

Extraction Decision and Tooth Selection in Borderline Orthodontic Cases: A Cross-Sectional Survey of Orthodontists

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Abstract

Objectives

To characterize orthodontists' general treatment-planning preferences and examine case-specific treatment decisions across standardized borderline orthodontic scenarios.

Materials and Methods

A closed web survey of 138 orthodontists assessed general appliance use, extraction frequency, usual extraction-tooth preference, planning priorities, and non-extraction strategies. Participants then evaluated three scenarios with the same non-intraoral diagnostic background but different localized maxillary characteristics, rating appliance preference, extraction/non-extraction planning, tooth selection, non-extraction strategies, and planning factors. Repeated outcomes were analyzed using Cochran Q/McNemar tests and parsimonious GEE models.

Results

Among 138 orthodontists, fixed buccal appliances predominated in general practice, and first premolars were the usual extraction teeth. Across the three borderline cases, which differed in localized maxillary intraoral characteristics, the proportion choosing extraction changed only modestly (71.0%, 63.0%, and 66.7% for Cases 1–3, respectively). In contrast, maxillary second-premolar selection increased from 7.2% in Case 1 to 19.6% in Case 2 and 31.2% in Case 3 ($p < 0.001$). Higher case-specific fixed buccal preference was associated with greater odds of extraction (OR 1.95, 95% CI 1.36–2.80), whereas higher clear aligner preference was associated with lower odds (OR 0.66, 95% CI 0.50–0.87). In exploratory analyses, greater concern about gingival level in Case 2 and crown morphology/size in Case 3 was associated with maxillary second-premolar selection.

Conclusions

The main case-related change was not whether orthodontists chose extraction, but which premolar they selected. Localized intraoral characteristics were more closely associated with tooth selection, whereas higher clear aligner preference was associated with non-extraction planning and higher fixed buccal preference with extraction planning.

Clinical Relevance:

In borderline orthodontic cases, localized dental and gingival characteristics may alter which tooth is selected for extraction even when the overall extraction decision remains similar. Appliance preference

may also be related to whether extraction or non-extraction treatment is planned.

Introduction

Extraction planning remains one of the most complex decisions in orthodontic diagnosis and treatment planning[1]. Although crowding, sagittal relationships, incisor inclination, facial profile, lip posture, vertical pattern, and stability are central to this decision, planning is rarely based solely on cephalometric or dental-arch parameters[1, 2]. Localized intraoral findings, including crown morphology, enamel defects, gingival margin levels, restorative prognosis, and esthetic asymmetry, may also influence which tooth is selected for extraction once extraction is considered[3].

The distinction between deciding whether to extract and which tooth to extract is clinically important. First premolars are traditionally selected when relief of anterior crowding, incisor retraction, and anchorage control are major objectives, whereas second-premolar extraction may be considered to preserve facial profile and lip fullness, maintain smile esthetics, or retain first premolars with more favorable crown form and gingival architecture[1, 3–5]. Selection of teeth for extraction should therefore be considered a related but separate component of extraction planning.

Borderline cases are particularly suited to studying this process. An arch-length discrepancy of 5–9 mm represents a gray zone in which both extraction and non-extraction treatment may be defensible depending on patient-specific factors, the clinician's treatment philosophy, appliance preferences, esthetic priorities, risk tolerance, and interpretation of localized dental findings[1, 6, 7]. Previous studies have examined both predictors of extraction decisions in Class I malocclusions and outcomes associated with extraction versus non-extraction treatment [8, 9]. Appliance preference may also be relevant. Clear aligner-oriented planning may be more closely aligned with non-extraction space-gaining strategies, whereas fixed-appliance-oriented planning may be more readily associated with extraction mechanics [10, 11]. It remains unclear, however, whether appliance preference is associated primarily with the extraction-versus-non-extraction decision or also with selection of teeth for extraction. Prior surveys have characterized the extraction-versus-non-extraction decision and its predictors in borderline cases but have not formally separated this decision from the distinct question of which tooth is selected[8, 12, 13].

Building on this distinction, the present study examined both general and case-specific aspects of orthodontic treatment planning. The general survey characterized appliance use, extraction frequency, usual extraction-tooth preferences, treatment-planning priorities, and non-extraction space-gaining strategies. The case-based section incorporated digitally modified intraoral photographs, an approach previously used in dental esthetic-perception research [14] within a standardized borderline orthodontic diagnostic framework. The same non-intraoral diagnostic background was maintained across scenarios, while localized maxillary intraoral characteristics differed. The primary aims were to determine whether extraction decisions and extraction-tooth selection differed across the three scenarios and to examine whether these two components of planning were associated with different clinical factors. Secondary

analyses evaluated whether case-specific appliance preference was associated with extraction versus non-extraction planning and whether localized feature ratings corresponded with feature-consistent tooth selection. We hypothesized that localized feature ratings would show clearer associations with tooth selection than with the broader decision to extract, whereas case-specific appliance preference would be more closely associated with extraction versus non-extraction planning.

