

Fracture Resistance of Zirconia Overlays with Different Preparation Designs with and without Endodontic Access

Objectives: To evaluate the fracture resistance of zirconia overlays or occlusal veneers with various preparation designs, considering the presence or absence of endodontic access.

Materials and Methods: Ninety translucent zirconia (5Y-PSZ) overlay restorations (n=15/group) were fabricated in different preparation designs with and without endodontic access and were categorized into six groups: group 1 (M4), with chamfer margin 4 mm above the gingival level; group 2 (M4End), with chamfer margin 4 mm above the gingival level and endodontic access, group 3 (M2), with chamfer margin 2 mm above the gingival level; group 4 (M2End), with chamfer margin 2 mm above the gingival level and endodontic access; group 5 (nM), overlay with no chamfer margin; and group 6 (nMEnd), overlay with no margin and endodontic access. Restorations were bonded to mandibular first molar resin dies, and the groups with endodontic access were sealed with flowable resin composite. All restorations underwent 100,000 cycles of thermal cycling between 5°C and 55°C, followed by loading until fracture. Maximum load and fracture resistance were recorded. ANOVA with Tukey post-hoc tests were used for statistical comparison ($\alpha < 0.05$).

Results: The fracture resistance among the overlays of different designs with and without endodontic access varied ($p < 0.001$). Overlays with margin located 2 mm above the gingival margin exhibited the highest fracture resistance, both without group 3 (M2) and with group 4 (M2End) endodontic access. This was followed by overlays with margin 4 mm above the gingiva without group 1 (M4), group 5 (nM), and group 6 (nMEnd). Group 2 (M4End) the overlays with finish line at 4 mm and endodontic access displayed the lowest fracture resistance values.

Conclusions: Zirconia overlay restorations with endodontic access have lower fracture resistance than those without endodontic access. Overlay with margins closer to the gingival level display higher fracture resistance compared to those with high chamfer and no chamfer margin.

TABLE 1. Fracture load and fracture resistance at maximum load of zirconia overlay with different preparation designs with and without endodontic access.

Group	Type of Restoration	Fracture Load (±SD),	Fracture N
Group 1 (M4)	Overlay restoration with finish line at 4 mm from gingival margin	567.07 (58.48) ^A	22.70 (2.27) ^A
Group 2 (M4End)	Overlay restoration with 4 mm finish line and endodontic access	458.05 (65.36) ^B	19.85 (1.53) ^B
Group 3 (M2)	Overlay with finish line located 2 mm coronally to gingival margin	959.27 (109.87) ^C	28.43 (2.80) ^C
Group 4 (M2End)	Overlay with margin located 2 mm above the gingiva and with endodontic access	842.94 (135.97) ^D	25.10 (2.68) ^D
Group 5 (nM)	Occlusal veneer (no margin overlay)	543.01 (41.69) ^{AB}	22.18 (1.37) ^{AB}
Group 6 (nMEnd)	Occlusal veneer with endodontic access	502.10 (40.09) ^{AB}	20.48 (1.61) ^{AB}

Note: Different superscript uppercase letters indicate significant difference ($p < 0.05$) within groups in each column.

Fifteen specimens per group were tested.

FIGURE 1. Cross-sectional illustration of different types of overlay restorations: (a) with margin located 4 mm coronal to the gingival level without endodontic access (Group 1); (b) with margin located 4 mm coronal to the gingival level with endodontic access (Group 2); (c) with margin located 2 mm coronal to the gingival level (Group 3); (d) with margin located 2 mm coronal to the gingival level and with endodontic access (Group 4); (e) without margin Group 5); and (f) without margin and with endodontic access (Group 6).

