Patient Perceptions in Shade Matching for Fixed Anterior Restorations: A Survey-Based Study

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Conflicts of Interest: Nil

ABSTRACT

Background

Achieving an accurate shade match is crucial for esthetic success in fixed dental restorations. Patient satisfaction is closely linked to how well the restoration mimics the natural dentition in terms of shade, comfort, and appearance.

Aim

To assess patient satisfaction with shade matching in fixed anterior restorations and evaluate their involvement in the shade selection process.

Materials and Methods

A cross-sectional questionnaire-based survey was conducted among 24 patients who received either PFM or zirconia anterior restorations. The questionnaire included 26 closed-ended questions covering demographics, perception of shade matching, technical quality, decision-making involvement, and overall satisfaction. Data were analyzed using descriptive statistics.

Results

All participants expressed satisfaction with their restorations. A majority (100%) felt involved in the shade selection process and received adequate information from the dentist. Regarding esthetics, 45.8% were very satisfied and 54.2% satisfied with the color match. Hue and chroma were well matched in over 87% of cases, while value showed slightly more variability. Overall, 62.5% were very satisfied and 37.5% satisfied with their restoration.

Conclusion

Patient satisfaction in shade matching was high, especially when patients were engaged in the selection process. Effective communication and shared decision-making significantly contributed to positive esthetic outcomes.

Keywords

Shade matching, Patient satisfaction, Fixed dental restorations, Esthetic dentistry

INTRODUCTION

Achieving accurate shade matching in fixed dental restorations is a fundamental component of aesthetic dentistry, directly impacting both clinical success and patient satisfaction. As the demand for natural-looking restorations increases, patients have become more discerning in their expectations regarding the colour, translucency, and overall harmony of their dental prostheses with adjacent teeth. In this context, patient satisfaction has emerged as a critical measure of treatment success, especially in anterior restorations where aesthetics are paramount [1]

Shade selection is inherently subjective and influenced by several variables, including lighting conditions, the clinician's expertise, and the patient's perception. The use of standardized lighting such as the D65 light source—recommended by ISO 7491:2019—aims to minimize errors due to environmental lighting variability. However, despite technological advances such as spectrophotometers and digital imaging systems, visual shade selection remains widely practiced, often relying on the clinician's experience and communication skills[2].

Importantly, discrepancies between clinician and patient perceptions of shade matching are not uncommon. Studies have shown that involving patients in the decision-making process regarding shade selection significantly increases their satisfaction levels[3]. Moreover, the type of restorative material—such as porcelain-fused-to-metal (PFM) versus zirconia—can influence the final aesthetic outcome, as each material reflects and transmits light differently, affecting colour perception[4].

Aesthetic outcomes are not only based on technical precision but also on the psychological satisfaction of the patient. Factors such as gender, age, and prior dental experiences can shape how patients perceive the outcome of restorative procedures[5]. As such, it becomes essential to assess patient-reported outcomes to ensure holistic success in restorative dentistry.

Despite the growing body of literature on aesthetic dentistry, there remains a relative paucity of studies focusing specifically on patient satisfaction related to shade matching in fixed restorations. This study aims to bridge this gap by surveying patients who received PFM or zirconia anterior restorations. The objective is to assess their satisfaction, involvement in shade selection, and identify potential areas for improvement in clinical communication and restorative protocols.

By exploring patient perceptions in real clinical settings, this survey intends to provide valuable insights for dental practitioners aiming to optimize aesthetic outcomes and improve patient-centered care.

MATERIALS AND METHODS

This descriptive, cross-sectional questionnaire-based study was conducted to assess patient satisfaction with shade matching in fixed anterior restorations. A total of 24 patients who had received fixed anterior restorations using either porcelain-fused-to-metal (PFM) or zirconia crowns were included. The sample size was calculated using G*Power software, ensuring adequate power for statistical analysis. Patients aged between 18 and 50 years, of both sexes, who had

received fixed partial dentures (FPDs) in the anterior region were considered eligible for inclusion. All participants had completed their dental treatment in a clinical setting and provided written informed consent prior to participation.