Materials and Methods

Study design and participants

This cross-sectional study was conducted after institutional review board approval and is reported in accordance with STROBE recommendations for cross-sectional studies and relevant CHERRIES items for web-based surveys. Participants were recruited through the X Orthodontic Society, a national orthodontic association. The survey was closed to registered orthodontists and was distributed through the association mailing system on April 14, 2025, with a reminder on June 10, 2025; data collection remained open until April 2026. Association records listed 2401 registered members in April 2025, but the number of invitations successfully delivered or opened could not be verified. Accordingly, a formal response rate could not be calculated.

The survey was administered in Google Forms. Before accessing the questionnaire, participants viewed an information page describing the study purpose, voluntary participation, and questionnaire content and proceeded only after electronic consent. Sign-in was required and submissions were limited to one per account. Missing responses were assessed before analysis, and available data were used for each relevant variable. The full questionnaire and completed STROBE and CHERRIES checklists are provided as Supplementary Information.

The questionnaire collected age group, sex, work setting, years of orthodontic experience, and average weekly patient volume. Participants reported general use of fixed buccal appliances, fixed lingual appliances, and clear aligners using percentage categories that were recoded to 0–5 ordinal use-intensity scores. They also reported how frequently they performed extraction treatment and identified their usual extraction-tooth preference separately for the maxillary and mandibular arches from predefined tooth categories. General treatment-planning priorities were rated on a 0–5 scale (0 = no influence, 5 = highly influential) for midline, profile, upper and lower lips, gingival levels, crown morphology/size, enamel defects, and treatment stability. Participants also rated their use of distalization, expansion, interproximal reduction, and proclination as non-extraction space-gaining strategies on a 0–5 frequency scale.

Case materials and image preparation

The case-based section represented a borderline extraction/non-extraction scenario in which both approaches were considered clinically defensible. The case-based section incorporated digitally

modified intraoral photographs, an approach previously used in dental and orthodontic esthetic-perception research [14–16]. The common diagnostic background represented a skeletal Class I relationship, an acceptable mildly convex profile, a normodivergent vertical pattern, and moderate crowding. The same profile silhouette, panoramic radiograph, lateral cephalometric information, midline information, and crowding values were presented in all three scenarios (Fig. 1).

The localized maxillary intraoral appearance differed across cases. Case 1 retained an enamel defect on the maxillary right first premolar, with premolars of similar size. In Case 2, the enamel defect was removed and the gingival levels of the maxillary second premolars were displaced by approximately 2 mm. In Case 3, the enamel defect was removed and the maxillary second premolars were digitally reduced to approximately 30% smaller area than the first premolars, corresponding to approximately 15% reductions in width and height. The modifications were created in Adobe Photoshop using the same canvas and resolution. Localized retouching and transform tools were used to alter the intended dental or gingival regions, with minor edge blending to maintain a natural appearance; pixel-based measurements were used to standardize the planned modifications.

Cases were presented in the fixed sequence Case 1, Case 2, and Case 3. Participants were told that they would evaluate different intraoral photographs under the same non-intraoral diagnostic conditions but were not informed that specific localized characteristics had been intentionally modified. This represented partial disclosure intended to avoid revealing the study hypothesis [17]. The digitally modified images and survey instrument were reviewed and approved by the institutional review board. Survey wording was reviewed by the orthodontic investigators, in consultation with a psychiatrist experienced in behavioral assessment, to reduce leading or hypothesis-revealing language; this was an expert wording review rather than psychometric validation.

Case-based outcomes

For each case, participants rated the likelihood of using fixed buccal appliances, fixed lingual appliances, and clear aligners on a 0–5 scale and then indicated whether they would treat with extraction, without extraction, or were undecided.

Participants also selected the tooth to be extracted in each quadrant and, when non-extraction treatment was selected, rated likely use of distalization, expansion, interproximal reduction, and proclination. For each case, the same treatment-planning factors used in the general section were rated again. A priori feature-consistent tooth selection was defined as selection of the maxillary right first premolar in Case 1 and selection of at least one maxillary second premolar in Cases 2 and 3.

