

Supplementary Appendix 1

Participant Information

Dear Participant,

You are invited to participate in the academic study entitled “Evaluation of Orthodontists’ Approaches to Tooth Extraction.” Participation in this study is entirely voluntary. You have the right not to participate in the study or to withdraw from the study at any time after participation. The personal data obtained through this survey will be kept strictly confidential and will be used only for research purposes. You will not receive any payment for participating in this study, and no payment will be requested from you.

The aim of this study is to evaluate orthodontists’ decisions regarding tooth extraction. The survey you will complete consists of 29 questions.

We sincerely thank you for taking the time to participate and for supporting our study.

Respectfully

By continuing to the survey, you confirm that you have read and understood the information above and voluntarily agree to participate.

Consent

Question 1

I voluntarily agree to participate in this survey study.

Select one option only.

☐ I agree.

Demographic and Clinical Practice Characteristics

Question 2

What is your age?

Select one option only.

☐ 26-32

☐ 33-37

☐ 38-48

☐ 48 or older

Question 3

What is your sex?

Select one option only.

☐ Female

☐ Male

Question 4

What is your work setting?

Select one option only.

- ☐ Private practice
- ☐ University
- ☐ Public hospital

Question 5

How many years have you been practicing as an orthodontist?

Select one option only.

- ☐ 0-5
- ☐ 6-10
- ☐ 11-20
- ☐ More than 20

Question 6

On average, how many patients do you treat per week?

Select one option only.

- ☐ 0-40
- ☐ 41-100
- ☐ 101 or more

Question 7

In what percentage of your patients do you use fixed buccal appliances?

Select one option only.

- ☐ 0%
- ☐ 1-25%
- ☐ 26-50%
- ☐ 51-75%
- ☐ 76-99%
- ☐ 100%

Question 8

In what percentage of your patients do you use fixed lingual appliances?

Select one option only.

- ☐ 0%
- ☐ 1-25%
- ☐ 26-50%
- ☐ 51-75%
- ☐ 76-99%
- ☐ 100%

Question 9

In what percentage of your patients do you use clear aligners?

Select one option only.

- ☐ 0%
- ☐ 1-25%
- ☐ 26-50%
- ☐ 51-75%
- ☐ 76-99%
- ☐ 100%

Question 10

How frequently do you use extraction treatment in your clinical practice?

Select one option only.

- ☐ 0%
- ☐ 1-25%
- ☐ 26-50%
- ☐ 51-75%
- ☐ 76-99%
- ☐ 100%

Question 11

Which tooth do you most commonly select for extraction in the maxillary arch during orthodontic treatment?

Select one option only.

- ☐ Central incisor
- ☐ Lateral incisor
- ☐ Canine
- ☐ First premolar
- ☐ Second premolar
- ☐ First molar
- ☐ Second molar
- ☐ Third molar
- ☐ I treat without extraction

Question 12

Which tooth do you most commonly select for extraction in the mandibular arch during orthodontic treatment?

Select one option only.

- ☐ Central incisor
- ☐ Lateral incisor
- ☐ Canine
- ☐ First premolar
- ☐ Second premolar
- ☐ First molar
- ☐ Second molar

- ☐ Third molar
☐ I treat without extraction

Question 13

Please rate the influence of the following factors on your orthodontic treatment-planning decisions.

0 indicates "not influential at all," and 5 indicates "extremely influential." Select only one column for each row.

Factor	0	1	2	3	4	5
Midline	☐	☐	☐	☐	☐	☐
Profile	☐	☐	☐	☐	☐	☐
Upper lip	☐	☐	☐	☐	☐	☐
Lower lip	☐	☐	☐	☐	☐	☐
Gingival levels	☐	☐	☐	☐	☐	☐
Crown morphology/size	☐	☐	☐	☐	☐	☐
Enamel defects	☐	☐	☐	☐	☐	☐
Stable treatment outcome	☐	☐	☐	☐	☐	☐

Question 14

For patients planned for non-extraction treatment, how frequently do you use the following methods to manage arch-length discrepancy?

0 indicates "never use," and 5 indicates "always use." Select only one column for each row.

Method	0	1	2	3	4	5
Distalization	☐	☐	☐	☐	☐	☐
Expansion	☐	☐	☐	☐	☐	☐
Interproximal reduction (IPR)	☐	☐	☐	☐	☐	☐
Proclination	☐	☐	☐	☐	☐	☐

Case Evaluation Section

From this section onward, you will be asked to evaluate different intraoral photographs of a patient with the same silhouette, panoramic radiograph, and lateral cephalometric information, and to indicate your treatment plan.

