered a gastric acid pump inhibitor since it works by blocking the final step of acid production.

In order to efficiently treat tooth erosion, a comprehensive understanding of the effects of tooth wear must be obtained. Potential results of tooth wear can be related to functional, aesthetic, and sensitivity concerns.8,9 Functional: Patients tend to have difficulty with mastication, broken teeth, and failing restorations.

• Functional: Patients tend to have difficulty with mastication, broken teeth, and failing restorations.
• Aesthetic: As the dentition undergoes wear and fracture, the patient’s general appearance may change as he or she reveals less teeth during speech and their natural smile. In some instances, the smile line may be reversed entirely; and
• Sensitivity: While most patients with excessive tooth wear often experience reduced sensitivity as a result of exposed dentin, some patients have reported preoperative hypersensitivity.

Minimally invasive treatments are procedures that restore form, function and aesthetics with minimal removal of sound tooth structure.10 As a person ages, so do their teeth and previously placed restorations. Eventually, teeth that have been restored will break down and need to have those restorations replaced.10 Fortunately, restorative materials and procedures are constantly evolving. The conservative nature of the initial restoration will allow more tooth structure to work with at the time that a second restoration may be needed.

Case presentation
A 55-year-old patient was referred to the practice with a severe (grade III) generalized loss of enamel and dentin. The patient was aware that his teeth were becoming thinner and was concerned that some of the anterior teeth may fracture (Figure 1). The patient was not aware of any systemic problems or that they had severe symptoms of acid reflux. Prior to proceeding with dental treatment, the patient was referred to a gastroenterologist for a full diagnostic exam. Following the diagnostic exam, which included the monitoring of acid reflux and pH while the patient slept, a final diagnosis of GERD was rendered. The patient was treated with a gastro intestinal suppressor medication.
molar relationship. There was minimal to no overjet and almost 100% overbite. Due to the severe wear of the teeth, it is possible that the vertical dimension of occlusion was lost, but it would only be possible to confirm if the patient had previously taken cephalometric x-rays from years ago that we could compare with today.

**Treatment plan**

This case could have been treated a number of different ways. Orthodontics was an option given to the patient to allow room for restorative material in the anterior region. This would be the most conservative treatment option. It would allow the anterior teeth to be restored and the poste-
rior conservatively restored without changing the vertical dimension. The teeth would be moved anteriorly and intruded to allow us room to restore. However, the patient did not want to proceed with orthodontics. The anterior teeth were very thin with severe notching and not enough overjet to restore functionally. If the teeth were prepared for full coverage crowns, they would be severely compromised and the risk of fracture would be high. The posterior teeth could be treatment planned for partial coverage restorations fabricated from gold, porcelain or composite. Since orthodontics was not an option, the vertical dimension of occlusion needed to be altered to restore the case properly. Considering the findings and the patient’s concern of possible fracturing of the anterior teeth, a minimal invasive treatment plan was presented. This would consist of fabricating lingual veneers made indirectly out of composite resin and composite onlays for the posterior mandibular molars. These restorations would be fabricated indirectly by the dentist from a diagnostic wax up using a silicone die material (Impregum, 3M ESPE) so that the silicone die material would not adhere to it when the models are fabricated. If you use a polyvinyl material, the silicone die material will adhere to the impression and cannot be removed. The models were sent to the laboratory so a Kois Deprogrammer could be fabricated to facilitate mounting the case in centric relation. The patient wore the appliance for 3 weeks and then bite registration impressions were made with the appliance in place to capture the jaw position. Once the casts were mounted on a Panadent articulator, wax was added to the lingual of the anterior teeth (Figure 7) to restore the tooth structure that was missing. By adding the wax to the lingual of the anterior teeth, this will open the articulator so the posteriors can be waxed (Figure 8) to the new vertical dimension. The minimal amount of opening was achieved so the teeth could be restored properly.