A structured questionnaire consisting of 26 closed-ended questions was developed to gather data on various aspects of patient satisfaction. The questionnaire was divided into five domains: demographic information, perception of shade matching, technical quality assessment, involvement in decision-making, and overall satisfaction. The demographic section included age, gender, and type of restoration. Perception of shade matching covered elements such as color match, brightness, hue, and the natural appearance of the prosthesis. The technical quality domain assessed aesthetic attributes like symmetry, surface texture, and appearance under different lighting conditions. The involvement in decision-making domain explored whether patients were included in the shade selection process and were adequately informed by the clinician. The final section on overall satisfaction evaluated the general patient experience and contentment with the final restoration. Each question was rated using a 5-point Likert scale, ranging from 1 (strongly dissatisfied) to 5 (strongly satisfied).

The questionnaire underwent content validation by two independent researchers with experience in prosthodontics and questionnaire design. To ensure the reliability of the tool, inter-rater agreement was calculated using Cohen's Kappa statistic, and a Kappa value of 0.85 indicated a high level of agreement between the reviewers. The finalized questionnaire was provided to participants in physical (paper-based) format.

Data were collected in person during routine follow-up visits after the completion of the restorative treatment. All responses were manually recorded and compiled in Microsoft Excel. Descriptive statistical analysis, including frequency and percentage distribution, was performed to evaluate the responses across the various domains of the questionnaire.

RESULTS

A total of 24 patients participated in the study. Among them, 54.2% were female (n = 13), 41.7% were male (n = 10). In terms of age distribution, half of the participants (50%) were between 26 and 35 years of age, 25% were between 18 and 25 years, 16.7% fell within the 46 to 50 years range, and 8.3% were aged between 36 and 45 years.(image 1)

Out of 24 participants, 11 (45.8%) were very satisfied and 13 (54.2%) satisfied with the color match of their restoration. For communication during shade selection, 7 (29.2%) were very satisfied and 17 (70.8%) satisfied. Comfort was rated very satisfactory by 10 (41.7%) and satisfactory by 13 (54.2%). Overall satisfaction was reported by 15 (62.5%) as very satisfied and 9 (37.5%) as satisfied. In terms of durability, 8 (33.3%) were very satisfied and 16 (66.7%) satisfied. Appearance was positively rated by 9 (37.5%) as very satisfied and 15 (62.5%) as satisfied.(image 2)

Half of the participants (n = 12, 50%) strongly agreed and the other half (n = 12, 50%) agreed that their opinion was valued during the shade-matching process. When asked whether the shade of their restoration matched their expectations based on the information and samples provided, 10 (41.7%) strongly agreed and 14 (58.3%) agreed. Similarly, 11 participants (45.8%) strongly agreed and 13 (54.2%)

agreed that the final shade looked as natural as expected.

Twelve participants (50%) strongly agreed and 12 (50%) agreed that they were shown different shade options before final selection. Regarding the adequacy of information provided by the dentist for informed decision-making, 11 (45.8%) strongly agreed while 13 (54.2%) agreed. A majority also felt comfortable expressing their shade preferences, with 10 (41.7%) strongly agreeing and 14 (58.3%) agreeing. Finally, 13 (54.2%) strongly agreed and 11 (45.8%) agreed that the shade of the final restoration met their expectations.(image 3)

When asked whether they would recommend their dentist based on their satisfaction with shade matching, 17 participants (70.8%) responded "Definitely" and 7 (29.2%) answered "Probably." Regarding explanation of the shade matching process, 11 participants (45.8%) reported receiving a detailed explanation, while 13 (54.2%) received only a brief explanation.

In terms of involvement, 5 participants (20.8%) felt *very involved*, 16 (66.7%) reported being *involved*, and 3 (12.5%) were *neutral*. When specifically asked if they were involved in the shade selection process, 20 participants (83.3%) said "Yes" and 4 (16.7%) said "No."

