

Clinical Evaluation of Complications for Single Visit Class III and Class V Restorations at the First Recall Appointment

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ABSTRACT

Objective: Clinical evaluation of senior students' Class III and Class V restorations at the first recall (control) appointment, regarding revised FDI criteria.

Methods: Seventy-six anterior Class III and V restorations were assessed. A nano-ceramic, simplyshade composite (NeoSpectra-ST, Dentsply) was used. Restorative procedures were checked and approved by an experienced (3 years) restorative dentistry instructor. The first recall (control) appointment was scheduled 1 week after the restorations and a restorative instructor re-evaluated the restorations based on the biological, functional, and esthetic aspects of revised FDI criteria.

Results: Significantly greater scores were observed for Esthetic criteria compared to Functional and Biological criteria ($p < .001$). Six failures were detected for form and contour, two for surface luster and texture, two for marginal staining, and two for color match. Only for the form and contour criteria, Class V restorations obtained significantly higher scores than Class III ($p = .033$).

Conclusion: Although anterior composite restorations were approved by an experienced instructor, various irreversible complications were observed at the first recall. Following the restorative procedure, a control appointment shortly is considered mandatory. The highest risk for failure was detected for Esthetic criteria. Class III restorations are considered more prone to failures compared to Class V.

Keywords: Resin composite, recall, complication, class III, class V.

1. INTRODUCTION

The longevity of single-visit direct composite restorations can be influenced by tooth-related factors, restorative material-related factors, operator-related factors, and patient-related factors. The tooth-related factors concern the occlusal/proximal contacts, cavity size, tooth position, deep margins, and endodontic treatment (1). The restorative material-related factors concern the selection of resin-based materials and photo-polymerization which may simplify the restorative procedure and improve the quality of the restoration (1, 2). Moreover, as the resin-based restorative materials may positively or negatively influence the level of success, it is advantageous for the operator to experience also some alternative materials previously for a proper selection depending on the case and for performing effectively during the restorative process (2). The level of clinical experience of the operator as well as the facilities of the clinical environment play a very important role during the restorative procedure in

planning the restorative treatment correctly, performing the restorative procedure properly, and avoiding or overcoming possible restoration-related complications clinically (1, 3, 4). Besides, the patient-related factors are usually beyond the operator's control which may affect the outcome significantly (2, 5). Individual choices and demands, caries risk and diet, socioeconomic status, periodontal health, oral hygiene level, brushing pattern, parafunctional habits, and smoking habits are some of the many patient-related factors accordingly (1, 6). The operator usually tries to minimize these risk factors by increasing the awareness and thereby the motivation of the patient.

Previous short-term and mid-term clinical trials reported that indication, restorative material selection, field isolation, surface polishing, frequent recalls, and operator's experience are required to succeed in direct anterior composite restorations (2, 6-8). Therefore, the assessment of success

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for dental restorations should be a stepwise decision-making process accordingly and is usually evaluated by specific clinical criteria such as United States Public Health Service (USPHS) criteria, Ryge criteria, and Fédération Dentaire Internationale (FDI) criteria (1-3). Especially the modified USPHS criteria were previously used in many clinical studies even though it's limitations regarding the definitive scoring (3, 5). However, FDI criteria were first published in 2007 and updated in 2010 to overcome the problem by providing more accurate, descriptive, and standardized evaluation criteria for the researchers compared to the predecessor USPHS (6, 8-10). The FDI criteria classified the restorations according to 3 main headings: functional, biological, and esthetic properties, including sub-groups in each one. Also, the evaluation scores (1 to 5 as very good, good, satisfactory, unsatisfactory, and poor respectively) are more detailed for the clinical assessments, which may provide enhanced judgment quality (6, 8, 10). The scores of 1, 2, and 3 indicate that the restoration is clinically sufficient/acceptable, while 4 and 5 indicate that it is clinically insufficient/inacceptable (5, 6, 10). Recently, in 2023 the FDI criteria were updated again for a better understanding and handling through a more standardized evaluation (10). It includes a revised set of criteria in different categories which can be selected independently and used as a modular diagnostic system.

Every single-visit direct composite restoration must be checked by the operator through one of the criteria above to approve the finalization. It is always better to combine clinical examination with radiographic findings when necessary (2). Generally, this approval is done immediately after the restoration. However, is it always possible to check all the FDI criteria immediately after the restoration clinically? Shade matching may be affected by the dehydration process during the restorative procedure depending on the chair time. As a result, assessing the shade matching, especially for the anterior composite restorations immediately after, may lead the operator to misjudge. Moreover, the status of surrounding gingival health is a very good indicator to assess the contour of the emergence profile while it may be affected by patients' oral hygiene level. However, it may also not be accurate to assess the gingival health immediately after the restoration as it usually has acute inflammation due to the field isolation during the restorative procedures, depending on the cavity size and location (2). In addition, bleeding may block the quality of visual inspection immediately after as well. Therefore, it may not be always possible to fill all the checklist in the FDI criteria of success immediately after the restoration (2).

