Submitted: 13 December, 2025 Accepted: 10 February, 2026 Published: 03 July, 2026 DOI:10.22514/jocpd.2026.096

ORIGINAL RESEARCH

Journal of Clinical Pediatric Dentistry

Comparative erosive resistance of different fissure sealants under simulated gastric acid exposure: an *in vitro* analysis

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Abstract

Background: This *in vitro* study aimed to quantitatively evaluate the erosive effects of simulated gastric acid exposure on the surface microhardness of contemporary fissure sealant materials. **Methods**: A total of 42 cylindrical specimens (4 mm × 2 mm) were fabricated and randomly allocated to six experimental groups (n = 7 per group): Group 1: BeautiSealant (Shofu, Japan), Group 2: Conseal F (SDI, Australia), Group 3: Clinpro (3M ESPE, USA), Group 4: UltraSeal XT Hydro (Ultradent, USA), Group 5: Fissured Nova (Imicryl, Turkey), and Group 6: Riva Protect (SDI, Australia). Specimens were conditioned in distilled water for 24 hours prior to exposure to a standardized 10-day gastric acid cycling regimen, consisting of six daily cycles of 60-second immersion in simulated gastric acid (pH ≈ 1.2) followed by 30-minute remineralization in artificial saliva. Surface microhardness measurements were obtained at baseline and after acid exposure using a Vickers microhardness tester (Shimadzu, Japan). **Results**: Significant intergroup differences were observed in baseline microhardness values ($p < 0.05$). No statistically significant difference was found between the groups in their post-exposure microhardness values ($p > 0.05$). These findings demonstrate a convergence in material behavior following simulated gastric acid exposure. All materials demonstrated a significant decline relative to baseline ($p < 0.05$), indicating susceptibility to acid-induced degradation. Notably, despite significant differences at baseline, post-exposure microhardness values converged across all material groups, indicating a uniform softening effect following repeated acid challenge. **Conclusions**: All tested fissure sealants showed reduced microhardness after repeated gastric acid exposure, indicating limited resistance to highly acidic conditions and potential vulnerability in patients with erosion-related conditions.

Keywords

Fissure sealant; Gastric acid; Microhardness; Pediatric dentistry

1. Introduction

Chronic destructive processes affecting dental hard tissues, including abrasion, mastication, attrition, abfraction, resorption, and erosion, have been widely documented and are characterized by irreversible surface loss that occurs independently of dental caries [1]. Dental erosion is defined as the progressive, chemically driven dissolution of enamel and dentin in the absence of bacterial activity and is increasingly recognized as a major contributor to tooth wear across diverse populations. The etiologic acids are of non-bacterial origin and may derive from dietary, occupational, or intrinsic gastric sources, each capable of directly demineralizing the tooth surface [1–4].

Dental erosion is conventionally classified as extrinsic, intrinsic, or idiopathic [1]. Extrinsic erosion arises from frequent contact with acidic foods and beverages such as carbonated drinks, wine, and citrus products; from the use of acidic medications including acetylsalicylic acid, iron preparations, and vitamin C supplements; and from occupational acid exposure, as observed in wine tasters and related professions [5–10]. Intrinsic erosion results from the regurgitation of gastric acid into the oral cavity, leading to direct chemical dissolution of dental hard tissues. Recurrent vomiting in eating disorders and repeated exposure to gastric contents in reflux conditions are strongly linked with characteristic erosive patterns on affected teeth. In addition, alcohol abuse may potentiate erosion both through emesis and through the frequent intake of acidic alcoholic beverages [5, 11–15].

Dental erosion affects not only adults but also children and adolescents, with both primary and permanent dentitions being susceptible [16]. In pediatric populations, erosion is principally associated with extrinsic and intrinsic acid exposure. The erosive potential of beverages is determined by their pH, titratable acidity, and the presence of minerals such as calcium,

phosphate, and fluoride [17, 18]. Citrus-based drinks, soft drinks, and sports beverages have been shown to produce notable tissue loss; for example, grapefruit juice induces more enamel dissolution than orange juice [19], while sports drinks containing citric acid exhibit prolonged chelating effects even after neutralization [20]. Reduced salivary flow during sleep further increases the risk, when acidic drinks are consumed before bedtime [16]. Intrinsic acid exposure from gastroesophageal reflux (GER) is also significant in children. Aine *et al*. [21] demonstrated that pathological GER is associated with distinct and consistent erosion patterns, suggesting its value as a clinical indicator of silent reflux. Similarly, O'Sullivan *et al*. [22] reported erosion in 17% of children with high reflux index scores, predominantly affecting the palatal surfaces of maxillary primary incisors.