As for the importance of shade matching in their final restoration decision, 13 participants (54.2%) considered it *very important*, 7 (29.2%) *important*, and 4 (16.7%) were *neutral*.(Table 1)

When evaluating how closely the shade of dental restorations matched natural teeth across different dimensions, 50% of participants (n = 12) rated the hue (color) as *perfectly matched*, while the remaining 50% (n = 12) considered it *well matched*. Regarding value

(lightness/darkness), 8 participants (33.3%) reported a *perfect match*, 12 (50%) noted it as *well matched*, and 4 (16.7%) as *moderately matched*. For chroma (color intensity), 9 participants (37.5%) rated it as *perfectly matched*, 12 (50%) as *well matched*, and 3 (12.5%) as *moderately matched*. These findings suggest generally favorable matching results across all three dimensions, with the highest consistency observed in hue.(Image 4)

DISCUSSION

In the present survey, patient-reported satisfaction with shade matching in PFM and zirconia restorations was notably high. All participants reported either being *very satisfied* or *satisfied*, particularly in terms of color match (100% satisfaction), comfort (96%), durability (100%), and overall appearance (100%). These results align with findings from Alegzabi et al. (2022), which demonstrated that active patient participation in shade selection is associated with an 87.8% satisfaction rate—similar to the 100% satisfaction observed in our sample[3]. Comparative studies have frequently noted discrepancies between patient and clinician perceptions. Okubo et al[6] found that patients consistently rated the shade of their PFM crowns higher than clinicians did, a phenomenon also reflected in our study, where all patients expressed satisfaction regardless of objective technical outcomes.

Furthermore, spectrophotometric comparisons indicate that while zirconia restorations may measure higher ΔE values than PFM restorations—suggesting greater deviation from natural tooth color—patients often do not perceive these discrepancies, remaining satisfied with esthetic results[7].

Aesthetic professionals recognize the complexity of shade matching due to optical variables such as hue,

value, and chroma. In this study, 100% of participants rated hue as either well- or perfectly matched; for value and chroma, more nuanced distribution was observed—16.7% considered value only moderately matched and 12.5% felt the same for chroma. These findings align with literature emphasizing that while hue often aligns visually, variations in value (lightness) and chroma (intensity) can be more challenging to replicate, particularly with zirconia-based materials [8].

Several limitations warrant consideration. First, the sample size was modest (n=24), limiting the generalizability of our findings. Second, the cross-sectional design captures patient perceptions at a single point in time, not accounting for potential changes over the lifespan of the restoration. Third, technical accuracy such as color difference (ΔE) was not objectively measured; patient perceptions were subjective and may not correlate with spectrophotometric readings. Lastly, the survey participants were limited to those attending the same institution, which may introduce selection bias.

Future research should incorporate objective colorimetric analyses alongside subjective surveys to correlate technical accuracy with patient perceptions. A larger, multicenter study involving diverse patient demographics and restoration types (e.g., implant-supported crowns) could provide more robust data. Longitudinal studies are also needed to track satisfaction trends over time. Finally, intervention-based studies examining clinician-led training on communication strategies and technology use (such as spectrophotometers) could inform best practices in reducing ΔE values and enhancing patient–clinician alignment during shade selection.

CONCLUSION

The study revealed high patient satisfaction with shade matching in fixed restorations, especially when patients were actively involved in the selection process. Effective communication and consideration of patient preferences played a key role in achieving esthetic outcomes that met expectations.

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| Questions :	Responses n(%)		
Would you recommend your dentist based on your satisfaction with the shade matching?	Definitely 17(70.8%	Probably 7(29.2%)	
Did the dentist explain the shade matching process to you?	Yes, in detail 11(45.8%	Yes, but briefly 13(54.2%)	
If yes, how would you rate your involvement in the shade selection process?	Very involved 5(20.8%)	Involved 16(66.7%)	Neutral 3(12.5%)
Were you involved in the shade selection process for your restoration?	Yes 20(83.3%)	No (16.7%)	
How important was the shade matching to you when considering the final restoration?	Very Important 13(54.2%)	Important 7(29.2%)	Neutral 4(16.7%)