Case 1

The cephalometric values are as follows: SNA: 80.7°, SNB: 78.1°, ANB: 2.6°. Wits appraisal: -1 mm. GoGn-SN: 32°, FMA: 28.8°, and the sum of posterior angles, including saddle angle, gonial angle, and articular angle, is 397°. U1-SN: 109.6°, U1-FH: 120.3°, and IMPA: 90.7°.

The maxillary midline is positioned 3 mm to the right of the facial midline.

The mandibular midline is coincident with the facial midline and corresponds to the mesial surface of tooth 41.

Maxillary crowding is 7 mm, and mandibular crowding is 7.5 mm.



Diagnostic records common to all case scenarios: silhouette, panoramic radiograph, and lateral cephalometric radiograph.



Case 1 intraoral photographs.



Case 1 occlusal photographs showing maxillary and mandibular crowding.

0 indicates "never use," and 5 indicates "always use." Select only one column for each row.

[illegible]

Question 19

How influential were the following factors in your treatment planning for this case?

0 indicates "not influential at all," and 5 indicates "extremely influential." Select only one column for each row.

Factor	0	1	2	3	4	5
Midline	☐	☐	☐	☐	☐	☐
Profile	☐	☐	☐	☐	☐	☐
Upper lip	☐	☐	☐	☐	☐	☐
Lower lip	☐	☐	☐	☐	☐	☐
Gingival levels	☐	☐	☐	☐	☐	☐
Crown morphology/size	☐	☐	☐	☐	☐	☐
Enamel defects	☐	☐	☐	☐	☐	☐
Stable treatment outcome	☐	☐	☐	☐	☐	☐

Case 2

For a patient with the same silhouette, panoramic radiograph, and lateral cephalometric information as in Case 1, you will be asked to evaluate different intraoral photographs and indicate your treatment preference.

The cephalometric values are as follows: SNA: 80.7°, SNB: 78.1°, ANB: 2.6°. Wits appraisal: -1 mm. GoGn-SN: 32°, FMA: 28.8°, and the sum of posterior angles, including saddle angle, gonial angle, and articular angle, is 397°. U1-SN: 109.6°, U1-FH: 120.3°, and IMPA: 90.7°.

The maxillary midline is positioned 3 mm to the right of the facial midline.

The mandibular midline is coincident with the facial midline and corresponds to the mesial surface of tooth 41.

Maxillary crowding is 7 mm, and mandibular crowding is 7.5 mm.



Case 2 intraoral photographs.

Case 2: How likely would you be to use each of the following treatment modalities for this case?

[illegible]

Would you treat this case with extraction?

☐ Yes

☐ No

☐ Undecided

In your primary treatment plan, which tooth would you consider extracting?

[illegible]

In your non-extraction treatment plan, how would you manage the arch-length discrepancy?

[illegible]

Question 24

How influential were the following factors in your treatment planning for this case?

0 indicates "not influential at all," and 5 indicates "extremely influential." Select only one column for each row.

Factor	0	1	2	3	4	5
Midline	☐	☐	☐	☐	☐	☐
Profile	☐	☐	☐	☐	☐	☐
Upper lip	☐	☐	☐	☐	☐	☐
Lower lip	☐	☐	☐	☐	☐	☐
Gingival levels	☐	☐	☐	☐	☐	☐
Crown morphology/size	☐	☐	☐	☐	☐	☐
Enamel defects	☐	☐	☐	☐	☐	☐
Stable treatment outcome	☐	☐	☐	☐	☐	☐

Case 3

For a patient with the same silhouette, panoramic radiograph, and lateral cephalometric information as in Case 1, you will be asked to evaluate different intraoral photographs and indicate your treatment preference.

The cephalometric values are as follows: SNA: 80.7°, SNB: 78.1°, ANB: 2.6°. Wits appraisal: -1 mm. GoGn-SN: 32°, FMA: 28.8°, and the sum of posterior angles, including saddle angle, gonial angle, and articular angle, is 397°. U1-SN: 109.6°, U1-FH: 120.3°, and IMPA: 90.7°.

The maxillary midline is positioned 3 mm to the right of the facial midline.

The mandibular midline is coincident with the facial midline and corresponds to the mesial surface of tooth 41.