Once the wax up was completed, polyvinyl impressions (RSVP, Cosmedent) were made so that we would have a matrix to form the new restorations in the posterior. The polyether impressions were injected with the silicone die material (Figure 9) and allowed to set for 2 minutes. The silicone die material was then removed from the impression and hybrid composite was added to form the lingual veneers (Figure 10). This was done freehand and only enough material to replace what was missing was added. This is what determined the new vertical dimension. A clear polyvinyl matrix could have been used for fabricating these restorations. The composite was light cured and then placed in a Triad unit for final light curing (Figure 11). This should make the restorations stronger, due to the heat and light. The restorations were finished and polished using finishing disks and polishing points (Figure 12). The restorations were first micro-etched with 50 micron aluminum oxide powder and then etched with hydrofluoric acid (Figure 13) for 90 seconds and silanated. The restorations would then be adhesively bonded with resin cement. The restorations were tried in for fit (Figure 14) and cleaned in an ultrasonic bath with acetone. The teeth were isolated with an Expandex retractor (Parkell) and micro-etched using aluminum oxide powder (Figure 15). The teeth were etched for 20 seconds (Figure 16) with ultra-etch (Ultra-dent) and then rinsed and air dried. A fourth generation bonding system (All...
Bond II, Bisco) was utilized for its excellent bond strength. The two-part primer was mixed in a dispensing well and applied in numerous coats to the moist surface (Figure 17). This was followed by an application of the unfilled D/E resin (Bisco). The restoration was treated with D/E resin and Insure resin cement (Cosmedent). The adjacent teeth were protected from the etch and adhesive by using Teflon tape. The restorations were seated one at a time and light cured for 40 seconds on the lingual and facial. Figure 18 shows the first three restorations placed. The same procedure was followed for the remaining anterior restorations.

To fabricate the posterior restorations, a clear silicone impression tray, fabricated from the diagnostic wax up was utilized (Figure 19). This would be filled with composite resin and placed over the silicone die material. In order to make the composite resin more flowable, a Calset composite heater (Addent) was used (Figure 20). The composite was injected into the clear matrix and placed on the silicone die material (Figures 21-22). The clear impression tray was seated over the silicone die material and light cured for 40 seconds. The tray was removed and the restorations are shown on the silicone die (Figure 23). These restorations were then separated, finished and polished and ready to be bonded on the posterior teeth.

Rubber dam isolation was used in the posterior for ideal moisture control. The teeth were etched with a microetcher first (Figure 24) and then etched with phosphoric acid. The same bonding protocol was utilized as the anterior restorations. In order to keep the etch from the adjacent teeth when bonding, a Brasseler serrated saw blade (Figure 25) was inserted interproximally because the contacts were not broken. A clear matrix would not go through the contacts. The restorations were then bonded individually (Figure 26) and the resin cement cleaned up. Figure 27 shows the lower right quadrant bonded to place prior to removing the rubber dam.

Once all of the posterior restorations were bonded to place, final equilibration was necessary. A composite platform was fabricated and placed on the lingual of the upper anterior teeth similar to a Kois deprogrammer (Figure 28). This was retained mechanically due to the diastema without any adhesive. The patient lightly

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occluded on the platform for about 15 minutes to allow the muscles to relax. The platform was then slightly modified (Figure 29) to allow the first tooth to touch. This would represent the initial contact in centric relation. Equilibration was then carried out until even simultaneous contacts were present on all the posterior teeth and cuspsides. The final equilibration to remove any interference on the lingual of the anterior tooth when chewing, was accomplished with the patient chewing gum in the posterior and 200 micron articulating paper placed in the anterior. Only the abrasions and aberrant lines are necessary to remove. These are areas of friction within the envelope of function.

The patient elected to have the diastema closed and all the cervical lesions were restored with direct composite resin (Renamel microfill, Cosmedent). The final results are shown in Figures 30-35.

Conclusion
This case could have been treated planned several ways. The patient in this case underwent a procedure with no tooth removal. The conservative nature of the treatment that was rendered will allow future restorations to be accomplished without worrying about previous destruction due to treatment. The restorations are easily repaired and should provide years of service.

About the author
Dr. Bob Margeas graduated from the University of Iowa College of Dentistry in 1986 and completed his AEGD residency the following year. He is currently an Adjunct Professor in the Department of Operative Dentistry at the University of Iowa. He is Board Certified by the American Board of Operative Dentistry and is a Fellow of the Academy of General Dentistry. He offers hands on courses at the Kios Centre as well as his own centre in Iowa. Dr. Margeas has written numerous articles on aesthetic implant dentistry and he lectures and presents hands-on courses on those subjects. He serves on the Editorial Advisory Board of Inside Dentistry, Functional Aesthetics & Restorative Dentistry, and is a contributing editor to Cosmetic and Oral Health in Dentistry Today and Oral Health in Canada. Dr. Margeas maintains a private practice focusing on comprehensive restorative and implant dentistry in Des Moines, Iowa.

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