Image 1 : Age distribution of study participants
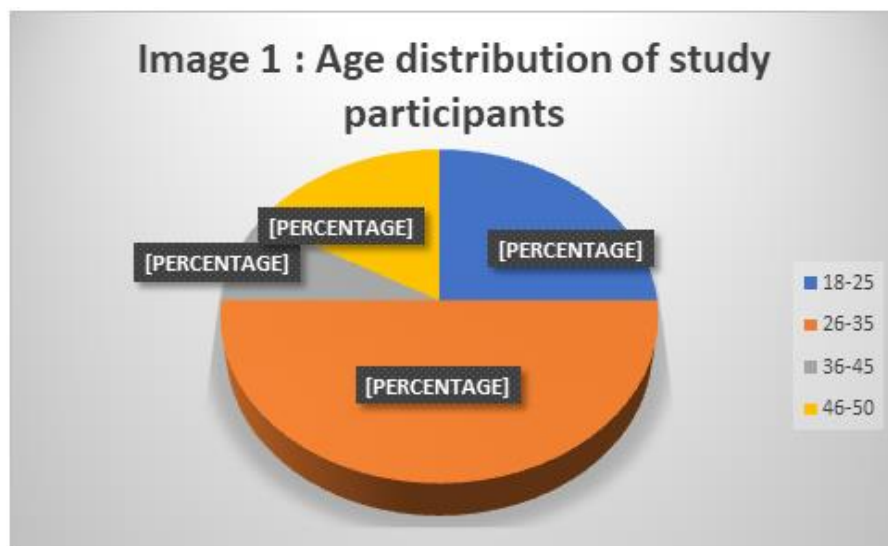
Image 2: Satisfaction question are about fixed dental restoration
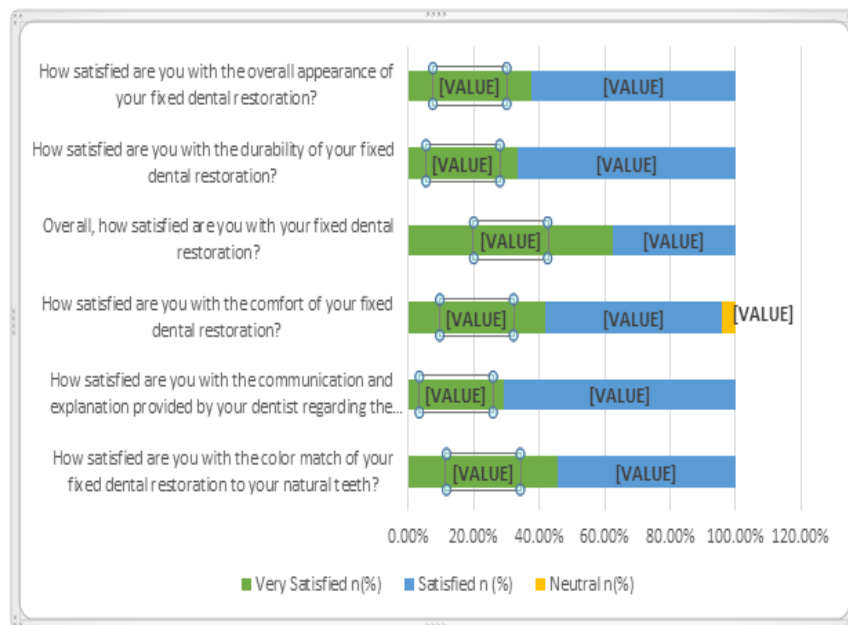