This clinical prospective study aimed to investigate the potential complications for the immediately approved Class III and Class V restorations at the first recall (one-week) appointment through the revised FDI criteria. It also aimed to investigate the clinical reversibility of the observed complications. The null (H_0) hypotheses of the study are (a) no difference in overall success between immediately after and one-week controls, (b) no difference in failure rates among FDI's biological, functional, and esthetic criteria at

one-week control, (c) no difference in success rates for Class III and Class V restorations.

2. METHODS

This clinical study was approved by a local ethical committee (protocol number: 09.2023.888).

2.1. Participants and Inclusion Criteria

The study included patients who applied to a university clinic requiring class III and class V restorations in anterior teeth. Senior students treated the patients under the control of an experienced restorative dentistry instructor with at least 3 years of clinical experience.

Healthy patients between 18-55 years of age, who had a complete initial periodontal treatment and had caries, abrasion, abfraction, and/or erosion lesions in the anterior teeth were included in the study. Systemic diseases, mental disabilities, severe periodontal diseases, former root canal treatment or indication, teeth that may require indirect or direct pulp capping, former restorations in anterior teeth, primary dentition, Class IV cavities, teeth with mobility, and cracked/fractured teeth were considered the exclusion criteria.

A minimum of 64 teeth were required for the study for a power of 80% (1- β) and a confidence interval of 95% (1- α), with an effect size of $w=0.352$ and a significance level of 0.05 (G*Power V.3.1.9.6, Germany) (11). Therefore, the present study was conducted with 32 patients who treated 26 senior students (graduate degree/5th class) with the same level of clinical experience, and a total of 76 restorations (44 Class III, 32 Class V) were evaluated. All the Class III restorations were performed due to caries and the restorations involved the buccal surface of the tooth. Seventeen Class V restorations were performed due to caries, while fifteen were due to abrasion/erosion. None of the Class III and Class V restorations were larger than 1/3 of the mesio-distal and servico-insical size of the tooth.

2.2. Restorative Procedure

An experienced restorative dentistry instructor who is responsible for the university clinic for the day approved the indications for Class III and Class V restorations for the students through clinical and radiographic examinations.

Before the preparation for caries removal, the composite shade was selected visually by using the Button technique in the very first 3 minutes of the appointment to avoid dehydration. The carious lesion was removed minimally-invasively without rubber-dam isolation using a diamond bur (at 20000 rpm with water-cooling) and a carbide bur (at 8000 rpm without water-cooling) for infected enamel and dentin tissues, respectively (Horico, Germany). Regarding the cavity margins, approximately 45° of beveling was performed on vestibular sharp enamel edges. The unsupported enamel tissues were also removed for preservation. Then, a 25% aluminum chloride-impregnated retraction cord (Cerkamed,

Poland) was used for isolating the tooth margins. For Class III cavities, a transparent strip (Tor Vm, Russia) was placed and fixed with a wooden wedge (Tor Vm), whereas the free-hand layering technique was used for the Class V cavities. Then the cavity was roughened with 37% phosphoric acid (President Dental, Germany) with the total-etch technique (30 seconds on enamel and 15 seconds on dentin). A universal adhesive agent (Prime & Bond Universal, Dentsply, USA) was applied to the cavity surfaces according to the manufacturer's instructions. A led curing unit with irradiation of 1000 mW/cm² (OLED Plus, Woodpecker, China) was used for photopolymerization. A nano-ceramic paste-type, simplyshade resin composite (Neo Spectra ST, Dentsply) was used for the restorations in 2 mm of incremental layering (Table 1).

Each composite load was polymerized with the curing unit. The occlusal contacts were checked not only statically but also dynamically at a sitting position using an 80 µm grit articulating paper (Hanel, Germany). The identified primary contacts were selectively reduced with a yellow-banded flame-shaped diamond bur. Medium and fine grits of composite polishing discs (Finishing Discs, BISCO, USA) were

used for the finishing procedure of embrasures. Interdental polishing was performed by medium, fine, and superfine paper strips (Tor Vm, Russia). Restoration surface polishing was performed by yellow and white polishing rubbers (Kenda, Liechtenstein).