Fissure sealants constitute a minimally invasive preventive strategy in which materials are applied to deep pits and fissures of caries-susceptible teeth. They bond micromechanically to enamel and form a protective barrier against bacterial colonization and nutrient penetration. Fissure sealants are broadly categorized as resin-based, glass ionomer, giomer, or polyacid-modified resin (compomer) materials. Resin-based sealants may be filled or unfilled, opaque or transparent, and often provide supplementary fluoride release. Glass ionomer sealants, including conventional and resin-modified types, offer chemical bonding and fluoride release but exhibit lower wear resistance, while compomers combine features of both material classes and allow improved handling and esthetics [23].

Although fissure sealants are highly effective in preventing occlusal caries, their longevity is challenged by mechanical stresses and chemical degradation within the oral environment. Notably, previous literature indicates that acidic conditions can compromise their surface integrity and accelerate material breakdown [24]. However, the specific response of fissure sealants to simulated gastric acid, particularly in terms of surface microhardness degradation, remains insufficiently characterized compared with bulk restorative materials.

Therefore, this study aimed to evaluate the resistance of different fissure sealant materials to simulated gastric acid exposure by quantitatively assessing changes in surface microhardness. The null hypothesis (H_0) was that no significant differences would be observed in erosion resistance among the tested materials following a gastric acid challenge.

2. Materials and methods

2.1 Study design and ethical statement

This *in vitro* experimental study was designed to evaluate the surface microhardness of selected fissure sealant materials before and after controlled exposure to simulated gastric acid. As the investigation did not involve human participants, identifiable biological samples, or animal testing, formal ethical approval was not required. The overall workflow and experimental sequence are illustrated in Fig. 1.

2.2 Sample size calculation

An a priori power analysis was performed using G*Power software (Version 3.1.9.6, Heinrich Heine University of Düsseldorf, Düsseldorf, NRW, Germany) to determine the minimum sample size necessary for adequate statistical power. Based on previously published *in vitro* studies evaluating material degradation under acidic conditions [25, 26], an effect size of 0.4, an alpha level of 0.05, and a desired power ($1 - \beta$) of 0.95, the analysis indicated that a total of 42 specimens, allocated as seven specimens per group, would be sufficient to detect statistically significant differences among the tested materials.

2.3 Specimen preparation and grouping

A total of 42 cylindrical specimens (4 mm diameter, 2 mm height) were prepared from six commercially available fissure sealants using polytetrafluoroethylene (PTFE) molds, constituting six experimental groups (n = 7 each):

Group 1: BeautiSealant (Shofu, Japan);
Group 2: Conseal F (SDI, Australia);
Group 3: Clinpro (3M ESPE, USA);
Group 4: UltraSeal XT Hydro (Ultradent, USA);
Group 5: Fissured Nova (Imicryl, Turkey);
Group 6: Riva Protect (SDI, Australia).

The materials were selected to represent a broad spectrum of commercially available and clinically relevant fissure sealant formulations, including conventional resin-based, giomer, compomer (polyacid-modified resin), and glass ionomer cement formulations. Detailed compositions and manufacturers of all materials are presented in Table 1.

Specimens in Groups 1–5 were fabricated using a standardized monolayer placement technique. Following surface leveling, each specimen was light-polymerized for 20 seconds with a light-emitting diode (LED) curing unit (T-LED, MyRay, Imola, Italy) operating at a verified irradiance of 1250 mW/cm^2. After curing, samples were polished using aluminum oxide abrasive discs (Sof-Lex, 3M ESPE) to obtain a uniform surface finish, and were then stored in distilled water at room temperature for 24 hours prior to testing.

The use of precision PTFE molds ensured consistent initial specimen dimensions. The subsequent polishing was a standardized surface-finishing step and was not intended to significantly alter specimen thickness.