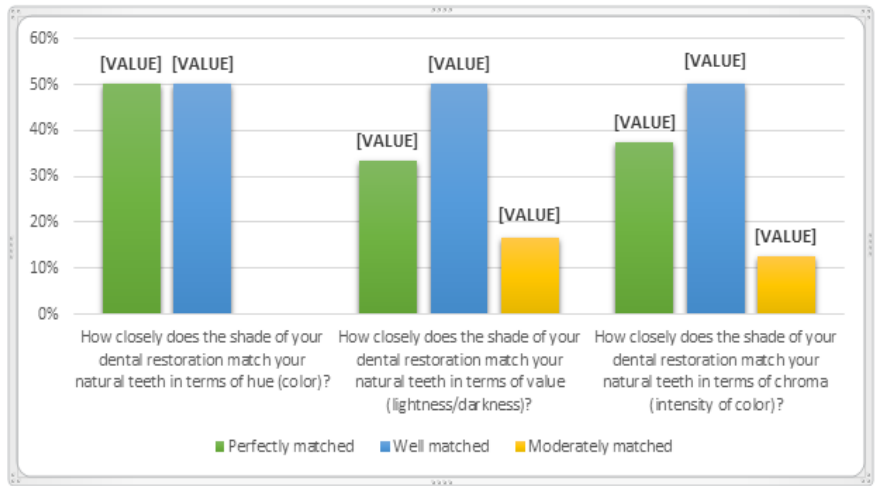**Image 3: Shade Selection questionnaire**
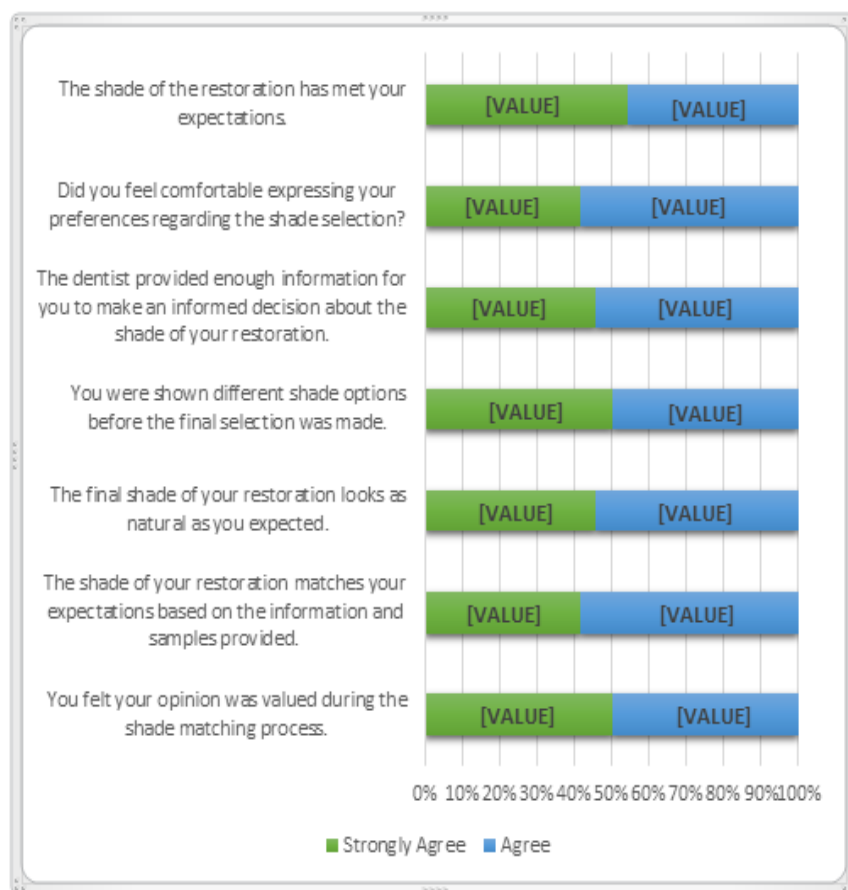
Image 4: Shade matching Selection of Study Participants

List of Abbreviations:

Abbreviation	Definition
PFM	Porcelain Fused Metal

Role	Contributor 1	Contributor 2	Contributor 2
Concepts, Design, Definition of intellectual content, investigation, manuscript writing, etc	√	√	√
Concepts, Design, Definition of intellectual content, investigation, manuscript writing, etc	√	√	√

Ethical policy and Institutional Review board statement: -

Patient declaration of consent statement: Informed consent was obtained from all individual participants included in the study.