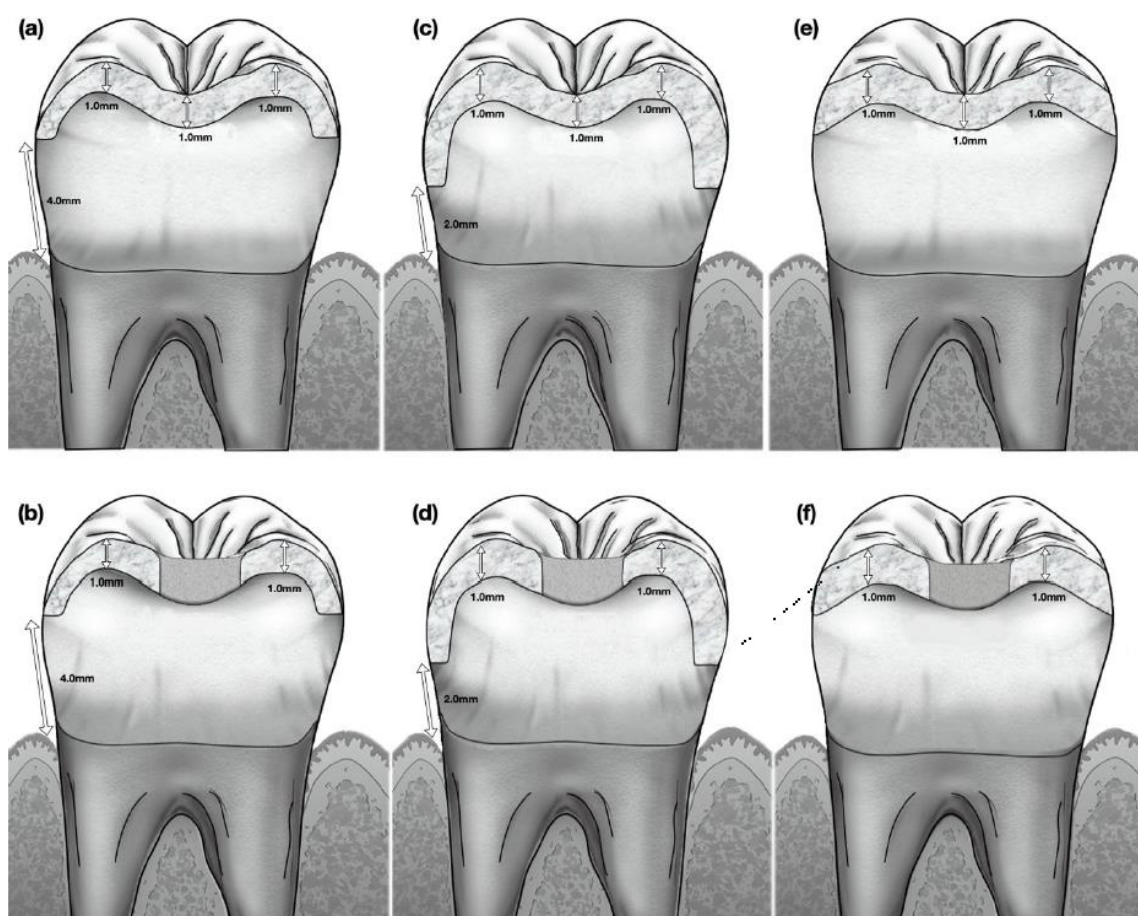


FIGURE 2. Representative SEM images of group 1 and 2. (A) Overlay restoration at x16 and x40 magnification. (B) Overlay restoration with endodontic access at x16 and x40 magnification.

