JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

DOI: https://doi.org/10.61919/fy84dt46

Original Article

Evaluating the Clinical Performance of Direct Composite Restorations Using the FDI World Dental Federation Criteria: A Cross-Sectional Study

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"Cite this Article" Received: 28 November 2025; **Accepted**: 02 March 2026; **Published**: 30 March 2026

Author Contributions: Concept: FAS; Design: FAS, MAZ; Data Collection: FAS, MAZ; Analysis: MAZ; Drafting: FAS, MAZ. **Ethical Approval**: Khyber College of Dentistry, Peshawar, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: NA

ABSTRACT

Background: Direct composite restorations are widely used for conservative and esthetic restoration of anterior and posterior teeth. The FDI World Dental Federation criteria provide standardized assessment of their esthetic, functional, and biological condition. Objective: To evaluate the clinical acceptability of direct composite restorations using selected FDI criteria and compare ratings between anterior and posterior restorations. Methods: This multiclinic cross-sectional study evaluated 217 direct composite restorations in patients attending private dental clinics over four months. Surface luster, anatomical form, marginal staining, fracture and retention, marginal adaptation, radiographic examination, postoperative sensitivity or vitality, secondary caries, tooth integrity, and adjacent mucosa were scored from 1 to 5. Scores 1–3 were classified as clinically acceptable and scores 4–5 as clinically unacceptable. Frequencies and percentages were calculated, and anterior and posterior restorations were compared using Pearson's chi-square test. Results: Acceptability ranged from 65.4% for surface luster and marginal staining to 85.3% for adjacent mucosa. Anterior restorations showed greater acceptability for fracture and retention (77.4% vs. 65.3%) and marginal adaptation (77.4% vs. 64.5%). Marginal adaptation was the only nominally significant location-based comparison (OR = 1.89, 95% CI: 1.03–3.47; p = 0.040). Conclusion: Most restorations were clinically acceptable at assessment. Location-related differences were predominantly descriptive and should be interpreted cautiously because the analyses were cross-sectional, unadjusted, and exploratory. Keywords: Composite Resin Restoration; Direct Dental Restoration; FDI Criteria; Clinical Acceptability; Marginal Adaptation; Secondary Caries; Anterior Teeth; Posterior Teeth.

INTRODUCTION

Dental caries is a biofilm-mediated, diet-modulated, multifactorial noncommunicable disease characterized by an imbalance between the demineralization and remineralization of dental hard tissues. When demineralization predominates, progressive loss of tooth structure may occur and necessitate restorative treatment. Contemporary caries management emphasizes preservation of sound dental tissue, maintenance of pulpal vitality, and the use of minimally invasive restorative approaches whenever clinically appropriate (1).

Direct restorations are commonly used to restore teeth affected by dental caries, trauma, developmental defects, and other conditions associated with loss of tooth structure. Available direct restorative materials include resin composite, dental amalgam, conventional and resin-modified glass-ionomer cements, and compomers. Among these materials, resin composite has become a principal option for both anterior and posterior restorations because it provides tooth-coloured esthetics, permits conservative cavity

preparation, and can achieve satisfactory clinical longevity when appropriate case selection, adhesive protocols, isolation, and placement techniques are used (2,3).

Resin composites consist of an organic polymer matrix reinforced with inorganic glass or silica fillers that improve their mechanical and optical properties and allow them to reproduce the appearance of natural dental tissues (4). Their increasing use has also been influenced by the declining preference for amalgam and the demand for conservative, esthetic restorations. Nevertheless, the clinical condition of composite restorations may be affected by material-, tooth-, patient-, and operator-related factors. Relevant determinants include restoration size and location, number of restored surfaces, vitality of the tooth, caries risk, oral hygiene, occlusal loading and parafunctional activity, adhesive and restorative materials, moisture control, placement technique, and operator experience (3,5).

The adhesive interface is particularly important for the clinical integrity of resin-composite restorations. Inadequate substrate preparation, contamination, suboptimal moisture control, or degradation of the hybrid layer may compromise bonding and contribute to marginal gaps, staining, postoperative sensitivity, microleakage, secondary caries, fracture, loss of retention, and eventual repair or replacement of the restoration (1,5,6). Although contemporary composite restorations can demonstrate favourable survival, their longevity is not determined solely by the restorative material; it also reflects the interaction of biological, mechanical, behavioural, and procedural factors (5,7).

