# Surface Altering of Band-and-Loop Space Maintainers for Retention to Stainless Steel Crowns

**Blake Gerard, Antheunis Versluis, Daranee Tantbirojn, Martha Wells, Ji Min Yochim**

**UTHSC, College of Dentistry, Memphis, TN**

## ABSTRACT

**Purpose:** To determine if retention of a unilateral band-and-loop space maintainer on a stainless steel crown (SSC) can be improved by modification of the intaglio surface of the band.

**Methods**: Size 37½ Denovo and NuSmile band-and-loop space maintainers were cemented with Ketac Cem Glass Ionomer Luting Cement on size 5 stainless steel crowns for lower right second primary molars. Band intaglio surfaces were modified by chemical roughening, sandblasting, or perforation with a 330 bur (six holes on the buccal and lingual surfaces). Unmodified bands served as controls. Sample size was 10 per group. Specimens underwent artificial aging (5,000 thermal cycling between 5 and 55°C) to simulate 6 months of oral conditions. Retention was tested using a universal testing machine applying a simulated occlusal load on the joint at 1.0 mm/min. Failure loads when bands dislodged were recorded and statistically analyzed using two-way ANOVA followed by pairwise comparisons (α=0.05).

**Results:** The effect of surface treatment was significant (P<.001), but no significant effect of band type was found (P=.392). Mean dislodgement forces did not differ significantly between unaltered NuSmile and Denovo bands (138±24N and 159±27N, respectively). Sandblasting increased retention (167 ± 58N and 177±15N, respectively), although not statistically significantly. Bur alteration and chemical roughening tended to reduce retention; in case of the Denovo band, significantly (103±43N after bur alteration, and 62±28N after chemical roughening).

**Conclusion:** Sandblasting tended to improve stainless steel band retention for both brands tested, whereas bur alteration and chemical roughening tended to lower dislodgement forces.

## INTRODUCTION

Premature loss of primary teeth can lead to space loss, making space maintainers essential in pediatric dentistry. However, band-and-loop appliances cemented to stainless steel crowns may fail due to inadequate retention. Surface modification of the band's intaglio surface has been proposed to improve retention, but evidence comparing techniques is limited. This study evaluates the effects of chemical roughening, sandblasting, and bur perforation on retention.

## PURPOSE

Band-and-loop space maintainers are susceptible to dislodgement under high occlusal forces, which can lead to patient discomfort, additional clinical visits, and increased treatment burden—particularly in pediatric patients who may require advanced behavior guidance techniques such as sedation for recementation. These complications also contribute to increased chair time and cost for providers. The purpose of this study was to evaluate surface modification techniques aimed at improving the retention of space maintainers, with the goal of reducing displacement and enhancing the longevity of these appliances.

## MATERIALS AND METHODS

Band-and-loop space maintainers from two manufacturers (NuSmile and Denovo Dental) were evaluated after three intaglio surface modifications: chemical roughening, sandblasting, and bur perforation, with unmodified bands as controls. Chemical roughening included pumice cleaning, 35% phosphoric acid etching, and application of a metal conditioner. Sandblasting was performed with 110 µm abrasive particles, and bur modification involved six perforations using a 330 carbide bur. Bands (size 37½) were cemented to mandibular primary second molar stainless steel crowns (size 5) with Ketac Cem Glass Ionomer Luting Cement and standardized using a silicone stent. Samples were stored in water at 37°C for 24 hours, then thermocycled 5,000 times (5–55°C) to simulate aging. Specimens were glued to acrylic abutments and subjected to tensile testing at 1 mm/min until dislodgement, with maximum force recorded (N). A sample size of 10 per group was used, and data were analyzed using two-way ANOVA (α = 0.05) to assess the effects of maintainer type and surface modification.