Maxillary crowding is 7 mm, and mandibular crowding is 7.5 mm.



Case 3 intraoral photographs.

Case 3: How likely would you be to use each of the following treatment modalities for this case?

[illegible]

Would you treat this case with extraction?

☐ Yes

☐ No

☐ Undecided

In your primary treatment plan, which tooth would you consider extracting?

[illegible]

In your non-extraction treatment plan, how would you manage the arch-length discrepancy?

[illegible]

Question 29

How influential were the following factors in your treatment planning for this case?

0 indicates "not influential at all," and 5 indicates "extremely influential." Select only one column for each row.

Factor	0	1	2	3	4	5
Midline	☐	☐	☐	☐	☐	☐
Profile	☐	☐	☐	☐	☐	☐
Upper lip	☐	☐	☐	☐	☐	☐
Lower lip	☐	☐	☐	☐	☐	☐
Gingival levels	☐	☐	☐	☐	☐	☐
Crown morphology/size	☐	☐	☐	☐	☐	☐
Enamel defects	☐	☐	☐	☐	☐	☐
Stable treatment outcome	☐	☐	☐	☐	☐	☐

STROBE checklist for the cross-sectional survey

Section/topic	Item	Recommendation	Reported information in this study	Location
Title and abstract	1(a)	Indicate the study design with a commonly used term in the title or abstract.	The title identifies the study as a cross-sectional survey; the structured abstract describes the closed web-based survey design.	Title; Abstract
Title and abstract	1(b)	Provide an informative and balanced summary of what was done and what was found.	The structured abstract summarizes the objectives, methods, principal findings, conclusions, and clinical relevance.	Abstract
Introduction	2	Explain the scientific background and rationale for the investigation.	The background addresses extraction versus non-extraction planning, extraction-tooth selection, borderline cases, appliance preference, localized intraoral characteristics, and use of digitally modified images.	Introduction
Introduction	3	State specific objectives, including any prespecified hypotheses.	Primary and secondary aims and the prespecified hypotheses are stated.	Introduction
Methods	4	Present key elements of study design early in the paper.	The cross-sectional survey design is stated at the beginning of the Methods.	Methods: Study design and participants
Methods	5	Describe the setting, locations, and relevant dates.	Participants were recruited through a national orthodontic association; the survey was distributed April 14, 2025, a reminder was sent June 10, 2025, and data collection remained open until April 2026.	Methods: Study design and participants
Methods	6(a)	Give eligibility criteria and sources/methods of participant selection.	Registered orthodontists were invited through the association mailing system; access was restricted to the closed survey.	Methods: Study design and participants
Methods	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers.	Extraction decision, tooth-selection outcomes, feature-consistent selection, appliance-preference scores, planning-factor ratings, general practice variables, and demographic/practice covariates are defined.	Methods
Methods	8	For each variable of interest, give sources of data and details of methods of assessment.	The Google Forms questionnaire, general practice questions, 0-5 rating scales, case-based assessments, tooth-selection items, non-extraction strategies, and image preparation are described.	Methods; Supplementary Appendix 1