The final preparation, adhesive agent application, composite layering, occlusion check, and finishing/polishing steps for all the restorations were checked, accordingly corrected by the student if needed, and then approved by an experienced restorative dentistry instructor who is in charge of the day at the clinic. The interdental surface of the Class III restorations was also evaluated through bitewing radiographs. The patients left the clinic only when the restorative dentistry instructor approved the final restoration. Patients were instructed to avoid coloring foods and beverages such as cigarettes, coffee, red wine, etc., especially for the first 24 hours, and to maintain good oral hygiene (by brushing and flossing). A control appointment was scheduled as the first recall one week after the restorative procedure for evaluating the quality of the previously approved restorations (2).

Table 1. Materials and their content were used in this study.

Material (Manufacturer)	Content	Instruction for use
Etching Gel (President, Germany)	37 % orthophosphoric acid	Total-etch is applied by waiting for 30 seconds on the enamel and 15 seconds on the dentin.
Neo Spectra ST (Dentsply Sirona, USA)	Nano ceramic restorative material, barium aluminum borosilicate glass fillers, 57% (by volume) / 76% (by weight) filler ratio, 1.1-1.5 µm filler size range	It is polymerized in layers with a maximum depth of 2 mm and condensed into the cavity using the incremental layering technique.
Prime & Bond Universal Adhesive (Dentsply Sirona, USA)	UDMA, PENTA, R5-62—1 resin, bisphenol-A dimethacrylate, butylate, silicon dioxide, acetone	The adhesive is applied for 20 seconds. Dry for 5 seconds and polymerize for 10 seconds.

Abbreviations, UDMA: urethane dimethacrylate, PENTA: Dipentaerythritol penta-acrylate monophosphate

2.3. Evaluation Protocol

A pilot study was conducted previously including 20 restorations that were different from those included in this study. Two restorative dentistry specialist instructors with the same level of experience (3 years of specialty education in restorative dentistry) evaluated and scored the restorations. According to the correlation results, an 80% high positive correlation between the two observers was obtained, therefore the present study included one of these restorative instructors for the scoring at the first recall appointment. The evaluations were performed visually for all the Class III and Class V restorations by the single observer at a one-week control appointment, based on the revised biological, functional, and esthetic aspects of the FDI criteria (2023) (Table 2a-c) (10). The evaluations were undergone in both dry and wet conditions in accordance with the revised FDI. No magnification was used for the visual scoring.

The observer evaluated 74 restorations (42 Class III and 32 Class V) in total according to the revised FDI criteria and then scored. The results were recorded per tooth. By the criteria,

1-3 scores were considered acceptable scores which are considered reversible complications. Whereas 4 and 5 scores were considered unacceptable scores (failures) which are considered irreversible complications. Also, the score 3 was evaluated individually in this study, to evaluate the potential risk of failure for the restorations with this score shortly.

2.4. Statistical Analysis

Data were analyzed using IBM SPSS V23 software. Normality was investigated using Kolmogorov-Smirnov Test. Fisher's Exact Test and Pearson Chi-Square Test were used to evaluate the acceptability rates for the criteria. Multiple comparisons were done with the Z Test with Bonferroni Correction. Friedman Test was used to compare the scores which were not normally distributed and multiple comparisons were done with the Dunn Test. The results were presented as frequency (percent), average $\pm$ standard deviation, and medium (minimum–maximum). The deemed significance was set at $p < .05$.

Table 2a. Evaluation of biological aspects (Domain B) according to revised FDI.