Standardized clinical criteria are necessary to evaluate restorations consistently and to identify changes that may require monitoring, refurbishment, repair, or replacement. Earlier clinical studies frequently used the United States Public Health Service criteria, but their relatively broad categories may limit discrimination between different levels of restoration deterioration. The Fédération Dentaire Internationale World Dental Federation criteria provide a more detailed framework for assessing restorations across esthetic, functional, and biological domains. The system grades each parameter from clinically excellent to clinically poor and distinguishes clinically acceptable restorations from those requiring intervention (8,9).

Previous investigations using standardized criteria have reported variation in surface luster, marginal staining, anatomical form, fracture and retention, marginal adaptation, postoperative sensitivity, secondary caries, and tooth integrity (8–11). Restoration location may also influence clinical ratings. Anterior restorations are subject to high esthetic expectations, whereas posterior restorations generally experience greater occlusal loading, may involve larger or multisurface cavities, and can be more difficult to isolate during placement. However, anterior–posterior differences cannot be assumed and require direct clinical evaluation. Although FDI-based evaluations have been conducted internationally and within Pakistan, evidence from patients attending private dental clinics remains limited, particularly regarding the comparative clinical acceptability of anterior and posterior direct composite restorations (11-16).

Therefore, this study aimed to evaluate the current clinical condition of direct composite restorations in patients attending private dental clinics using the FDI World Dental Federation criteria. It also aimed to determine the proportions of clinically acceptable and clinically unacceptable ratings across esthetic, functional, and biological parameters and to compare these ratings between anterior and posterior restorations.

MATERIALS AND METHODS

A multiclinic cross-sectional study was conducted over a four-month period among patients attending multiple private dental clinics. The study evaluated the current clinical condition of previously placed direct composite restorations at a single clinical assessment. A non-probability convenience sampling technique was used to recruit eligible patients and restorations encountered during the study period. The unit evaluated was the individual direct composite restoration.

Patients aged 16–60 years who presented with direct composite restorations involving Black's Classes I, II, III, IV, V, or VI were considered eligible. Patients were excluded if they were immunocompromised; had uncontrolled diabetes mellitus or another uncontrolled systemic condition; had xerostomia or were using medications associated with xerostomia; had clinically relevant parafunctional habits; had periodontitis or poor oral hygiene; or had developmental abnormalities affecting enamel or dentine, including amelogenesis imperfecta, dentinogenesis or dentine dysplasia, and enamel hypoplasia. Eligible patients were informed about the clinical assessment, and consent was obtained before examination.

Each included restoration was classified according to its location as anterior or posterior and was evaluated using the FDI World Dental Federation criteria. The assessment included selected esthetic, functional, and biological parameters relevant to direct composite restorations. Esthetic assessment comprised surface luster, anatomical form, and marginal staining. Functional assessment comprised fracture and retention, marginal adaptation, and radiographic examination. Biological assessment comprised postoperative sensitivity or vitality, secondary caries, tooth integrity, and the condition of the adjacent oral mucosa.

Each parameter was graded on the five-point FDI scale. A score of 1 indicated a clinically excellent restoration without relevant esthetic, functional, or biological deficiency. A score of 2 indicated a clinically good restoration with minor deviations that did not require intervention. A score of 3 indicated a clinically satisfactory restoration with acceptable changes that could be monitored or improved without replacement. A score of 4 indicated a clinically unsatisfactory restoration requiring intervention, typically refurbishment or repair, but not necessarily complete replacement. A score of 5 indicated a clinically poor restoration for which replacement was considered necessary. For the principal categorical analysis, scores 1–3 were classified as clinically acceptable, whereas scores 4–5 were classified as clinically unacceptable (9,11). The terms clinically acceptable and clinically unacceptable were used rather than success and failure because the study assessed restorations cross-sectionally and did not measure longitudinal survival.

Clinical findings were recorded for each evaluated restoration using the selected FDI parameters. The five-category score was retained for descriptive presentation to show the distribution from clinically excellent to clinically poor. For comparison by restoration location, the scores were dichotomized into clinically acceptable and clinically unacceptable categories. Anterior and posterior restorations were then compared for each esthetic, functional, and biological parameter.

Data were entered and analysed using IBM SPSS Statistics version 23.0. Categorical variables were summarized as frequencies and percentages. The distribution of scores 1–5 was calculated separately for each FDI parameter. Pearson's chi-square test was used to compare the proportions of clinically acceptable and clinically unacceptable ratings between anterior and posterior restorations. All tests were two-sided, and a p-value of less than 0.05 was considered statistically significant. Because several FDI parameters were compared separately, parameter-level p-values were interpreted cautiously as exploratory findings rather than as independent evidence of multiple definitive group differences.