Section/topic	Item	Recommendation	Reported information in this study	Location
Methods	9	Describe efforts to address potential sources of bias.	The survey was closed, submissions were limited to one per account, the non-intraoral diagnostic background was held constant across cases, images were digitally standardized, partial disclosure was used to avoid revealing the hypothesis, and wording was reviewed to reduce leading language. Fixed case order and response-rate limitations are acknowledged.	Methods; Discussion
Methods	10	Explain how the study size was arrived at.	The study used the available respondent sample obtained during the survey period. Association records listed 2401 members, but a formal response rate could not be calculated because delivery/opening data were unavailable.	Methods; Study design and participants
Methods	11	Explain how quantitative variables were handled in the analyses.	Ordinal and Likert-type variables were summarized descriptively; appliance-use percentage categories were recoded to 0-5 use-intensity scores; binary outcomes were defined for repeated and regression analyses.	Methods; Statistical analysis
Methods	12(a)	Describe all statistical methods, including those used to control for confounding.	Cochran Q and McNemar tests, Spearman correlations, Benjamini-Hochberg correction, and GEE logistic regression with robust sandwich standard errors are described; models used clinically motivated covariate adjustment.	Methods; Statistical analysis
Methods	12(b)	Describe any methods used to examine subgroups and interactions.	A prespecified arch-by-case interaction was evaluated; subgroup analyses were treated as secondary or exploratory and are reported in the supplementary material.	Methods; Statistical analysis; Results; Supplementary Tables
Methods	12(c)	Explain how missing data were addressed.	Missing responses were assessed before analysis; available data were used for each relevant variable, and model-specific complete-case counts are reported where applicable.	Methods; Table notes; Supplementary Tables
Methods	12(d)	Describe analytical methods taking account of sampling strategy, if applicable.	No sampling weights were applied. Recruitment through the closed association mailing system and the inability to calculate a formal response rate are reported.	Methods; Discussion
Methods	12(e)	Describe any sensitivity analyses.	Sensitivity analyses recoded undecided responses alternatively as extraction or non-extraction; alternative adjustment using age or orthodontic experience was also examined.	Methods; Statistical analysis; Results
Results	13(a)	Report numbers of individuals at each stage of study.	The approximate sampling frame of 2401 registered members and the final sample of 138 orthodontists are reported; a formal response rate was not calculable.	Methods; Results
Results	13(b)	Give reasons for non-participation at each stage.	Reasons for non-participation were unavailable because the association mailing system did not provide delivery, opening, or individual view data.	Methods; Discussion
Results	14(a)	Give characteristics of study participants.	Participant age, experience, work setting, and general practice characteristics are summarized.	Results; Online Resource Fig. S1
Results	14(b)	Indicate number of participants with missing data for each variable of interest.	Available-data and model-specific complete-case information are reported where applicable.	Methods; Table notes; Supplementary Tables
Results	15	Report numbers of outcome events or summary measures.	Extraction/non-extraction/undecided counts, premolar-selection patterns, appliance-preference associations, correlations, and model estimates are reported.	Results; Tables 1-2; Supplementary Tables
Results	16(a)	Give unadjusted and adjusted estimates with precision.	Odds ratios with 95% confidence intervals are reported for GEE models; correlation coefficients and p values are reported for association analyses.	Results; Table 2; Supplementary Tables
Results	16(b)	Report category boundaries when continuous variables were categorized.	Age, orthodontic experience, weekly patient volume, and appliance-use categories are described in the questionnaire and Methods.	Methods; Supplementary Appendix 1
Results	17	Report other analyses done, including subgroup and sensitivity analyses.	Arch-by-case interaction, exploratory correlations, sensitivity analyses, and additional subgroup/supplementary analyses are reported.	Results; Supplementary Tables

Section/topic	Item	Recommendation	Reported information in this study	Location
Discussion	18	Summarize key results with reference to study objectives.	The Discussion opens by summarizing general practice patterns and the principal distinction between extraction decision and extraction-tooth selection.	Discussion
Discussion	19	Discuss limitations, considering potential sources of bias or imprecision.	Limitations include fixed case order, non-identical intraoral baselines across scenarios, different magnitudes of image modification, absence of a formal manipulation check, inability to calculate a formal response rate with possible self-selection, and use of standardized digital scenarios rather than observed clinical decisions.	Discussion
Discussion	20	Give a cautious overall interpretation of results.	Results are interpreted as associations rather than causal effects; the proposed biomechanical explanation for appliance preference is explicitly presented as an interpretation rather than a demonstrated mechanism.	Discussion
Discussion	21	Discuss generalisability of results.	Generalisability is considered in light of self-selection, association-based recruitment, and the use of standardized digital case scenarios; future studies with randomized/counterbalanced presentation and a common intraoral baseline are proposed.	Discussion
Other information	22	Give the source of funding and role of funders.	The authors state that no funding was received for the study.	Declarations: Funding