This procedure was performed to simulate routine intraoral clinical finishing procedures and to standardize surface characteristics prior to testing. Surface polishing is acknowledged as a factor that may influence surface characteristics, such as microhardness. Standardized polishing protocols are therefore commonly used in *in vitro* studies to enhance clinical relevance while minimizing surface-related variability between specimens [27, 28].

For the glass ionomer-based material in Group 6, specimen preparation followed the manufacturer's instructions, allowing complete chemical setting without light activation. All specimens were inspected for voids, defects, or surface irregularities under a stereomicroscope (Leica MZ16; Leica Microsystems, Wetzlar, HE, Germany) at 20× magnification prior to inclusion in the study.

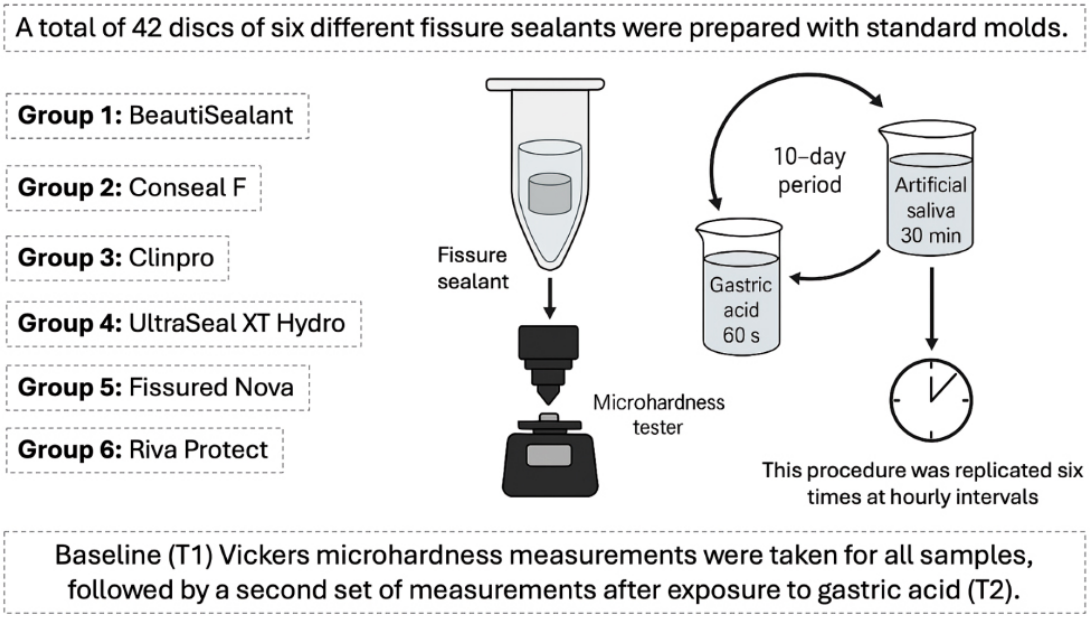

FIGURE 1. Flow diagram of the experimental design and microhardness assessment protocol.

TABLE 1. Composition and manufacturers of the fissure sealant materials used in this study.

Fissure Sealants	Manufacturer	Composition	Lot No
BeautiSealant	Shofu, Kyoto, Japan	Fluoroboroaluminosilicate glass, UDMA, TEGDMA, Microfumed silica, and other components; S-PRG filler (30% by weight).	042401
Conseal F	SDI, Bayswater, Victoria, Australia	Ester methacrylate, inorganic fillers, sodium fluoride, photoinitiator.	1237745
Clinpro	3M ESPE, St. Paul, MN, USA	Triethylene glycol dimethacrylate, bis-GMA, tetrabutylammonium tetrafluoroborate, dichloride methylsilane, silica (6% wt), dye.	121447
UltraSeal XT Hydro	Ultradent Products, South Jordan, Utah, USA	Triethylene glycol dimethacrylate, DUDMA, aluminium oxide, methacrylic acid, titanium dioxide, sodium monofluorophosphate.	C2NRB
Fissured Nova	Imicryl, Konya, Turkey	Hydrophilic Dimethacrylates, hydrophobic dimethacrylates, highly dispersed silica, sodium fluoride, fluorosilicate glass, stabilizers, and catalysts. Filler ratio: 55%.	NFP04
Riva Protect	SDI, Bayswater, Victoria, Australia	Liquid: acrylic acid homopolymer; tartaric acid. Powder: fluoroaluminosilicate glass; acrylic acid homopolymer, calcium amorphous phosphate ($Ca_3(PO_4)_2$).	1206902