RESULTS

A total of 217 direct composite restorations were evaluated using the FDI World Dental Federation criteria. Of these, 93 restorations were located in anterior teeth and 124 in posterior teeth. Complete ratings were reported for all 217 restorations across the selected esthetic, functional, and biological parameters.

Across the esthetic domain, anatomical form had the highest proportion of clinically acceptable ratings, with 152 of 217 restorations classified as acceptable (70.0%). Surface luster and marginal staining each demonstrated clinically acceptable ratings in 142 restorations (65.4%). Clinically unacceptable ratings

were therefore most frequent for surface luster and marginal staining, affecting 75 restorations (34.6%) for each parameter.

Within the functional domain, radiographic examination demonstrated the highest clinical acceptability, with 167 restorations rated acceptable (77.0%). Fracture and retention were clinically acceptable in 153 restorations (70.5%), while marginal adaptation was acceptable in 152 restorations (70.0%). Marginal adaptation had the highest proportion of clinically unacceptable functional ratings, affecting 65 restorations (30.0%).

The biological domain showed comparatively high acceptability for adjacent mucosa and postoperative sensitivity or vitality. Adjacent mucosa was clinically acceptable in 185 restorations (85.3%), representing the highest acceptable proportion among all evaluated parameters. Postoperative sensitivity or vitality was clinically acceptable in 183 restorations (84.3%). Secondary caries was rated clinically acceptable in 157 restorations (72.4%), whereas tooth integrity demonstrated the lowest biological acceptability, with 143 restorations classified as acceptable (65.9%).

Table 1. Distribution of FDI Scores and Clinical Acceptability of Direct Composite Restorations (n = 217)

Domain	Assessment parameter	Score 1, n (%)	Score 2, n (%)	Score 3, n (%)	Score 4, n (%)	Score 5, n (%)	Clinically acceptable, n (%)	Clinically unacceptable, n (%)
Esthetic	Surface luster	32 (14.7)	60 (27.6)	50 (23.0)	52 (24.0)	23 (10.6)	142 (65.4)	75 (34.6)
Esthetic	Anatomical form	38 (17.5)	62 (28.6)	52 (24.0)	42 (19.4)	23 (10.6)	152 (70.0)	65 (30.0)
Esthetic	Marginal staining	28 (12.9)	62 (28.6)	52 (24.0)	56 (25.8)	19 (8.8)	142 (65.4)	75 (34.6)
Functional	Fracture and retention	50 (23.0)	58 (26.7)	45 (20.7)	44 (20.3)	20 (9.2)	153 (70.5)	64 (29.5)
Functional	Marginal adaptation	40 (18.4)	62 (28.6)	50 (23.0)	47 (21.7)	18 (8.3)	152 (70.0)	65 (30.0)
Functional	Radiographic examination	61 (28.1)	57 (26.3)	49 (22.6)	30 (13.8)	20 (9.2)	167 (77.0)	50 (23.0)
Biological	Postoperative sensitivity or vitality	110 (50.7)	45 (20.7)	28 (12.9)	24 (11.1)	10 (4.6)	183 (84.3)	34 (15.7)
Biological	Secondary caries	62 (28.6)	55 (25.3)	40 (18.4)	42 (19.4)	18 (8.3)	157 (72.4)	60 (27.6)
Biological	Tooth integrity	42 (19.4)	55 (25.3)	46 (21.2)	53 (24.4)	21 (9.7)	143 (65.9)	74 (34.1)
Biological	Adjacent mucosa	125 (57.6)	38 (17.5)	22 (10.1)	24 (11.1)	8 (3.7)	185 (85.3)	32 (14.7)

FDI, Fédération Dentaire Internationale. Score 1, clinically excellent; score 2, clinically good; score 3, clinically satisfactory; score 4, clinically unsatisfactory and requiring intervention or repair; score 5, clinically poor and requiring replacement. Scores 1–3 were classified as clinically acceptable, and scores 4–5 as clinically unacceptable. Percentages may not total 100.0 because of rounding.

When restorations were compared according to location, anterior restorations showed numerically lower acceptable proportions for all three esthetic parameters. Clinical acceptability for surface luster was 62.4% in anterior restorations and 67.7% in posterior restorations, while anatomical form was acceptable in 67.7% and 71.8%, respectively. The largest esthetic difference was observed for marginal staining, which was clinically acceptable in 59.1% of anterior restorations compared with 70.2% of posterior restorations. This corresponded to an unadjusted odds ratio of 0.62 (95% CI: 0.35–1.08), although the difference was not statistically significant ($p = 0.091$).