CHERRIES checklist for the web-based survey

CHERRIES item	Recommendation	Reported information in this study	Location
Survey design	Describe target population, sampling frame, and survey design.	Cross-sectional, closed web-based survey of registered orthodontists recruited through a national orthodontic association. Association records listed 2401 members in April 2025, representing the approximate sampling frame.	Methods: Study design and participants
IRB approval	State whether ethics/IRB approval was obtained.	The study was conducted after institutional review board approval. The survey instrument and digitally modified case images were reviewed and approved by the IRB.	Methods; Declarations
Informed consent	Describe the informed consent process.	An introductory page described the study purpose, voluntary participation, and questionnaire content; participants proceeded only after providing electronic consent.	Methods; Supplementary Appendix 1
Data protection/privacy	Describe privacy and confidentiality.	Participant information stated that personal data would be kept confidential. Google Forms sign-in was required and submissions were limited to one per account.	Methods; Supplementary Appendix 1
Development and testing	Describe questionnaire development/testing.	The survey was developed by the orthodontic investigators. Wording was reviewed, with input from a psychiatrist experienced in behavioral assessment, to reduce leading or hypothesis-revealing language; this was an expert wording review rather than psychometric validation.	Methods: Case materials and image preparation
Open versus closed survey	State whether the survey was open or closed.	Closed survey; access was distributed to registered orthodontists through the association rather than through a public link.	Methods: Study design and participants
Contact mode	Describe how participants were contacted.	The survey invitation was distributed by e-mail through the association mailing system.	Methods: Study design and participants
Advertising/recruitment	Describe recruitment/advertising.	Initial invitation distributed April 14, 2025; reminder distributed June 10, 2025.	Methods: Study design and participants
Survey administration mode	Describe web/e-mail administration.	The questionnaire was administered using Google Forms and accessed through the association-distributed survey link.	Methods: Study design and participants
Survey context	Describe where/how the survey was accessed.	Participants completed the survey online through Google Forms.	Methods: Study design and participants
Mandatory/voluntary participation	State whether participation was voluntary.	Participation was voluntary and electronic consent was required before questionnaire access.	Methods; Supplementary Appendix 1
Incentives	State whether incentives were offered.	The participant information stated that no payment would be provided for participation.	Supplementary Appendix 1

CHERRIES item	Recommendation	Reported information in this study	Location
Survey period	Report dates the survey was available.	The survey was distributed April 14, 2025; a reminder was sent June 10, 2025; data collection remained open until April 2026.	Methods: Study design and participants
Randomization of items/questionnaires	Describe randomization/counterbalancing.	Cases were presented in the fixed sequence Case 1, Case 2, and Case 3; no randomization or counterbalancing was used.	Methods: Case materials and image preparation; Discussion
Adaptive questioning	Describe adaptive or conditional items.	No adaptive skip logic is described. For case-specific non-extraction mechanics, respondents choosing extraction were instructed to select "X" for each row.	Supplementary Appendix 1
Number of items	Report number of questionnaire items.	The participant information described a 29-question survey, and the full questionnaire is reproduced in Supplementary Appendix 1.	Supplementary Appendix 1
Number of screens/pages	Report number of survey pages/screens.	The number of Google Forms screens/pages was not reported; the complete questionnaire is reproduced in Supplementary Appendix 1.	Supplementary Appendix 1
Completeness check	Describe completeness checks.	Missing responses were assessed before analysis; analyses used available data for relevant variables, with model-specific complete-case counts reported where applicable.	Methods; Table notes; Supplementary Tables
Review step	Describe whether respondents could review/change answers.	Not reported.	N/A
Unique site visitors	Report unique visitors if available.	Not available because the association mailing system did not provide individual link-view data.	Methods; Results
View rate	Report view rate if applicable.	Not calculable because delivery/opening/viewing data were unavailable.	Methods; Results
Participation rate	Report participation rate if applicable.	Not calculable because the number of unique viewers or recipients who opened the survey was unavailable.	Methods; Results
Completion rate	Report completion rate if applicable.	The final analytic sample comprised 138 orthodontists; a formal completion rate could not be calculated because the number of consented survey starters/non-completers was not available.	Methods; Results
Cookies	State whether cookies were used to prevent duplicates.	Cookie use was not reported. Duplicate submissions were limited by requiring Google Forms sign-in and allowing one submission per account.	Methods: Study design and participants
IP check	State whether IP addresses were used to identify duplicates.	Not reported.	N/A
Log file analysis	State whether log files were analyzed.	Not reported.	N/A
Registration/log-in	State whether registration/log-in was required.	Google Forms sign-in was required and submissions were limited to one per account.	Methods: Study design and participants
Handling incomplete questionnaires	Describe handling of incomplete questionnaires.	Missing responses were assessed and available data were used for each relevant variable; model-specific complete-case counts are reported where applicable.	Methods; Table notes; Supplementary Tables
Atypical timestamps/response time	Describe response-time exclusions.	No response-time or timestamp-based exclusion was reported.	N/A
Statistical correction	Describe weighting or adjustment for representativeness.	No weighting was applied. GEE models included clinically motivated covariates where appropriate.	Methods: Statistical analysis