UDMA: Urethane dimethacrylate; TEGDMA: Triethylene glycol dimethacrylate; bis-GMA: Bisphenol A-glycidyl methacrylate; DUDMA: Diurethane dimethacrylate; S-PRG: Surface pre-reacted glass-ionomer.

2.4 Gastric acid challenge protocol

A standardized gastric acid cycling model was applied over a 10-day period [29–31]. Each daily session comprised six uniform erosion–remineralization cycles conducted at one-hour intervals. Each cycle consisted of the following sequential steps:

1. Acid Immersion: Specimens were immersed in 5 mL of freshly prepared artificial gastric acid (pH 1.2; Testonic Laboratory, Colin® Specific Solutions, Istanbul, Turkey) for 60 seconds to reproduce short-term intrinsic acid exposure.

2. Rinsing: Specimens were gently rinsed in distilled water for 5 seconds to eliminate residual acid without inducing mechanical surface alteration.

3. Saliva Immersion: Specimens were subsequently immersed in 5 mL of artificial saliva for 30 minutes, simulating oral neutralization and remineralization phases.

This cycling regimen was designed to simulate repeated short-duration intrinsic acid exposure, as observed in pediatric patients with gastroesophageal reflux or recurrent vomiting.

The artificial saliva was prepared with the following composition per liter of distilled water: 2.560 g sodium chloride (NaCl), 0.333 g calcium chloride ($CaCl_2$), 0.250 g magnesium chloride hexahydrate ($MgCl_2{\cdot}6H_2O$), 0.189 g potassium chloride (KCl), 3.015 mg potassium acetate (CH_3COOK), 0.772 g tripotassium phosphate trihydrate ($K_3PO_4{\cdot}3H_2O$), and 0.1 mL phosphoric acid (H_3PO_4) (85%), providing a physiochemically relevant ionic environment.

2.5 Microhardness testing

Vickers microhardness (VHN) values were recorded at two time points: baseline (T1), following 24-hour water storage, and post-challenge (T2), after completion of the 10-day acid cycling protocol. Measurements were obtained using a Shimadzu Type M microhardness tester (Shimadzu, Kyoto, Japan) with a 300 g load and a 15-second dwell time. Three indentations were placed in the central region of each specimen, ensuring a minimum spacing of 1 mm between indentations and from specimen margins to prevent interaction between stress fields. The mean of the three indentations was recorded as the representative microhardness value for each specimen. Fig. 2 illustrates representative surface images of fissure sealant specimens from each experimental group before gastric acid exposure (T1) and after completion of the gastric acid cycling protocol (T2). Paired images are presented side-by-side to facilitate visual comparison of surface changes induced by acidic challenge.

2.6 Statistical analysis

In the present study, descriptive statistics (mean, standard deviation, minimum, maximum) were calculated for all variables. The Shapiro-Wilk test was used to assess the normality of distributions, and Levene's test was used to verify homogeneity of variances. For comparisons between two dependent measurements satisfying normality, the paired-samples *t*-test was applied. For comparisons involving three or more independent groups with normally distributed data, one-way analysis of variance (ANOVA) was performed. When significant differences were detected, Bonferroni or Tamhane's T2 *post-hoc* tests were used to determine pairwise group differences according to variance equality. All statistical analyses were performed using IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA). The significance level was set at $\alpha = 0.05$.

3. Results

The distribution of surface microhardness (Vickers hardness number, VHN) measurements according to the study groups and time points is provided in Table 2. One-way ANOVA was used for comparisons between groups, and paired sample *t*-tests were used to examine differences between time points. Statistical analysis revealed a statistically significant difference between the baseline measurements of the groups ($p < 0.05$). According to Tamhane's tests, statistically significant differences were observed between the Riva Protect group and the BeautiSealant, Conseal F, Clinpro, and Fissured Nova groups ($p = 0.018$, $p = 0.044$, $p = 0.037$, and $p = 0.011$, respectively). The mean change in microhardness for the Riva Protect group was higher than that of the BeautiSealant, Conseal F, Clinpro, and Fissured Nova groups.