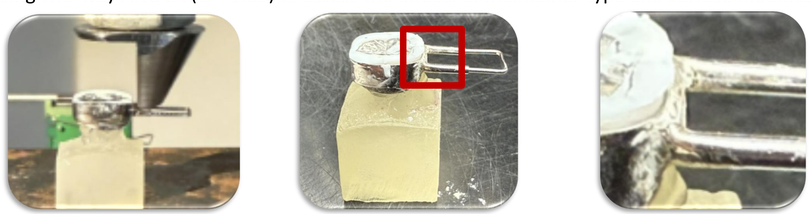

**Figure 1.**
(A) Occlusal load applied to the band-and-loop space maintainer. (B) Region of interest, with the red box highlighting the site of dislodgment. (C) Magnified view of the dislodgment area where measurements were obtained.

## RESULTS

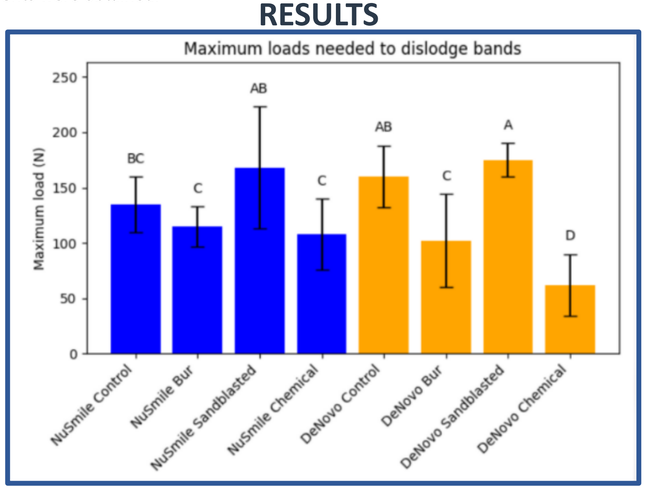


**Figure 2**: Maximum load before dislodgement.

**Table 1:** Maximum loads needed to dislodge the bands (mean ± standard deviation).

| Band | Band surface treatment | Maximum load (N) |
|---|---|---|
| NuSmile | Unaltered (Control) | 138 ± 24 BC |
| | Altered with bur | 116 ± 18 C |
| | Sand Blasted | 167 ± 58 AB |
| | Chemical Roughening | 108 ± 33 C |
| Denovo | Unaltered (Control) | 159 ± 27 AB |
| | Altered with bur | 103 ± 43 C |
| | Sand Blasted | 177 ± 15 A |
| | Chemical Roughening | 62 ± 28 D |

Groups that are not significantly different share the same letter (2-wat ANOVA followed by pairwise comparison; adjusted significance level 0.05/2).

- The dislodgement forces are shown in Table 1 and Figure 2. Two outliers were excluded from the bur altered NuSmile group (183 N) and the sandblasted Denovo group (66 N). Two-way ANOVA demonstrated a significant effect of surface treatment on dislodgment forces ($P < 0.001$), whereas band type had no significant effect ($P = 0.392$).
- In both the NuSmile and Denovo groups, surface treatment by sandblasting demonstrated higher dislodgement loads compared to the unaltered control groups, but the difference was not statistically significant. Perforating the bands with a carbide bur resulted in significantly lower dislodgement loads compared to the corresponding control groups for both band types, but these were only significantly different in the Denovo group. Similarly, chemical roughening the surface lowered dislodgement loads for both types of band-and-loop space maintainers compared to the unaltered control groups, but was significantly different only in the Denovo group.

## CONCLUSION

- Sand blasting increased the dislodgement forces of band-and-loop space maintainers to stainless steel crown, although not statistically significant from the unaltered bands.
- Altering the band intaglio surface with a chemical roughening agent decreased the dislodgement forces of band-and-loop space maintainers to stainless steel crown.
- Perforating the band with a carbide bur decreased the dislodgement forces of band-and-loop space maintainers to stainless steel crown.
- Dislodgement forces were not affected by the type of band-and-loop space maintainers tested.

**ACKNOWLEDGEMENTS:** We gratefully acknowledge the support and funding provided by the University of Tennessee College of Dentistry Alumni Endowment Grant for this research.