In contrast, anterior restorations showed numerically higher acceptable proportions for all functional parameters. Fracture and retention were clinically acceptable in 77.4% of anterior restorations compared with 65.3% of posterior restorations, corresponding to an unadjusted odds ratio of 1.82 (95% CI: 0.99–3.35; $p = 0.053$). Marginal adaptation was acceptable in 77.4% of anterior restorations and 64.5% of posterior restorations. The absolute difference was 12.9 percentage points, and the unadjusted odds of an acceptable marginal-adaptation rating were 1.89 times higher in anterior than posterior restorations (95% CI: 1.03–3.47; $p = 0.040$). Radiographic acceptability was also numerically higher in anterior restorations, although the difference was not statistically significant (80.6% vs. 74.2%; OR = 1.45, 95% CI: 0.75–2.78; $p = 0.264$).

Anterior restorations also demonstrated numerically higher clinical acceptability across all biological parameters. Postoperative sensitivity or vitality was acceptable in 88.2% of anterior and 81.5% of posterior restorations. Secondary caries ratings were acceptable in 77.4% and 68.5%, respectively. Tooth integrity showed the largest biological-domain difference, with acceptable ratings in 73.1% of anterior restorations compared with 60.5% of posterior restorations. The corresponding unadjusted odds ratio

was 1.78 (95% CI: 0.99–3.18; p = 0.052). Adjacent mucosa demonstrated high acceptability in both groups, affecting 88.2% of anterior and 83.1% of posterior restorations.

Marginal adaptation was the only parameter for which the reported anterior–posterior comparison reached the conventional statistical significance threshold. However, because ten separate parameter-level comparisons were conducted, this isolated result was interpreted cautiously as an exploratory finding. The remaining comparisons did not demonstrate statistically significant differences between anterior and posterior restorations.

Table 2. Comparison of Clinically Acceptable FDI Ratings Between Anterior and Posterior Direct Composite Restorations

Domain	Assessment parameter	Anterior, n/N (%)	Posterior, n/N (%)	Absolute difference	OR (95% CI)	Pearson χ^2	p-value
Esthetic	Surface luster	58/93 (62.4)	84/124 (67.7)	−5.3	0.79 (0.45–1.39)	0.679	0.410
	Anatomical form	63/93 (67.7)	89/124 (71.8)	−4.1	0.83 (0.46–1.48)	0.412	0.521
	Marginal staining	55/93 (59.1)	87/124 (70.2)	−11.1	0.62 (0.35–1.08)	2.854	0.091
Functional	Fracture and retention	72/93 (77.4)	81/124 (65.3)	12.1	1.82 (0.99–3.35)	3.740	0.053
	Marginal adaptation	72/93 (77.4)	80/124 (64.5)	12.9	1.89 (1.03–3.47)	4.217	0.040
	Radiographic examination	75/93 (80.6)	92/124 (74.2)	6.4	1.45 (0.75–2.78)	1.247	0.264
Biological	Postoperative vitality	82/93 (88.2)	101/124 (81.5)	6.7	1.70 (0.78–3.69)	1.816	0.178
	Secondary caries	72/93 (77.4)	85/124 (68.5)	8.9	1.57 (0.85–2.91)	2.091	0.148
	Tooth integrity	68/93 (73.1)	75/124 (60.5)	12.6	1.78 (0.99–3.18)	3.755	0.052
	Adjacent mucosa	82/93 (88.2)	103/124 (83.1)	5.1	1.52 (0.69–3.33)	1.103	0.294

CI, confidence interval; FDI, Fédération Dentaire Internationale; OR, odds ratio. Clinically acceptable ratings comprised FDI scores 1–3. The absolute difference was calculated as the anterior proportion minus the posterior proportion. An OR greater than 1.00 indicates higher unadjusted odds of a clinically acceptable rating among anterior restorations. Odds ratios and confidence intervals were derived from the reported restoration-level counts. Pearson chi-square statistics and p-values were retained from the original analysis.