DOMAIN B	B1: Caries at restoration margins (CAR)	B2: Dental hard tissue defects at restoration margin	B3: Postoperative hypersensitivity & Pulp status
1. Clinically very good restoration (sufficient/ acceptable)	B1.1 No caries / demineralization at the restoration margin detectable after air drying.	B2.1 Intact dental hard tissue without crack lines and fractures at the restoration margin.	B3.1 No postoperative hypersensitivity or pain on chewing and/or cold/warm food items reported by the patient. Normal (short) reaction to sensitivity test on cold.
2. Clinically good restoration (sufficient/acceptable)	B1.2 First visible signs of a non-cavitated caries lesion at the restoration margin detectable after air drying.	B2.2 Minor vertical/horizontal hairline crack lines in enamel at the restoration margin.	B3.2 Patient reports minor postoperative hypersensitivity or minor pain on chewing and/or cold/warm food items reported by the patient for a limited period of time (<1 week). Normal (short) reaction to sensitivity test on cold.
3. Clinically satisfactory restoration (sufficient/ acceptable)	B1.3 Established, non-cavitated caries lesion or microcavity at the restoration margin detectable without air drying.	B2.3 Distinct enamel chipping or enamel fracture at the restoration margin. If necessary, deficiencies can be corrected by refurbishment.	B3.3 Patient reports distinct postoperative hypersensitivity or distinct pain on chewing and/or cold/warm food items reported by the patient for a prolonged period of time (>1 week). Normal (short) or more intense reaction to sensitivity test on cold.
4. Clinically unsatisfactory restoration (insufficient/ unacceptable)	B1.4 Localized dentin cavity (width >250 µm, depth >2 mm) at the restoration margin. Repair is possible.	B2.4 Severe marginal (enamel) fracture, partially fractured cusp or ridge at the restoration margin. Repair is possible.	B3.4 Patient reports severe/persistent, postoperative hypersensitivity or persistent pain on chewing and/or cold/warm food items reported by the patient for a prolonged period of time (>1month) AND/OR intense reaction to sensitivity test on cold. Both symptoms indicate an irreversible pulpitis. Endodontic treatment requires access cavity only.
5. Clinically poor restoration (insufficient/unacceptable)	B1.5 Extensive dentin cavity at the restoration margin. Repair not possible/ reasonable.	B2.5 Cusp or tooth fracture, e.g. involving enamel, dentin and cementum possible with mobile fragments/ pain when biting OR cracked tooth syndrome related to restoration. Repair not possible/reasonable.	B3.5 Irreversible pulpitis, nonvital tooth, pulp necrosis with or without periapical periodontitis after restoration placement. Endodontic treatment requires replacement of the restoration.

Table 2b. Evaluation of functional aspects (Domain F) according to revised FDI.

DOMAIN F	F1: Fracture of material & Retention	F2: Marginal adaptation	F3: Proximal contact point	F4: Form & Contour	F5: Occlusion & Wear
1. Clinically very good restoration (sufficient/ acceptable)	F1.1 Restoration is completely present without deficiencies detectable after air drying: No crack, chipping/delamination or Material bulk fracture.	F2.1 Ideal marginal adaptation of the restoration at the dental hard tissue after air drying. No marginal gap detectable by gentle probing.	F3.1 Ideal contact point: 25 µm metal blade can pass through proximal contact and no inflammation of the gingiva/ periodontium due to the proximal restoration. No food impaction.	F4.1 Outline, contour, convexity, embrasure and/or marginal ridges are restored ideally in comparison to the individual, age-related and functional anatomy. No marginal step detectable by gentle probing	F5.1 Ideal individual and age-related static and dynamic occlusion with multiple antagonistic contact points. No premature contacts, non-/ hyper-occlusion and/or balancing interferences.
2. Clinically good restoration (sufficient/acceptable)	F1.2 Restoration is completely present with minor deficiencies detectable after air drying, e.g. insignificant material chipping or one hairline crack.	F2.2 Slight deficiencies of marginal adaptation after air drying: Minor, superficial marginal gap(s) or ditching.	F3.2 Slightly weak contact point: 50 µm metal blade can pass through proximal contact and no inflammation of the gingiva/periodontium due to the proximal restoration. No food impaction.	F4.2 Minor deviations in outline, contour, convexity, embrasure and/or marginal ridges in comparison to the individual, age-related and functional anatomy AND/OR minor marginal steps, overhangs detectable by gentle probing.	F5.2 Minor deviations in individual and age-related static and dynamic occlusion with at least one antagonistic contact point per tooth. No premature contacts, non-/hyperocclusion and/or balancing interferences.