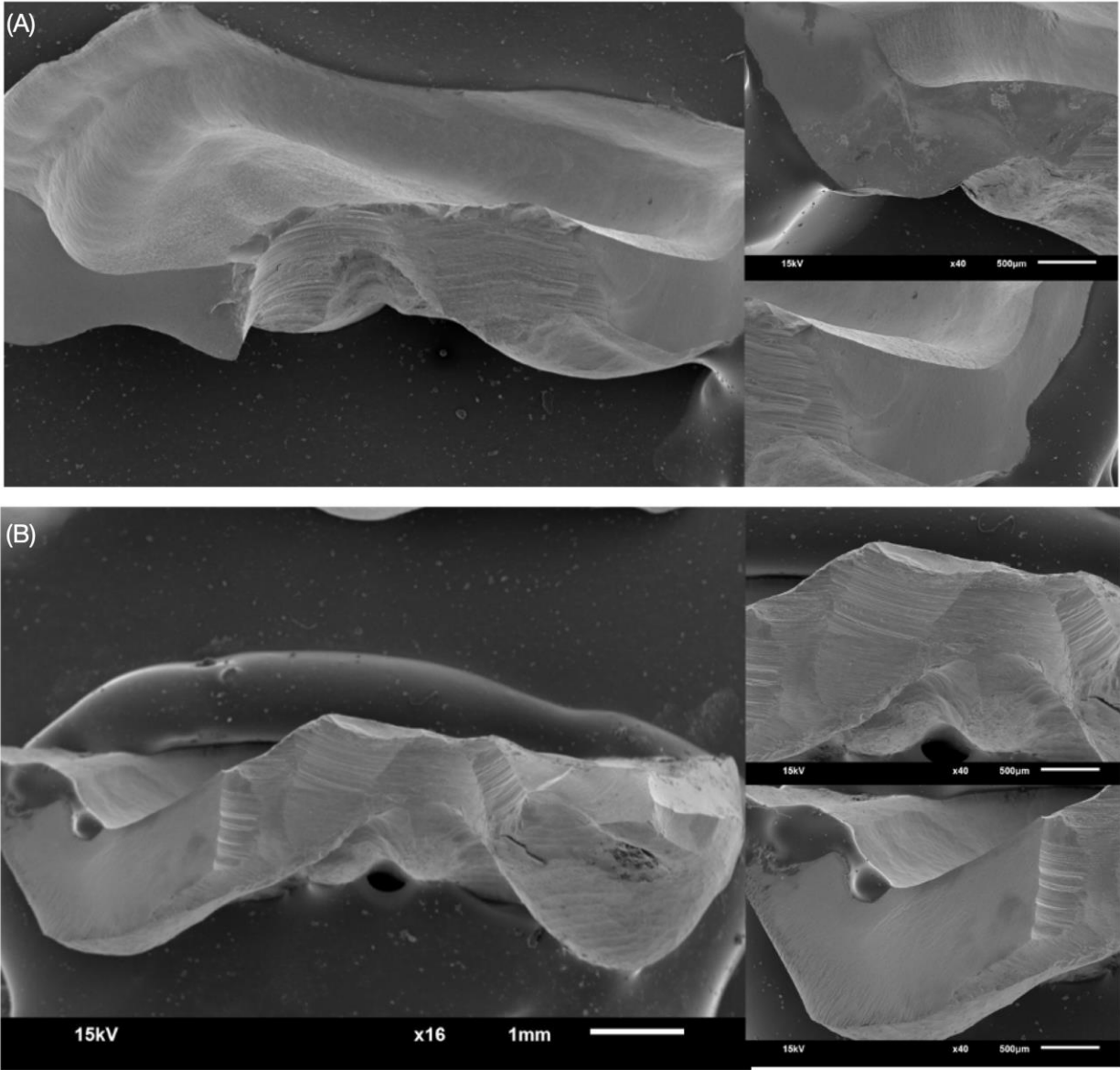


FIGURE 3. Representative SEM images of group 3 and 4. (A) Overlay restoration with margin located 2 mm coronally to the gingival level at x16 and x40 magnification. (B) Overlay restoration with margin located 2 mm coronally to the gingival level and with endodontic access at x16 and x40 magnification.