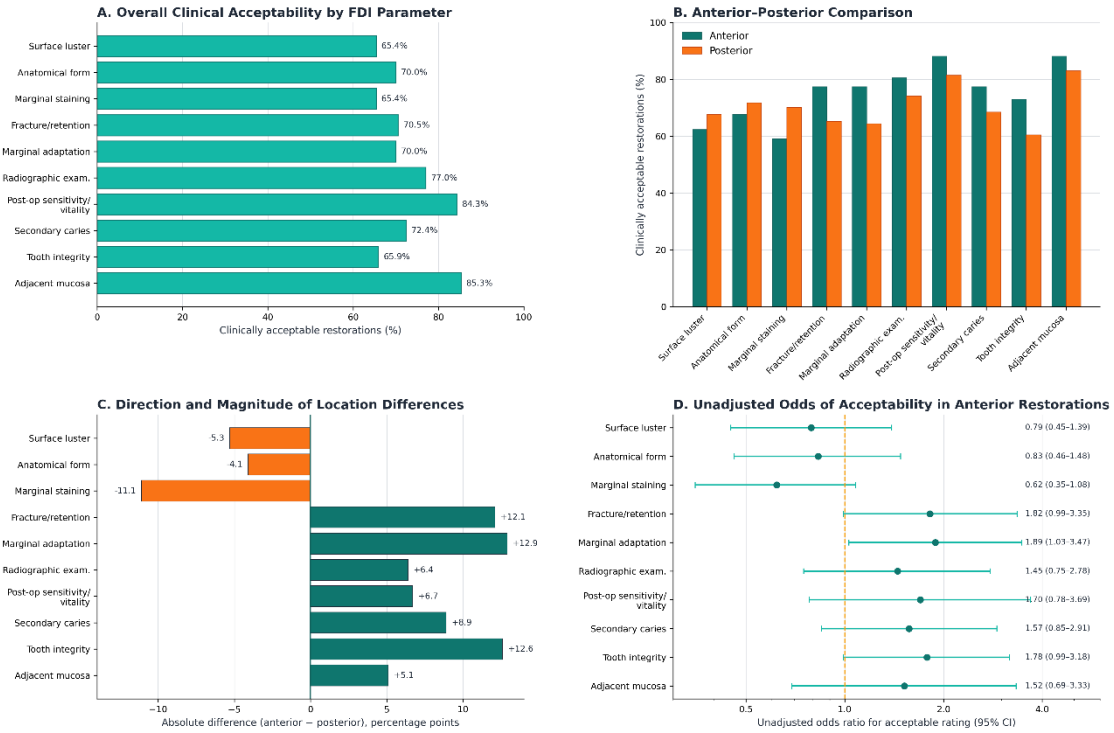

Figure 1. Clinical Acceptability of Direct Composite Restorations Assessed Using the FDI World Dental Federation Criteria

Panel A presents the overall proportions of clinically acceptable restorations for each esthetic, functional, and biological parameter. Panel B compares clinically acceptable ratings between anterior and posterior restorations. Panel C shows the absolute percentage-point difference between anterior and posterior restorations, with positive values indicating higher acceptability among anterior restorations. Panel D presents the unadjusted odds ratios and 95% confidence intervals for clinically acceptable ratings in anterior compared with posterior restorations. FDI scores 1–3 were classified as clinically acceptable,

whereas scores 4–5 were classified as clinically unacceptable. Odds ratios greater than 1.00 favour anterior restorations. All location-based comparisons were unadjusted and exploratory.

Overall clinical acceptability ranged from 65.4% for surface luster and marginal staining to 85.3% for adjacent mucosa. Anterior restorations showed lower acceptable proportions for all esthetic parameters, with the largest esthetic difference observed for marginal staining at −11.1 percentage points. Conversely, anterior restorations showed higher acceptable proportions for all functional and biological parameters. The largest positive differences were observed for marginal adaptation at 12.9 percentage points, tooth integrity at 12.6 percentage points, and fracture and retention at 12.1 percentage points. Marginal adaptation was the only parameter whose unadjusted confidence interval excluded the null value, with an odds ratio of 1.89 (95% CI: 1.03–3.47), although this finding should be interpreted cautiously because multiple parameter-level comparisons were performed.

DISCUSSION

The present cross-sectional study evaluated 217 direct composite restorations using selected FDI World Dental Federation criteria and found that most restorations were clinically acceptable across the esthetic, functional, and biological domains. Adjacent mucosa and postoperative sensitivity or vitality showed the highest acceptable proportions, whereas surface luster, marginal staining, and tooth integrity showed comparatively lower acceptability. Anterior restorations had numerically lower acceptable ratings for the three esthetic parameters but higher acceptable ratings for all functional and biological parameters. Marginal adaptation was the only location-based comparison that reached the conventional statistical significance threshold; however, this isolated finding should be interpreted cautiously because multiple parameter-level comparisons were undertaken (12-13).