3. Clinically satisfactory restoration. (sufficient/acceptable)	F1.3 Restoration is present with deficiencies detectable without air drying, e.g. hairline cracks or distinct material loss (chipping). Material loss can mainly be corrected by refurbishment if needed.	F2.3 Distinct deficiencies of marginal adaptation without air drying: marginal gap(s) or ditching (width <250 µm and/or depth <2 mm).	F3.3 Oversized contact point or excessive material: 25 µm metal blade cannot pass through proximal contact and inflammation of the gingiva/periodontium due to the proximal restoration. Refurbishment is possible. OR severely weak contact point: 100 µm metal blade can pass through proximal contact but no inflammation of gingiva or discomfort.	F4.3 Outline, contour, convexity, embrasure and/or marginal ridges are distinctly misshaped, but clinically acceptable AND/OR distinct negative/positive steps, overhangs. Refurbishment (removal of overhangs/steps) to some extent is possible.	F5.3 Hyper-occlusion, premature contacts and/or balancing interferences which can be eliminated by refurbishment.
4. Clinically unsatisfactory restoration (insufficient/inacceptable)	F1.4 Localized but severe deficiencies regarding fracture and retention, e.g. chipping/delamination which cannot be refurbished, bulk fracture or partially loose/lost restoration. Repair is possible. A lost, indirect restoration which can be recemented/reluted is considered here.	F2.4 Localized but severe deficiencies of marginal adaptation: width ≥250 µm and/or depth ≥2 mm marginal gap(s). Partially loose/lost restoration. Repair is possible.	F3.4 Severely weak contact point: 100 µm metal blade can pass through proximal contact or unintended interlocked contact point. Inflammation of the gingiva/periodontium due to the proximal restoration and/or food impaction. Repair is possible.	F4.4 Outline, contour, convexity, embrasure and/or marginal ridges are in parts severely undersized in comparison to the individual, age-related and functional anatomy AND/OR prominently negative marginal steps. Repair is possible.	F5.4 Localized, flat occlusal structure with severe non-occlusion AND/OR severely worn restoration. Repair is possible.
5. Clinically poor restoration (insufficient/inacceptable)	F1.5 Generalized severe deficiencies, e.g. extensive delamination, multiple bulk fractures or (nearly) completely loose/lost restoration. Repair not possible/reasonable.	F2.5 Generalized and severely compromised marginal adaptation: width ≥250 µm and/or depth ≥2 mm. Complete loose/lost restoration. Repair not possible/reasonable.	F3.5 Severely weak contact point: 100 µm metal blade can easily pass through proximal contact or unintended interlocked contact point (impossible to pass). Inflammation of the gingiva/periodontium due to the proximal restoration and/or food impaction. Repair not possible/reasonable.	F4.5 Outline, contour, convexity, embrasure and/or marginal ridges are generally and severely under – or oversized in comparison to the individual, age-related and functional anatomy. Repair not possible/reasonable.	F5.5 Generalized, severe non-occlusion AND/OR extensively worn restoration. Repair not possible/reasonable.

Table 2c. Evaluation of esthetic aspects (Domain A) according to revised FDI.

DOMAIN A	A1: Surface luster & surface texture	A2: Marginal staining	A3: Color match
1. Clinically very good restoration (sufficient/ acceptable)	A1.1 Surface luster and surface texture comparable to dental hard tissue/adjacent teeth after air drying. A1.2 Slightly dull surface luster and/or surface texture with minor deviations, e.g. isolated/small marks, pores and/or voids detectable compared to dental hard tissue/adjacent teeth after air drying.	A2.1 No marginal staining detectable after air drying. A2.2 Minor marginal staining detectable after air drying.	A3.1 No deviation in shade, translucency/opacity between restoration and neighbouring dental hard tissue/adjacent teeth. A3.2 Minor deviation in shade, translucency/opacity between restoration and neighbouring dental hard tissue/adjacent teeth detectable.
3. Clinically satisfactory restoration (sufficient/acceptable)	A1.3 Dull surface luster and/or surface texture with distinct deviations, e.g. marks, pores and/or voids detectable compared to dental hard tissue/adjacent teeth detectable without air drying. Refurbishment is possible.	A2.3 Distinct marginal staining detectable without air drying but not displeasing. Refurbishment is possible.	A3.3 Distinct deviation in shade, translucency/opacity between restoration and neighbouring dental hard tissue/adjacent teeth detectable – but not displeasing.
4. Clinically unsatisfactory restoration (insufficient/inacceptable)	A1.4 Localized, displeasing dull surface luster and/or rough surface texture with substantial deviations/multiple pores/voids detectable compared to dental hard tissue/adjacent teeth which can be repaired.	A2.4 Localized, displeasing deep marginal staining. Marginal staining can be removed/improved by repair.	A3.4 Localized, displeasing deviation in shade, translucency/opacity between restoration and neighbouring dental hard tissue/adjacent teeth which can be improved by repair.
5. Clinically poor restoration (insufficient/inacceptable)	A1.5 Generalized, displeasing dull surface luster and/or rough surface texture with substantial deviations/multiple pores/voids compared to dental hard tissue/adjacent teeth. Repair not possible/reasonable.	A2.5 Generalized, displeasing deep marginal staining. Repair not possible/reasonable.	B3.5 Generalized, displeasing deviation in shade, translucency/opacity between restoration and neighbouring dental hard tissue/adjacent teeth. Repair not possible/reasonable.

3. RESULTS

35.1% of the participants were male and 64.9 % were female. 18.9 % of the restorations were on tooth #22, followed by 13.5 % and 12.2 % for teeth #11 and #21, respectively.

Significant differences were observed among the main criteria of FDI. Significantly greater scores were observed for the Esthetic criteria compared to the Functional criteria, and it was followed by the Biological criteria ($p < .001$; Table 3).