No statistically significant differences were observed between groups in post-gastric acid exposure microhardness values ($p > 0.05$). Notably, although significant intergroup differences were present at baseline, the absence of statistically significant differences after acid exposure indicates a convergence in microhardness behavior among all tested fissure sealant materials under severe acidic conditions. Statistically significant differences were found between the measurements over time in all study groups ($p < 0.05$). The baseline measurements were higher than the "after gastric acid attack" measurements (Fig. 3).

The distributions of the T1–T2 change amounts according to the study groups are shown in Table 3, and one-way ANOVA was used for comparisons. As a result of the analyses performed for the study groups, a statistically significant difference was found in the amount of change between the groups ($p < 0.05$). According to Bonferroni tests, statistically significant differences were identified between the Riva Protect group and the BeautiSealant, Conseal F, Clinpro, UltraSeal XT Hydro, and Fissured Nova groups ($p < 0.001$, $p = 0.001$, $p = 0.001$, $p = 0.002$, and $p < 0.001$, respectively). The mean change measurement of the Riva Protect group was higher than that of the BeautiSealant, Conseal F, Clinpro, UltraSeal XT Hydro, and Fissured Nova groups.

4. Discussion

Intrinsic exposure of the oral cavity to gastric contents during episodes of reflux or vomiting is a well-established etiological factor in dental erosion [22]. Although numerous studies have examined the effects of acidic challenges on restorative materials [25, 32, 33], the specific behavior of pit-and-fissure sealants, particularly with respect to microhardness degradation, has received limited attention. Given their widespread preventive use in pediatric and high-risk populations, and their distinct formulations optimized for flow, penetration, and adhesion, sealants may not mirror the degradation patterns of bulk restorative materials. The present study addressed this gap by comparatively evaluating six commercially available sealants under a standardized gastric acid challenge. All materials demonstrated a significant reduction in microhardness following exposure. Furthermore, a statistically significant difference was found in the magnitude of microhardness reduction (T1–T2 change) among the groups ($p < 0.001$, Table 3), leading to the rejection of the null hypothesis (H_0). This post-exposure convergence suggests that repeated intrinsic acid challenges may override initial compositional differences among fissure sealant materials, resulting in comparable surface softening behavior.

Although compositional categories differed, resin-based, compomer (polyacid-modified resin), and the glass ionomer cement (Riva Protect) exhibited the greatest absolute loss. Notably, microhardness values converged across all groups after exposure, indicating that differential degradation kinetics ultimately resulted in comparable softening.

The susceptibility of dental materials to highly acidic conditions is well documented. Gastric acid induces hydrolytic resin matrix degradation, filler leaching, and disruption of the filler-matrix interface [25, 26]. Our results parallel findings from computer-aided manufacturing (CAD/CAM) ceramics and composites, which consistently show measurable hardness reductions following simulated intrinsic acid exposure [32, 34–37]. A systematic review by Radwan *et al.* [25] emphasized that no restorative material is fully resistant to acid-induced softening, and that severity of degradation depends strongly on material type and exposure duration.