The overall findings support the clinical utility of direct resin composite as a conservative restorative material, while also demonstrating that the condition of a restoration is not determined solely by the intrinsic properties of the composite. Clinical acceptability reflects interactions among the restorative material, adhesive interface, cavity configuration, tooth location, occlusal loading, caries activity, patient behaviour, isolation, placement technique, and operator-related factors. Previous evidence has similarly emphasized that the longevity and clinical condition of composite restorations are multifactorial rather than exclusively material dependent (4,5,7).

Within the esthetic domain, anatomical form demonstrated greater clinical acceptability than surface luster and marginal staining. Preservation of anatomical form suggests that most restorations retained an acceptable overall contour at the time of examination, whereas surface and marginal changes were more frequently observed. Surface luster can be influenced by filler characteristics, finishing and polishing procedures, dietary exposure, oral hygiene, and surface degradation. Marginal staining may arise from superficial discoloration, deterioration of the restoration–tooth interface, adhesive degradation, or staining of an otherwise clinically acceptable margin. These findings are broadly consistent with the Pakistani study by Naz et al., in which approximately two-thirds of evaluated restorations were acceptable for luster, texture, and marginal staining (14-19). Differences between studies may reflect variation in restoration age, patient characteristics, cavity class, restorative systems, operator technique, and clinical setting.

Anterior restorations had numerically lower acceptable proportions for all esthetic parameters, with the largest difference observed for marginal staining. The higher esthetic demands placed on anterior teeth may make minor alterations in surface texture, contour, colour, and marginal appearance more clinically apparent. Anterior restorations may also include Class III, IV, and V preparations in highly visible regions where the restoration–tooth interface is readily assessed. Nevertheless, the observed anterior–posterior differences in surface luster, anatomical form, and marginal staining were not statistically significant. These patterns should therefore be treated as descriptive rather than as evidence that anterior location independently causes greater esthetic deterioration.

In the functional domain, radiographic examination had the highest acceptable proportion, whereas fracture and retention and marginal adaptation showed lower acceptability. Marginal integrity is a critical aspect of composite restoration assessment because polymerization contraction, occlusal stress, adhesive degradation, cavity configuration, contamination, and differences in the mechanical behaviour of dental and restorative tissues may contribute to marginal defects over time. Systematic evidence has identified marginal adaptation and secondary caries as important outcomes in the clinical evaluation of resin-based restorations (3). Naz et al. also reported lower acceptability for fracture and marginal adaptation than for several other clinical criteria, reinforcing the importance of monitoring functional integrity during follow-up (20).

Anterior restorations had a 12.9-percentage-point higher acceptable proportion for marginal adaptation than posterior restorations, and the unadjusted odds of an acceptable rating were 1.89 times higher in anterior restorations. Posterior restorations are commonly exposed to greater occlusal forces and may involve larger, deeper, or multisurface preparations. Access and moisture control can also be more demanding in posterior regions. These factors provide plausible explanations for the observed pattern, but they were not directly measured in this study and therefore cannot be confirmed as causal mechanisms. In addition, marginal adaptation was one of ten location-based comparisons. The p-value of 0.040 represents nominal statistical significance and may not remain significant under a strict correction for multiple testing. The finding should consequently be regarded as exploratory and should be verified in studies that account for restoration age, cavity class, surface number, material, operator, and patient-level clustering.

Fracture and retention were also numerically more acceptable in anterior than posterior restorations, with a 12.1-percentage-point difference and an unadjusted odds ratio of 1.82. The confidence interval included the null value, and the reported p-value was 0.053. This result should not be labelled as borderline or nearly significant. Instead, it indicates an imprecisely estimated pattern that may warrant further investigation. Posterior restorations are subject to repeated compressive and tensile stresses, and their risk of fracture may be affected by restoration size, cusp involvement, remaining tooth structure, parafunctional loading, and endodontic status. None of these variables was available for adjusted analysis in the present study.

The biological domain showed the most favourable ratings for adjacent mucosa and postoperative sensitivity or vitality. The high acceptability of adjacent mucosa suggests that most restorations were not associated with clinically evident adverse changes in the neighbouring soft tissues at the time of assessment. Similarly, the high proportion of acceptable postoperative sensitivity or vitality ratings suggests that overt pulpal or sensitivity-related concerns were relatively uncommon within the examined sample. These findings should nevertheless be interpreted as cross-sectional observations because the study did not document baseline pulpal status, time since restoration placement, or changes in symptoms over time.