Table 3. Comparisons for the main criteria.

	Average $\pm$ S.dev	Median (min. – max.)	Test Statistics	p*
Biological	1.11 $\pm$ 0.19	1 (1 – 1.67) ^c	60.65	< .001
Functional	1.31 $\pm$ 0.33	1.2 (1 – 2.4) ^b		
Esthetic	1.46 $\pm$ 0.44	1.4 (1 – 3.48) ^a		

*Friedman Test; a-c: No difference between the main criteria with the same letter, S. dev: Standard deviation, min.-max.: minimum-maximum.

Twelve unacceptable scores out of 74 restorations were obtained, and all were observed in Class III restorations (Table 4). Six unacceptable scores were detected for form and contour criteria (Fig. 1), two were detected for surface luster and surface text criteria (Fig. 2), two were detected for marginal staining criteria, and two were detected for color match criteria (Fig. 3). However, regarding the acceptability rates, a significant difference was observed only for form and contour criteria between the Class III (85.7 %) and Class V (100 %) restorations ($p = .033$; Table 4).

Score 3 was observed 27 times in total and 26 scores were for Class III restorations while only 1 score was for Class V restorations (Table 5). Score 3 was observed 4 times for postoperative hypersensitivity and pulpal status criteria, 2 times for proximal contact point criteria, 10 times for form and contour criteria, 6 times for surface luster and surface texture criteria, 2 times for marginal staining criteria, and 3 times for color match criteria. However, significant differences were only observed for form and contour criteria ($p = .036$) and surface luster and surface texture criteria ($p = .033$).

Table 4. Comparison of restoration types regarding the criteria and acceptable and unacceptable scores.

	Restoration Type		Test Statistics	p*
	Class III	Class V		
Caries in restoration margin				
Acceptable	42 (100)	32 (100)	---	---
Inacceptable	0 (0)	0 (0)		
Dental hard tissue defects at restoration margin				
Acceptable	42 (100)	32 (100)	---	---
Inacceptable	0 (0)	0 (0)		
Postoperative hypersensitivity and pulp status				
Acceptable	42 (100)	32 (100)	---	---
Inacceptable	0 (0)	0 (0)		
Fracture of material and retention				
Acceptable	42 (100)	32 (100)	---	---
Inacceptable	0 (0)	0 (0)		
Marginal adaptation				
Acceptable	42 (100)	32 (100)	---	---
Inacceptable	0 (0)	0 (0)		
Proximal contact point				
Acceptable	41 (100)	32 (100)	---	---
Inacceptable	0 (0)	0 (0)		
Form and contour				
Acceptable	36 (85.7)	32 (100)	---	.033
Inacceptable	6 (14.3)	0 (0)		
Occlusion and wear				
Acceptable	42 (100)	32 (100)	---	---
Inacceptable	0 (0)	0 (0)		
Surface luster and surface texture				
Acceptable	40 (95.2)	32 (100)	---	.502
Inacceptable	2 (4.8)	0 (0)		
Marginal staining				
Acceptable	40 (95.2)	32 (100)	---	.502
Inacceptable	2 (4.8)	0 (0)		
Color match				
Acceptable	40 (95.2)	32 (100)	---	.502
Inacceptable	2 (4.8)	0 (0)		

*Fisher's Exact Test; Scores of 1,2, and 3 are acceptable; 4 and 5 are unacceptable according to FDI criteria.

Table 5. Comparison of restoration types regarding the criteria and score 3.

	Restoration Type		Restoration Type	p*
	Class III	Class V		
Caries in restoration margin				
Score 3	0 (0)	0 (0)	---	---
Other	42 (100)	32 (100)		
Dental hard tissue defects at restoration margin				
Score 3	0 (0)	0 (0)	---	---
Other	42 (100)	32 (100)		
Postoperative hypersensitivity and pulp status				
Score 3	4 (9.5)	0 (0)	---	.129
Other	38 (90.5)	32 (100)		
Fracture of material and retention				
Score 3	0 (0)	0 (0)	---	---
Other	42 (100)	32 (100)		
Marginal adaptation				
Score 3	0 (0)	0 (0)	---	---
Other	42 (100)	32 (100)		
Proximal contact point				
Score 3	2 (4.9)	0 (0)	---	.501
Other	39 (95.1)	32 (100)		
Form and contour				
Score 3	9 (21.4)	1 (3.1)	---	.036
Other	33 (78.6)	31 (96.9)		
Occlusion and wear				
Score 3	0 (0)	0 (0)	---	---
Other	42 (100)	32 (100)		
Surface luster and surface texture				
Score 3	6 (14.3)	0 (0)	---	.033
Other	36 (85.7)	32 (100)		
Marginal staining				
Score 3	2 (4.8)	0 (0)	---	.502
Other	40 (95.2)	32 (100)		
Color match				
Score 3	3 (7.1)	0 (0)	---	.254
Other	39 (92.9)	32 (100)		

*Fisher's Exact Test.