Data Availability statement: The data set used in the current study is available (tick the appropriate option and fill the information)

❑ repository name

❑ name of the public domain resources

_____

❑ data availability within the article or its supplementary materials

_____

√available on request from (contact name/email id)

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❑ dataset can be made available after embargo period due to commercial restrictions

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Reporting guidelines:

Fill the relevant checklist (Original research articles – STROBE or Randomised trials – CONSORT) given below :

Reporting guidelines for Original Research Articles (Case control, Cohort and Cross-sectional studies): STROBE (2007).

	Item No	Recommendation	Yes/ No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Yes
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found. Structured abstract: Aims & Objectives, Materials & Methods, Results, Conclusion Format to be consistent	Yes
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Yes
Objectives	3a	State specific objectives, including any prespecified hypotheses. The research objective should not be biased.	Yes
	3b	Statements to be appropriately cited	Yes
Methods – Structured methods section (with subheadings) is preferred			
Study design	4a	Present key elements of study design early in the paper (cross sectional/ cohort/ case-control)	Yes
	4b	Is the study design robust and well-justified?	Yes
Setting	5a	Describe the setting, locations, and relevant dates, including	Yes

		periods of recruitment, exposure, follow-up, and data collection	
	5b #	Mention the details of the Supplier/manufacturer of the equipment/ materials (E.g. Chemicals) used in the study	na
	5c #	Mention the details of the drugs (manufacturer, dosage, dilution, frequency and route of administration, monitoring equipment) used in the study	na
	5d #	Mention the details about the cell lines (names and where it was obtained from)	Yes
	5e #	Mention the details of plant sample collection (Location, time period, validation of the specimen, Institution where the specimen is submitted and the voucher specimen number)	na
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria (Inclusion/ exclusion), and the sources and methods of selection of participants. Describe methods of follow-up	-
		Case-control study—Give the eligibility criteria (Inclusion/ exclusion), and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	-
		Cross-sectional study—Give the eligibility criteria (Inclusion/ exclusion), and the sources and methods of selection of participants	Yes
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed	-
		Case-control study—For matched studies, give matching criteria and the number of controls per case	-
Variables	7a	Clearly define all outcomes (primary and secondary), exposures, predictors, potential confounders, and effect modifiers.	Yes
	7b	Give diagnostic criteria, if applicable	Yes
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes
Bias	9	Describe any efforts to address potential sources of bias	-

Study size	10	Explain how the study size (sample size) was arrived at	Yes
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes
Statistical methods **(a separate heading needed)**	12	(*a*) Describe all statistical methods, including those used to control for confounding	Yes
		(*b*) Describe any methods used to examine subgroups and interactions	na
		(*c*) Explain how missing data were addressed	na
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	na
		(*e*) Describe any sensitivity analyses	na
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yes
		(b) Give reasons for non-participation at each stage	Na
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes
		(b) Indicate number of participants with missing data for each variable of interest	-
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	na
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	Na
		Case-control study—Report numbers in each exposure	Na

		category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	Yes
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Yes
		(*b*) Report category boundaries when continuous variables were categorized	Yes
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Na
Presentation	18a	Tables and graphs properly depicted with no repetition of the data in the text	Yes
	18b	Annotation/ footnotes to be mentioned appropriately	Yes
	18c	Abbreviations to be defined in the footnotes	
Discussion			
Key results	19	Summarise key results with reference to study objectives	Yes
Limitations	20	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes
Interpretation	21	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes
Generalisability	22	Discuss the generalisability (external validity) of the study results	Yes
Citations	23a	The statements should be adequately cited	Yes
	23b	Recent citations (last 5 years) to be cited in a greater proportion	Yes
Other information			

Funding	24a	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Yes
	24b	Mention the Grant Number	-
Ethical approval and Patient Consent	25a	Mention the IRB approval and the approval number (For animal and human subjects)	-
	25b	Mention if the study has been conducted in accordance with the ethical principles mentioned in the Declaration of Helsinski (2013)	Yes
	25c	Mention if the patients have consented to participate in the study. To mention if consent has been waived/ exempted by IRB	Yes
Conflict of Interest	26	Mention the financial, commercial, legal, or professional relationship of the author (or the author's employer) with sponsors/ organizations that could potentially influence the research.	Yes
Language	27	The language should be understandable without grammatical errors that hinders the readability	Yes