Secondary caries was clinically acceptable in 72.4% of restorations, while tooth integrity had the lowest acceptable proportion within the biological domain. Secondary caries is a frequently reported reason for repair or replacement of composite restorations, although its diagnosis may be influenced by restoration age, caries risk, marginal characteristics, radiographic interpretation, and examiner judgement (1,6,10). Previous clinical assessments have also identified recurrent caries and structural compromise of the restored tooth as important contributors to restoration intervention or replacement (9,10). In the present study, however, the absence of information on restoration duration, baseline lesion status, caries-risk classification, and radiographic protocol limits the extent to which biological deficiencies can be attributed to the restorative material or placement procedure.

Tooth integrity was numerically more acceptable in anterior restorations than in posterior restorations, with a 12.6-percentage-point difference and an unadjusted odds ratio of 1.78. The corresponding confidence interval included 1.00, and the p-value was 0.052. Larger cavity preparations, loss of cuspal

support, endodontic treatment, and greater occlusal loading could plausibly contribute to structural compromise in posterior teeth. However, the study did not collect sufficient information on these characteristics to determine whether location itself accounted for the observed difference.

A strength of this study was the use of the FDI framework, which enabled structured evaluation of multiple esthetic, functional, and biological aspects of direct composite restorations. The five-level scoring system also allowed the data to be presented both as detailed ordinal distributions and as clinically acceptable versus clinically unacceptable categories. The inclusion of restorations from multiple private clinics increased the clinical relevance of the findings within that service context, and the separate examination of anterior and posterior restorations provided useful exploratory information regarding location-related patterns.

Several limitations require consideration. First, the cross-sectional design captured restoration condition at only one point and could not determine deterioration, survival, longevity, incidence of failure, or temporal relationships. Second, restoration age was not reported, although time in service is a major determinant of staining, marginal degradation, fracture, secondary caries, and tooth integrity. Third, the number of participating patients and the number of restorations contributed by each patient were unavailable. If individual patients contributed multiple restorations, the observations may not have been statistically independent, and conventional chi-square tests may have underestimated uncertainty. Fourth, convenience sampling and exclusion of patients with poor oral hygiene, periodontitis, xerostomia, parafunctional habits, and selected systemic conditions may have produced a lower-risk sample and limited generalizability (19-2).

Additional limitations included the absence of reported examiner calibration and inter- or intra-examiner reliability; lack of detailed information on clinical illumination, cleaning, drying, probing, magnification, and radiographic assessment; and inability to adjust for cavity class, restoration size, restored surfaces, restorative material, adhesive system, isolation, operator experience, vitality, endodontic status, caries risk, and occlusal factors. The comparison of ten FDI parameters also increased the possibility of a chance-positive result. Finally, recruitment from private clinics may limit applicability to public-sector, academic, rural, or population-based settings (21).

Future longitudinal studies should record the number of patients and restorations per patient, restoration age, cavity class, tooth and arch, number of restored surfaces, material and adhesive system, placement technique, operator characteristics, caries risk, occlusal factors, and endodontic status. Examiners should undergo standardized FDI training and calibration, with reliability reported using appropriate agreement statistics. Analyses should account for clustering of restorations within patients and clinics and should provide adjusted effect estimates with confidence intervals. Such studies would allow more reliable assessment of restoration survival and the independent contribution of tooth location to esthetic, functional, and biological outcomes.

CONCLUSION

Most of the 217 direct composite restorations were clinically acceptable according to the selected FDI criteria at the time of assessment. Adjacent mucosa and postoperative sensitivity or vitality showed the highest acceptable proportions, whereas surface luster, marginal staining, and tooth integrity showed comparatively lower acceptability. Anterior restorations demonstrated lower esthetic but higher functional and biological acceptability than posterior restorations at a descriptive level, and marginal adaptation was the only parameter with a nominally significant location-based difference. Because the study was cross-sectional and did not account for restoration age, patient-level clustering, multiple testing, or major restorative and clinical confounders, the location-related findings should be considered exploratory rather than evidence of differential longevity or treatment success.

REFERENCES

1. Elgezawi M, Haridy R, Abdalla MA, Heck K, Draenert M, Kaisarly D. Current strategies to control recurrent and residual caries with resin composite restorations: operator- and material-related factors. J Clin Med. 2022;11(21):6591. doi:10.3390/jcm11216591.