Statistical analysis

Categorical variables were summarized as frequencies and percentages; ordinal and Likert-type variables were summarized using means, standard deviations, medians, and interquartile ranges.

Extraction responses were retained as extraction, non-extraction, or undecided for descriptive reporting. Binary extraction analyses compared definitive extraction and non-extraction responses, with undecided responses excluded; sensitivity analyses recoded undecided responses alternatively as extraction or non-extraction.

Repeated binary outcomes across the three cases were assessed using Cochran Q tests, followed by pairwise McNemar tests when an omnibus difference was present. Tooth-selection outcomes included any maxillary second-premolar selection, bilateral maxillary second-premolar selection, and bilateral maxillary first-premolar selection. An arch-by-case generalized estimating equation model assessed whether changes in second-premolar selection differed between the maxillary and mandibular arches. Spearman correlations assessed associations among ordinal variables; the Benjamini-Hochberg procedure controlled the false discovery rate within the exploratory correlation family. Exploratory correlations also examined relationships between general appliance-use intensity and reported use of non-extraction space-gaining strategies.

GEE logistic regression models used a binomial distribution, logit link, exchangeable working correlation structure, and robust sandwich standard errors to account for repeated responses within participants. Models were restricted to clinically motivated predictors; automated stepwise selection was not used, and age and orthodontic experience were not entered together because of collinearity. The extraction model was based on 389 definitive case-level responses from 138 participants and included case, case-specific appliance-preference scores, general extraction frequency, orthodontic experience, and weekly patient volume. Odds ratios with 95% confidence intervals are reported.

The repeated extraction-decision analysis, repeated maxillary second-premolar selection analysis, and pooled feature-consistent target-tooth model were prespecified principal analyses. Because the Case 1 target definition was not fully comparable with Cases 2 and 3, the pooled model is reported in the Supplementary Information and interpreted cautiously. Appliance-preference models, individual feature-rating associations, subgroup analyses, and other post hoc analyses were considered secondary or exploratory. No global multiplicity correction was applied across clinically distinct model families. Statistical analyses were performed in Python with a nominal two-sided alpha of 0.05.

Results

Among 138 participating orthodontists, 51 (37.0%) were aged 26–32 years and 47 (34.1%) reported 0–5 years of orthodontic experience; 38 (27.5%) had 6–10 years, 26 (18.8%) had 11–20 years, and 27 (19.6%) had at least 20 years of experience. Most participants worked in private practice (78/138, 56.5%), followed by university settings (56/138, 40.6%). Fixed buccal appliances predominated in general practice, whereas lingual appliance use was limited. First premolars were the most commonly reported usual extraction teeth in both arches (maxillary: 121/138, 87.7%; mandibular: 113/138, 81.9%). Profile, midline, upper lip, and treatment stability received the highest general planning-priority ratings, while interproximal reduction and expansion were the most preferred non-extraction space-gaining

approaches. Participant characteristics and general treatment-planning preferences are summarized in Online Resource Fig. S1.

Extraction, non-extraction, and undecided responses were 98/138 (71.0%), 34/138 (24.6%), and 6/138 (4.3%) in Case 1; 87/138 (63.0%), 41/138 (29.7%), and 10/138 (7.2%) in Case 2; and 92/138 (66.7%), 37/138 (26.8%), and 9/138 (6.5%) in Case 3 (Fig. 2a; Table 1). Among definitive responses, the omnibus Cochran Q test was significant ($p = 0.0116$). The more pronounced between-case difference involved tooth selection. Maxillary second-premolar selection increased from 7.2% in Case 1 to 19.6% in Case 2 and 31.2% in Case 3 (Cochran Q $p < 0.001$). Among 138 participating orthodontists, 51 (37.0%) were aged 26–32 years and 47 (34.1%) reported 0–5 years of orthodontic experience; 38 (27.5%) had 6–10 years, 26 (18.8%) had 11–20 years, and 27 (19.6%) had at least 20 years of experience. Most participants worked in private practice (78/138, 56.5%), followed by university settings (56/138, 40.6%). Fixed buccal appliances predominated in general practice, whereas lingual appliance use was limited. First premolars were the most commonly reported usual extraction teeth in both arches (maxillary: 121/138, 87.7%; mandibular: 113/138, 81.9%). Profile, midline, upper lip, and treatment stability received the highest general planning-priority ratings, while interproximal reduction and expansion were the most preferred non-extraction space-gaining approaches. Participant characteristics and general treatment-planning preferences are summarized in Online Resource Fig. S1. Bilateral maxillary first-premolar extraction decreased descriptively across cases (Fig. 2b; Table 1). Agreement between usual maxillary extraction preference and the case-specific pattern was low and decreased across cases ($\kappa = 0.202, 0.175, \text{ and } 0.126$). The case-related difference in second-premolar selection was greater in the maxillary than mandibular arch for both Case 2 versus Case 1 (interaction OR 2.43, 95% CI 1.34–4.40, $p = 0.003$) and Case 3 versus Case 1 (interaction OR 3.93, 95% CI 2.10–7.36, $p < 0.001$) (Fig. 2c).