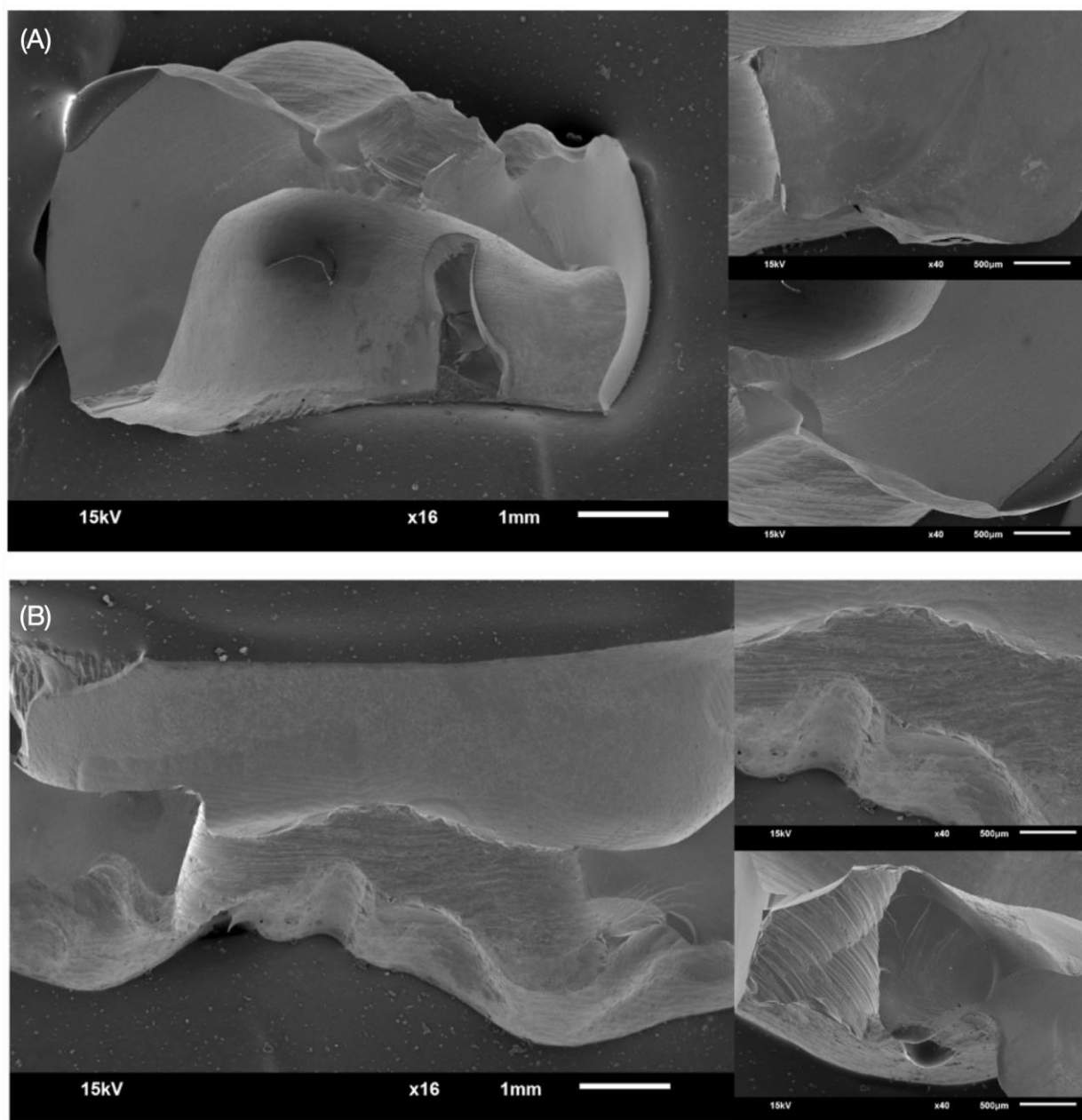


FIGURE 4. Representative SEM images of group 3 and 4. (A) Overlay restoration with no margin at x16 and x40 magnification. (B) Overlay restoration with no margin and with endodontic access at x16 and x40 magnification.