**Figure 1.** The mesial class III restorations scored 4 according to the form and contour criteria (lower left central and lateral)**Figure 2.** The mesial class III restoration scored 4 according to the surface luster and surface structure criteria (left upper lateral).



Figure 3. The mesial class III restoration scored 4 according to the color match criteria (right upper lateral).

4. DISCUSSION

All the hypotheses of the study were rejected. Even though all the evaluated restorations were approved by a restorative dentistry instructor, some of the restorations were considered inacceptable due to several irreversible complications at the first control appointment just one week after the restorative procedure. The inacceptable scores differed among the restoration types.

Direct resin composite restorations offer several advantages including durability, permanence, esthetics, ease of application, and a good imitation of dental tissues (12, 13). In addition, they are preferred because of their low cost, immediate aesthetic results, and shorter fabrication time since they do not require laboratory procedures (14). To ensure a high-quality composite restoration, restorative procedures play an important role besides the selected composite material. Korkut, mentioned the esthetic success and longevity of a direct anterior restoration depend on the indication and treatment planning, composite and instrument selection, shade selection, isolation, adhesion, layering procedure, finishing and polishing, and frequent recalls (2). Color mismatch, plaque retention, marginal discoloration, marginal chipping, secondary caries, gingival inflammation, and fracture of restoration were presented as the possible reasons for failure (15, 16). In this study, the most frequent reasons for failure were observed in the form and contour criteria and it was followed by the color match (Table 4) in the first recall due to several factors such as external/internal discoloration and improper composite/shade selection, layering strategy, or finishing/polishing procedures (2, 6, 7).

It is essential to use objective, reliable, repeatable, and outcome-related criteria for the clinical evaluation of the anterior composite restorations (2). Previously, several evaluation systems were used accordingly (9, 17). Recently, in 2023, Hickel et al. published the revised FDI criteria with improved clinical understanding and handling (10). The criteria are based on the evaluation of biological, esthetic, and functional parameters which can be selected or adjusted

according to the needs of the clinician. Although the United States Public Health Service (USPHS) criteria are the most frequently used method in previous clinical research for evaluating the clinical success of the restorations, the sensitivity in revealing the changes of the restoration is lower than the FDI criteria (6-8). Previous studies mentioned FDI assessments as more sensitive than even the modified USPHS criteria regarding the small changes in clinical outcomes (18) and the marginal discoloration and compatibility (19). Therefore, the latest revision of the FDI criteria was selected in the present study to evaluate the restorations, clinically. Additionally, Mesinger et al., stated that the clinicians may have some difficulties in the assessments with the revised FDI criteria due to significant differences in categories and tooth types. He suggested observer training and calibration to ensure a reliable assessment (20). In accordance with that statement in the present study, the restorations were carried out by two different restorative dentistry specialist instructors with the same level of clinical experience (at least 3 years) under the same conditions, to minimize the operator-related variability.

Twelve inacceptable scores out of 74 restorations were observed at the first control appointment in this study. Therefore, the first hypothesis of the study was rejected. A systematic review in 2021 by Shah et al., and a recent one in 2023 by Demarco et al., reported that the primary reasons for failure in anterior restorations are related to the restoration fractures and esthetic appearance (21). The mid-term clinical reports of Korkut and Türkmen, and Korkut et al. mentioned that the unacceptable esthetic and anatomical form is the most common reason for the failure of the anterior composite restorations clinically (4, 6, 8). Consistent with that, the failure rate in this very short-term clinical follow-up study for the Esthetic criteria was significantly higher compared to the Functional and Biological criteria ($p < 0.001$; Table 3), and the failures were mostly observed for the form and contour criteria with 6 inacceptable scores (Table 4). Thus, the second hypothesis of the study was rejected. According to our results, a control appointment shortly after the restorative procedure is needed to check the form and contour.