Table 1
Case-based extraction decisions and premolar-selection patterns across the three scenarios

Outcome	Case 1, n (%)	Case 2, n (%)	Case 3, n (%)	Overall comparison
Extraction	98 (71.0)	87 (63.0)	92 (66.7)	Cochran Q $p = 0.0116$
Non-extraction	34 (24.6)	41 (29.7)	37 (26.8)	—
Undecided	6 (4.3)	10 (7.2)	9 (6.5)	—
Bilateral maxillary first-premolar extraction	84 (60.9)	61 (44.2)	48 (34.8)	—
Bilateral maxillary second-premolar extraction	4 (2.9)	23 (16.7)	38 (27.5)	—
Any maxillary second-premolar selection	10 (7.2)	27 (19.6)	43 (31.2)	Cochran Q $p < 0.001$
Any mandibular second-premolar selection	12 (8.7)	15 (10.9)	17 (12.3)	—

☐ Cochran Q analysis compared definitive extraction and non-extraction responses; undecided responses were excluded. Counts and percentages are based on all 138 participants unless otherwise indicated

Case-specific appliance preference was associated with the extraction decision. Higher fixed buccal preference scores were associated with higher odds of extraction (OR 1.95, 95% CI 1.36–2.80, $p < 0.001$), whereas higher clear aligner preference scores were associated with lower odds (OR 0.66, 95% CI 0.50–0.87, $p = 0.003$). After adding general appliance-use intensity, the associations remained similar (fixed buccal: OR 1.79, 95% CI 1.20–2.66, $p = 0.004$; clear aligner: OR 0.66, 95% CI 0.50–0.87, $p = 0.003$) (Table 2). In exploratory analyses, greater general clear-aligner use was positively associated with the reported use of distalization and expansion, whereas greater fixed-buccal use showed inverse associations with both strategies (Supplementary Tables). Sensitivity analyses using alternative handling of undecided responses and either age or experience for adjustment produced similar directions of association.

Table 2
GEE estimates for appliance-preference associations with definitive extraction treatment

Model	Predictor	OR (95% CI)	p value
Primary extraction-decision model	Case-specific fixed buccal score	1.95 (1.36–2.80)	< 0.001
	Case-specific clear aligner score	0.66 (0.50–0.87)	0.003
	Case-specific lingual score	1.16 (0.78–1.73)	0.466
Model including general appliance use	General fixed buccal use	0.99 (0.51–1.91)	0.976
	General clear aligner use	1.30 (0.66–2.56)	0.447
	Case-specific fixed buccal score	1.79 (1.20–2.66)	0.004
	Case-specific clear aligner score	0.66 (0.50–0.87)	0.003

GEE, generalized estimating equation; OR, odds ratio; CI, confidence interval. Models used a binomial distribution with logit link, exchangeable working correlation structure, and robust sandwich standard errors. ORs for appliance scores represent a one-unit increase in the corresponding ordinal score. The primary model was additionally adjusted for case, general extraction frequency, orthodontic experience, and weekly patient volume. The model including general appliance use additionally included general fixed-buccal and clear-aligner use-intensity scores

General planning-factor scores were positively correlated with corresponding case-specific ratings, most consistently for treatment stability, midline, and crown morphology/size and most weakly for enamel

defects (Fig. 3a; Supplementary Table). Case-specific gingival-level rating in Case 2 was associated with maxillary second-premolar selection ($\rho = 0.268$, $p = 0.0016$; OR 1.58, 95% CI 1.13–2.21, $p = 0.008$) but not with the extraction decision ($\rho = 0.131$, $p = 0.142$). In Case 3, crown morphology/size showed the strongest association with maxillary second-premolar selection ($\rho = 0.453$, $p < 0.001$; OR 2.21, 95% CI 1.49–3.28, $p < 0.001$) (Fig. 3b). In Case 1, enamel-defect rating was associated with selection of the maxillary right first premolar ($\rho = 0.325$, $p = 0.0001$; OR 1.51, 95% CI 1.16–1.97, $p = 0.002$), but asymmetric extraction of the affected tooth was uncommon and no right-left asymmetry was detected (McNemar $p = 0.508$).