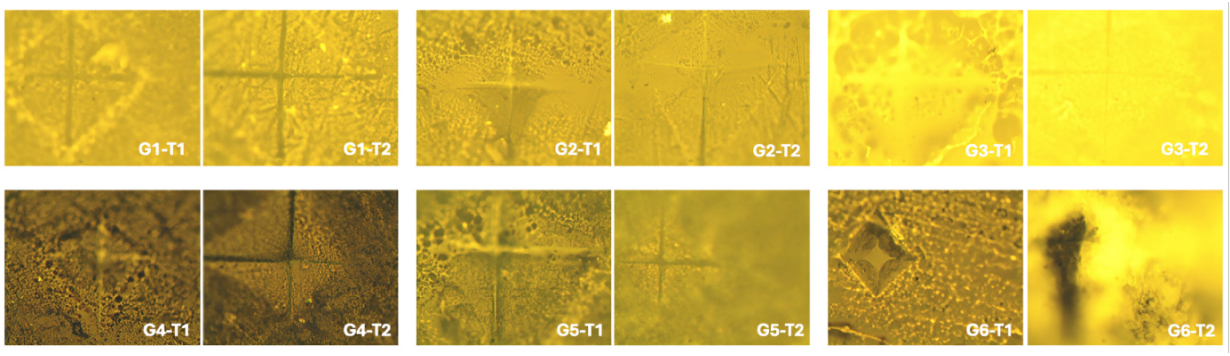

FIGURE 2. Representative surface images of fissure sealant specimens before (T1) and after (T2) gastric acid exposure.

TABLE 2. Distribution of Vickers microhardness values by material groups and time points.

	Baseline		After gastric acid attack		Between Time Intervals		
Between Groups	Min.–Max.	Mean ± S.D.	Min.–Max.	Mean ± S.D.	Test Statistics	*p*	Effect Size
Group 1: BeautiSealant	54.88–96.87	69.94 ± 14.16	24.68–59.71	39.34 ± 11.51	3.988	0.007*	1.507
Group 2: Conseal F	49.23–94.84	77.40 ± 15.55	26.73–69.23	46.10 ± 17.04	4.037	0.007*	1.526
Group 3: Clinpro	54.49–90.93	76.12 ± 12.88	33.15–65.51	45.22 ± 12.75	5.053	0.002*	1.910
Group 4: UltraSeal XT Hydro	50.40–110.45	88.19 ± 23.93	41.03–89.42	55.86 ± 16.29	3.699	0.010*	1.398
Group 5: Fissured Nova	48.44–85.68	66.02 ± 14.88	29.07–64.17	42.22 ± 14.17	4.063	0.007*	1.536
Group 6: Riva Protect	93.37–167.38	125.30 ± 27.88	39.92–52.34	45.52 ± 4.93	8.518	<0.001*	3.219
Test Statistics/*p*	9.059	<0.001*	1.220	0.320			
Effect Size	0.557		-				

Values are presented as minimum–maximum and mean ± standard deviation. Within-group comparisons (baseline vs. post-exposure) were analyzed using paired-samples t-tests, with effect size expressed as Cohen's d. Between-group comparisons at each time point were performed using one-way ANOVA, with effect size expressed as η^2 (eta squared). $p < 0.05$ (*) indicates statistical significance.
Min.: Minimum; Max.: Maximum; S.D.: Standard Deviation.

