Retention of Dental Cements to Band-and-Loop Space Maintainers

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ABSTRACT

Purpose: To compare retention strength between chairside orthodontic band-and-loop space maintainers and stainless-steel crowns using 4 luting cements.

Methods: Two brands band-and-loop space maintainers (NuSmile and Denovo) were cemented to stainless-steel crowns using four luting cements: GC FujiCEM® 2 (FujiCEM), 3M™ Ketac™ Cem Radiopaque Glass Ionomer Luting Cement (Ketac CEM), G-CEM® Self-Adhesive Resin Luting Cement (G-CEM), and 3M™ RelyX™ Luting Plus Cement (RelyX) (n=10/group). Specimens underwent 5,000 thermocycles between 5°C and 55°C to simulate six months of clinical service. Retention strength was measured using a universal testing machine applying force at 1.0 mm/min until band dislodgement. Maximum dislodging force was recorded and analyzed using two-way ANOVA with pairwise comparisons (α=0.05).

Results: Mean dislodgement forces ranged from 101–178 N. Cement type significantly affected retention (P<.001), while band type did not (P=.052). FujiCEM showed the highest dislodgement loads. For NuSmile bands, Ketac CEM, G-CEM, and RelyX showed no significant differences. For Denovo bands, FujiCEM and RelyX demonstrated significantly higher retention than Ketac CEM and G-CEM.

Conclusion: Luting cement significantly influenced orthodontic band retention to stainless-steel crowns. FujiCEM showed the highest dislodgement resistance, while RelyX performed well with Denovo bands, suggesting cement selection may impact the longevity of band-and-loop space maintainers.

INTRODUCTION

Premature loss of primary molars may lead to space loss and malocclusion. Band-and-loop space maintainers, often cemented onto stainless-steel crowns, help preserve arch integrity. Their success depends on band retention, with failures frequently due to cement loss. Luting cements vary in properties, yet limited data exist for stainless-steel crowns. This study compared retention strength of two systems using four cements, hypothesizing no significant differences.

PURPOSE

The purpose of this in vitro study was to compare the retention strength of two commercially available band-and-loop space maintainers cemented onto stainless-steel crowns using four commonly used luting cements, and to evaluate whether cement type and band design significantly influence retention.

MATERIALS AND METHODS

Standardized acrylic dies were fabricated using a crown form to ensure consistent preparation for stainless-steel crowns. Eighty crowns were allocated into two band-and-loop groups (Denovo and NuSmile; n=40 each) and further subdivided into four cement groups (n=10): FujiCEM, Ketac Cem, G-CEM, and RelyX. Oversized bands were selected to ensure passive fit and consistent cement thickness. A custom mold was used to standardize positioning during cementation. All specimens were stored at 37°C for 24 hours and thermocycled between 5°C and 55°C for 5,000 cycles to simulate oral conditions. Retention strength was measured using a universal testing machine at 1.0 mm/min until dislodgement, and failure modes were recorded. Data were analyzed using two-way ANOVA with significance set at $p < 0.05$.

RESULTS

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

Cement	Maximum load (N) NuSmile	Maximum load (N) Denovo
GC FujiCEM® 2 (FujiCEM)	173 ± 24 A	178 ± 26 A
3M™ Ketac™ Cem Radiopaque Glass Ionomer Luting Cement (Ketac CEM)	128 ± 21 B	120 ± 39 B
G-CEM® Self-Adhesive Resin Luting Cement (G-CEM)	101 ± 31 B	114 ± 34 B
3M™ RelyX™ Luting Plus Cement (RelyX)	119 ± 31 B	165 ± 38 A

- Maximum dislodgement loads ranged from 101 ± 31 N to 178 ± 26 N. One Denovo specimen in the FujiCEM group was excluded due to acrylic die fractured prior to band dislodgement. Two-way ANOVA showed no significant effect of band type on retention strength (P = .052), while cement type significantly affected dislodgement load (P < .001).
- In the NuSmile group, FujiCEM showed significantly higher retention than Ketac CEM, G-CEM, and RelyX (P < .05), with no differences among the latter three. In the Denovo group, FujiCEM and RelyX had significantly higher retention than Ketac CEM and G-CEM (P < .05), with no difference between FujiCEM and RelyX.

Table 2. Failure mode evaluations.

Cement	NuSmile	Denovo
FujiCEM	100% Adhesive failure at the band-cement interface (mesial of band bent)	90% Adhesive failure at the band-cement interface (band slid down)
Ketac CEM	100% Cohesive failure in the cement layer (cement degraded and crumbled)	100% Cohesive failure in the cement layer (cement degraded and crumbled)
G-CEM	100% Cohesive failure in the cement layer (cement cracked)	100% Adhesive failure at the band-cement interface (cement remained on crown)
RelyX	100% Adhesive failure at the band-cement interface (cement appeared to be flexible)	100% Adhesive failure at the crown-cement interface (cement remained on band)

- Failure characteristics are reported in Table 2. Specimens within each band/cement combination failed similarly, showing predominantly adhesive failure at band-cement interface (NuSmile/FujiCEM, NuSmile/RelyX, Denova/FujiCEM, Denovo/G-CEM), adhesive failure at cement-crown interface (Denovo/RelyX), or cohesive failure in the cement (NuSmile/Ketac CEM, NuSmile/G-CEM, Denovo/Ketac CEM).

CONCLUSION

Within the limitations of this in vitro study, luting cement type significantly affected retention of band-and-loop space maintainers on stainless-steel crowns. FujiCEM showed the highest resistance to dislodgement, while RelyX Luting Plus performed well with Denovo but not NuSmile systems.

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