On the other hand, Freitas et al. evaluated direct anterior restorations in recent clinical research according to the FDI criteria and stated that the most frequent complication was related to the color which was followed by anatomical form, and fracture of restoration (22). Liu et al. and Demarco et al. mentioned that the type of organic matrix and inorganic filler particle sizes and quantity influence the surface structure and mechanical and optical properties of resin composites (4, 23). In the present study, a simplyshade nano-ceramic composite with an inorganic filler size of 1.1-1.5 μm (76% in weight) was used for all the restorations. Only two inacceptable scores were observed in color match criteria with no significant difference ($p \geq 0.05$) at the control appointment (Table 4). This might be related to the high color adjustment potential of the selected simplyshade composite which also minimizes the shade selection mistakes (24, 25). The selection of the composite shade always in the first 3

minutes and the incremental layering under the control of an experienced instructor to avoid dehydration, may also be the reason for this result, even though the restorations were performed by the senior students (26, 27). Therefore, it can be interpreted that, depending on the experience of the clinician and the color adjustment potential of the resin composite, a higher failure rate in shade matching may be expected at the control appointment. Moreover, the level of polymerization as well as the rehydration affects the level of color match, especially for partial direct restorations (7, 28). Accordingly, the color adjustment cannot be evaluated immediately after the restorative procedure, precisely and an additional appointment is mandatory in this regard (2, 28). There is evidence that color training for the clinician may also have a positive effect on restoration shade matching in clinical practice (29).

All the unacceptable scores were observed for the Class III restorations in this study, while no failures were observed for the Class V restorations at the first control (Table 4). Therefore, the third hypothesis of the study was rejected. Regarding the comparisons between the restoration types, a greater risk for failure was mentioned previously for the larger restorations with less surrounding dental tissue (2, 6, 7). At the university student clinics, Class III restoration cases of the senior dentistry students usually have cavities lacking one or two marginal enamel wall loss, compared to Class V. Class III restorations also present additional challenges, including the need to mask the cavity line, management of contact points, and achieve color harmony. This might be the reason for the observed significant difference between class III and V restoration types in the form and contour criteria in the present study ($p=0.033$; Table 4). Also, the absence of rubber-dam isolation might be another reason for the higher unacceptable scores of Class V restorations (30). In this clinical study, rubber dam isolation was not utilized, as this is a standard procedure in the student's clinic. Although the two restoration types were considered statistically similar for all the criteria other than form and contour, Class III restorations also obtained unacceptable scores for surface luster and surface texture, marginal staining, and color match. It is important to remember that Class III and Class V restorations have different regional requirements in terms of contouring and polishing, supporting the previous report of Vargas et al. (28). As a result, Class III restorations might be considered riskier in terms of possible failures at the first control, and it might be advantageous for clinicians to be aware of that.

This study also assessed the score 3, to evaluate the potential failure risk for the restorations in the future. Accordingly, score 3 was observed in some restorations for postoperative hypersensitivity and pulp status, proximal contact point, form and contour, surface luster and surface texture, marginal staining, and color match criteria. Class III restorations were significantly less acceptable than the Class V restorations regarding form and contour criteria ($p=0.036$) and for surface luster and surface texture criteria ($p=0.033$) (Table 5). However, the clinical situation of some criteria such as fractures, external discoloration, or wear could not

be identified due to the very short period of evaluation. The possibility of encountering failures in such criteria gets higher in long-term evaluations (3, 21, 29, 31).

No remaining caries were detected at the margin of the restorations in the present study. Other than the control of the restorative dentistry instructor during the restorative process, the intensive preclinical training in the 1st and 2nd grades and then the clinical experience since the 3rd grade probably played an important role in the obtained 83.8% overall success rate of the students at one week control. This education strategy is very intensive and relatively different compared to many other European countries. Accordingly, Velayo et al., showed that preclinical performance was positively associated with clinical success (32).

This study is limited by the fact that although there was an 80% high positive correlation, the evaluations of the two instructors may have differed, and the students may have exhibited individual differences in education and skills, despite being at the same level of education. The findings of this very short-term clinical follow-up study revealed the importance of the control appointment shortly after the direct restorative procedure of anterior teeth, clinically. There is a lack of evidence in the literature regarding this. Whereas the restoration types were limited in this study, and it might be better to expand the anterior restoration types and the posterior restorations with an increased number, for further studies. Additionally, patient-related risks should be considered when evaluating composite restorations, clinically (33-35).

5. CONCLUSION

Even though the single-visit anterior composite restorations were approved by an experienced restorative dentistry instructor, various irreversible complications were observed at the first recall appointment. Following the restorative procedure, the arrangement of a control appointment shortly is considered mandatory to re-evaluate the restoration and thereby avoid possible complications. The highest risk for failure was detected for the Esthetic criteria and followed by Functional and Biological criteria, respectively. Class III restorations are considered more prone to form and contour failures compared to Class V restorations.

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Acquisition of data for the study: BDK, EKÖ, EA

Analysis of data for the study: BK, BDK, PYA

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