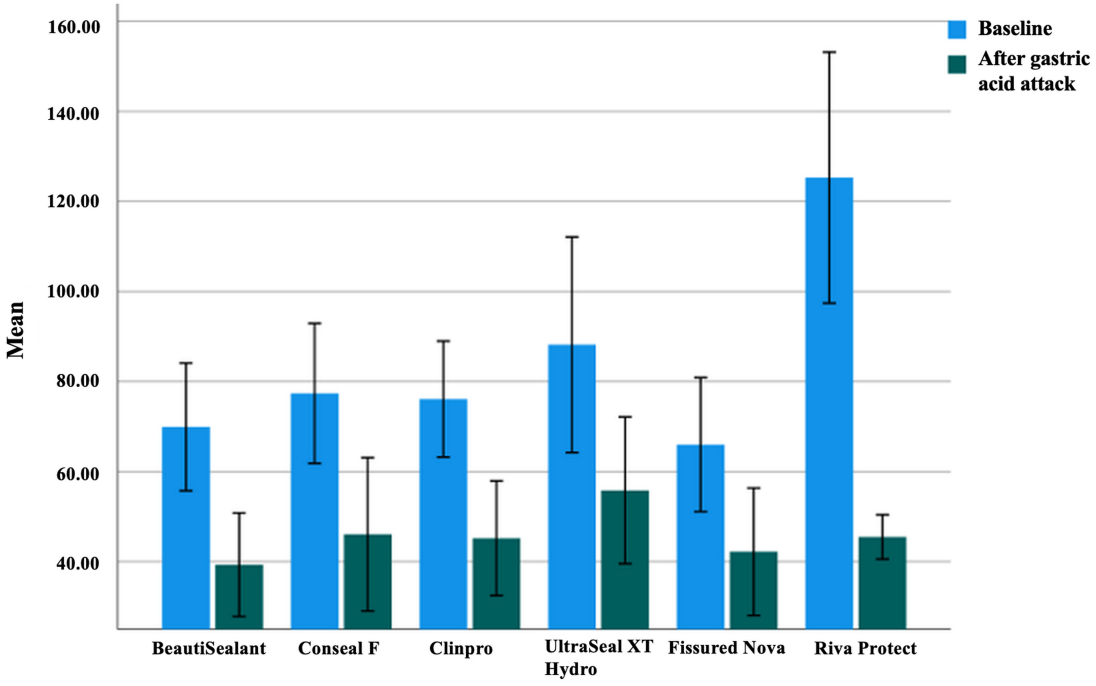

FIGURE 3. Mean ± SD Vickers Microhardness Values of the fissure sealant materials at baseline and after simulated gastric acid exposure. Connecting lines represent the paired, within-material change for each group.

TABLE 3. Comparison of the changes in Vickers microhardness (T1–T2) among the fissure sealant materials.

	T1–T2	
Between Groups	Min.–Max.	Mean ± S.D.
Group 1: BeautiSealant	10.06–72.19	30.60 ± 20.30
Group 2: Conseal F	4.25–54.19	31.30 ± 20.51
Group 3: Clinpro	11.77–57.78	30.90 ± 16.18
Group 4: UltraSeal XT Hydro	1.12–64.36	32.33 ± 23.12
Group 5: Fissured Nova	9.81–52.77	23.80 ± 15.50
Group 6: Riva Protect	53.45–115.22	79.78 ± 24.78
Test Statistics/*p* (One-way ANOVA)	7.202	<0.001*
Effect Size (η^2)	0.500	

Values are expressed as minimum–maximum and mean ± standard deviation (SD). T1–T2 represents the reduction in microhardness (VHN) following gastric acid exposure. Group differences were evaluated using one-way ANOVA, with effect size expressed as η^2 (eta squared). $p < 0.05$ (*) indicates statistical significance.
Min.: Minimum; Max.: Maximum; ANOVA: Analysis of Variance.

Gulakar *et al*. [32] demonstrated that CAD/CAM resin, hybrid, and ceramic materials all show reduced microhardness after gastric acid exposure, irrespective of composition. Similarly, the present findings confirm that fissure sealants, despite being chemically distinct from bulk restorative materials, undergo comparable acid-induced softening. Other investigations further indicate that ceramics, composites, and universal-shade restorative materials exhibit variable but significant declines in hardness when challenged with low-pH environments [33, 37]. These collective observations underscore the vulnerability of resin-based systems, irrespective of matrix chemistry or filler technology.

Studies evaluating giomers, ormocers, indirect composites, and alkasites reported significant microhardness reductions following simulated gastric acid immersion, with giomers often demonstrating the greatest susceptibility [26, 38]. Although the giomer-based sealant in the present study (BeautiSealant) did not show disproportionately higher degradation than other resin-type sealants, this discrepancy may reflect differences in filler loading, degree of conversion, or the relatively shorter exposure duration used here. Importantly, these investigations collectively confirm that acidic challenges compromise the mechanical integrity of diverse restorative categories, reinforcing the present study's findings.

Extended immersion protocols ranging from days to months have been used to simulate long-term intraoral exposure [39–41]. Von Fraunhofer and Rogers noted that 14 days of continuous erosion may approximate more than a decade of clinical acidic challenge [42], highlighting the validity of prolonged *in vitro* aging models. Although the present 10-day cycling protocol represents a moderate exposure duration, the consistent decreases across all groups indicate substantial susceptibility even under relatively conservative conditions.

The performance of Riva Protect warrants particular consideration. Its higher baseline microhardness reflects the inherently brittle yet high-initial-strength nature of glass ionomer matrices. Its pronounced softening under acidic challenge is consistent with the known sensitivity of glass ionomer cements (GICs) to low pH, extensive ion exchange, and matrix dissolution [37, 41]. Conversely, resin-based and compomer sealants exhibited more moderate reductions; however, the eventual convergence of microhardness values suggests that prolonged or recurrent acid exposure may diminish compositional advantages, resulting in similar long-term outcomes. Clinically, this implies that material selection alone may not fully mitigate the erosive impact of intrinsic acid exposure, though factors such as fluoride release, adhesion durability, and wear resistance remain relevant.