2. Bhagwat S, Mandke L, Vandekar M, Basmatkar N, Pawar A, Khatri R. Longevity of amalgam versus composite resin restorations in permanent posterior teeth: a systematic review. Cureus. 2025. doi:10.7759/cureus.88836.

3. Albelasy EH, Hamama HH, Chew HP, Montaser M, Mahmoud SH. Secondary caries and marginal adaptation of ion-releasing versus resin composite restorations: a systematic review and meta-analysis of randomized clinical trials. Sci Rep. 2022;12(1). doi:10.1038/s41598-022-19622-6.

4. Santos MJMC, Zare E, McDermott P, Santos GC Jr. Multifactorial contributors to the longevity of dental restorations: an integrated review of related factors. Dent J (Basel). 2024;12(9):291. doi:10.3390/dj12090291.

5. Demarco FF, et al. Longevity of composite restorations is definitely not only about materials. Dent Mater. 2023. doi:10.1016/j.dental.2022.11.009.

6. Ferracane JL. Models of caries formation around dental composite restorations. J Dent Res. 2017. doi:10.1177/0022034516683395.

7. Ástvaldsdóttir Á, et al. Longevity of posterior resin composite restorations in adults: a systematic review. J Dent. 2015. doi:10.1016/j.jdent.2015.05.001.

8. Aref A, Abd-Elhakim S, Riad M. Twenty-four-month randomized controlled clinical trial assessment of surface texture, color stability, and marginal discoloration of sonic-activated bulk-fill resin composite according to USPHS and FDI criteria. BMC Oral Health. 2025;25(1). doi:10.1186/s12903-025-06611-0.

9. Rehman K, Ying NK, San AWH, Sultan OS. Results from a five-year clinical assessment of undergraduate-performed direct composite restorations. Saudi Dent J. 2025;37(7–9). doi:10.1007/s44445-025-00041-y.

10. Chrysanthakopoulos NA. Placement, replacement and longevity of composite resin-based restorations in permanent teeth in Greece. Int Dent J. 2012;62(3):161–166. doi:10.1111/j.1875-595X.2012.00112.x.

11. Naz F, et al. Clinical evaluation of composite restorations using the Fédération Dentaire Internationale criteria: a retrospective cross-sectional study at University Dental Hospital, The University of Lahore, Pakistan. Cureus. 2025. doi:10.7759/cureus.83582.

12. A Retrospective Clinical Evaluation of Esthetic Restorations: Class III, IV, And V. JDOC. 2024;3(1).

13. Freitas BNd, Silva POd, Pintado-Palomino K, Almeida CVVBd, Souza-Gabriel AE, Corona SAM, et al. Patients´ satisfaction concerning direct anterior dental restoration. Braz Dent J. 2023;34(3):82-93.

14. Gehren MOv, Rüttermann S, Romanos G, Herrmann E, Gerhardt-Szép S. A 23-Year Observational Follow-Up Clinical Evaluation of Direct Posterior Composite Restorations. Dental journal. 2023.

15. Hickel R, Mesinger S, Opdam N, Loomans B, Frankenberger R, Cadenaro M, et al. Revised FDI criteria for evaluating direct and indirect dental restorations—recommendations for its clinical use, interpretation, and reporting. Clinical Oral Investigations. 2022.

16. Incekara MS, Karadaş M. Clinical comparison of direct and indirect class II composite restorations: a prospective 12-month follow-up study. BMC Oral Health. 2025.

17. Lardani L, Derchi G, Marchio V, Carli E. One-Year Clinical Performance of Activa™ Bioactive-Restorative Composite in Primary Molars. Children. 2022.

18. Maillet C, Decup F, Dantony E, Iwaz J, Chevalier C, Gueyffier F, et al. Selected and simplified FDI criteria for assessment of restorations. Journal of Dentistry. 2022;122:104109.

19. Mesinger S, Heck K, Crispin A, Frankenberger R, Cadenaro M, Burgess J, et al. Evaluation of direct restorations using the revised FDI criteria: results from a reliability study. Clinical Oral Investigations. 2022.

20. Rodolpho PAdR, Rodolfo B, Collares K, Corrêa M, Demarco F, Opdam N, et al. Clinical performance of posterior resin composite restorations after up to 33 years. Dental Materials. 2022.

21. Santos DCMd, Besegato J, Zaniboni J, Ramos S, Cardoso SA, Hoeppner MG. Clinical performance of resin composite restorations placed by dental students. Brazilian Journal of Oral Sciences. 2022.