Microhardness is a key indicator of mechanical performance, correlating with wear resistance and material stability [40]. The significant reductions observed here suggest that gastric acid exposure could predispose sealants to increased wear, surface roughness, and potential loss of protective efficacy. Clinically, this underscores the need for more frequent monitoring of sealant integrity and reinforced preventive strategies (*e.g.*, fluoride therapy, dietary counseling) in patients at risk for intrinsic erosion, such as those with gastroesophageal reflux disease (GERD) or eating disorders.

Taken all together, the available evidence demonstrates that acidic challenges can compromise the mechanical integrity of a wide range of restorative materials, and the present study confirms that pit-and-fissure sealants are not exempt from this vulnerability. All six sealants exhibited reduced microhardness following simulated gastric acid exposure, despite their compositional differences, indicating that none of these materials is fully resistant to acid-induced softening. Clinically, this may translate into increased susceptibility to wear, surface degradation, and potential loss of sealant efficacy in patients experiencing recurrent episodes of gastric reflux or vomiting.

A key strength of this study is its novel focus on fissure sealants, providing the first comparative data on their microhardness response to simulated gastric acid. However, certain limitations must be acknowledged. This investigation was a static *in vitro* study conducted under controlled laboratory conditions that did not incorporate dynamic oral factors such as salivary buffering, thermal cycling, or mechanical loading

(*e.g.*, brushing, mastication). Therefore, it is important to note that the experimental setup represents a controlled laboratory model rather than a direct simulation of the dynamic oral environment. Saliva, in particular, plays a crucial role in remineralization and neutralization, and its absence may amplify the measured erosive effect. Moreover, variations in salivary flow rate, composition, and buffering capacity among pediatric patients may further affect the clinical performance of fissure sealants. These variations cannot be fully replicated under standardized laboratory conditions. Furthermore, the assessment was limited to surface microhardness; future investigations should incorporate complementary analyses of surface roughness, morphological changes via scanning electron microscopy (SEM), and fluoride release kinetics to provide a more comprehensive understanding of sealant degradation. Additionally, the incorporation of dynamic pH cycling models, thermal aging protocols, and mechanical fatigue simulations that more closely reflect intraoral functional conditions may enhance the translational relevance of future experimental designs. Long-term *in situ* and clinical studies are also warranted to validate whether the observed *in vitro* material behavior translates into clinically meaningful performance differences.

5. Conclusions

This *in vitro* study demonstrated that simulated gastric acid exposure significantly reduces the surface microhardness of all tested fissure sealant materials. The glass ionomer-based sealant (Riva Protect) exhibited the greatest absolute decrease in microhardness. Notably, post-exposure microhardness values converged across the material types, suggesting that repeated acidic challenges may diminish initial compositional advantages.

The findings of this study may help inform material selection and preventive planning for pediatric patients exposed to intrinsic acid challenges, such as those with gastroesophageal reflux or recurrent vomiting. Further clinical studies are warranted to confirm the translational relevance of these *in vitro* findings.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author, Dr. Ceren Sağlam, PhD, DDS, upon reasonable request.

AUTHOR CONTRIBUTIONS

CS, AA and DÇ—conceived the idea; collected and analyzed the data. CS and AA—performed the research. All authors contributed to writing and critically revised the manuscript and gave final approval of the version to be published and agreed to be accountable for all aspects of the study.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This *in vitro* experimental study did not involve human participants, identifiable biological samples, or animal testing; therefore, formal ethical approval was not required.

ACKNOWLEDGMENT

Not applicable.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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How to cite this article: Ceren Sağlam, Aslı Aşık, Dilşah Çoğulu. Comparative erosive resistance of different fissure sealants under simulated gastric acid exposure: an *in vitro* analysis. Journal of Clinical Pediatric Dentistry. 2026; 50(4): 122-129. doi: 10.22514/jocpd.2026.096.