Sex, age category, private-practice setting, and orthodontic experience were not independently associated with definitive extraction decisions or maxillary second-premolar selection. Higher weekly patient volume was associated with lower odds of maxillary second-premolar selection (OR 0.34, 95% CI 0.18–0.62, $p < 0.001$); this and other subgroup findings were exploratory and are reported in the Supplementary Information rather than emphasized in the main analysis. Additional analyses are provided in the Supplementary Tables.

Discussion

This study captured both general and case-specific aspects of orthodontic treatment planning. At the general-practice level, fixed buccal appliances predominated, first premolars were the usual extraction teeth, and profile, midline, lip position, and treatment stability received the greatest emphasis. Within the case-based section, extraction versus non-extraction decisions varied relatively little across the three scenarios, whereas the more pronounced change involved which premolar was selected. In particular, maxillary second-premolar selection increased in Cases 2 and 3 without a comparable change in the mandibular arch. These findings support considering the decision whether to extract and the subsequent choice of which tooth to remove as related but distinct components of borderline orthodontic treatment planning.

The broader extraction literature has shown that extraction versus non-extraction treatment may be associated with different dentoalveolar and soft-tissue outcomes, particularly in borderline Class I patients [8, 9, 18]. In the present study, however, first-premolar extraction remained the predominant pattern in every scenario. This is consistent with previous work showing that first premolars remain the most frequently selected extraction teeth and that crowding, incisor position, and soft-tissue considerations contribute importantly to extraction planning [1, 8, 19]. The localized intraoral characteristics therefore did not replace the broader diagnostic framework. Rather, the principal case-related change occurred within an otherwise relatively stable extraction pattern. This is clinically plausible in borderline cases, where more than one treatment approach may be defensible and inter-clinician variation in treatment decisions has previously been reported [12, 13]

The clearest case-related shift involved increasing selection of the maxillary second premolars. The absence of a comparable mandibular change is consistent with the fact that the modified characteristics

were localized to the maxillary arch. Clinically, the choice between first- and second-premolar extraction may incorporate tooth morphology, soft-tissue objectives, space requirements, anchorage demands, and anticipated treatment stability [3, 5, 20]. In Case 2, greater weighting of gingival level was associated with maxillary second-premolar selection but not with the overall extraction decision. In Case 3, crown morphology/size showed the strongest association with maxillary second-premolar selection. Together, these findings suggest that localized dental characteristics may be more relevant to refinement of tooth selection than to the preceding decision of whether extraction is indicated.

The three localized characteristics should not, however, be interpreted as directly comparable effects. Previous dental and orthodontic esthetic-perception studies have shown that clinicians respond to digitally altered gingival relationships, crown dimensions, and dental asymmetries [14–16]. The present study, however, addressed treatment planning rather than esthetic perception alone. In addition, the modifications differed in magnitude, and the scenarios were not created by adding equivalent isolated changes to a single identical intraoral baseline. The larger shift observed in Case 3 therefore should not be interpreted as evidence that crown-size discrepancies are intrinsically more influential than gingival or enamel findings. Case 1 also requires cautious interpretation: although enamel-defect rating was associated with selection of the affected maxillary right first premolar, asymmetric extraction of that tooth was uncommon and no right-left asymmetry was detected. Thus, this finding is better interpreted as correspondence between case-specific feature weighting and tooth selection than as evidence of a distinct defect-driven asymmetric extraction strategy.

The relationship between general and case-specific planning-factor ratings provides another perspective on this decision process. General priorities emphasized profile, midline, lip position, and treatment stability, whereas localized dental characteristics received lower overall ratings. Nevertheless, when gingival level or crown morphology/size was rated as more important within an individual scenario, the corresponding rating was associated with tooth selection. General treatment priorities and case-specific assessments therefore appear to capture related but not interchangeable aspects of clinical planning. Because feature ratings and treatment decisions were obtained during the same case assessment, these associations may represent case-specific weighting of the localized characteristic, post-decision rationalization, or a combination of both. The present design cannot establish the direction of this relationship.

Case-specific appliance preference represented another dimension of planning. Higher fixed buccal preference scores were associated with greater odds of extraction, whereas higher clear aligner preference scores were associated with lower odds, indicating a greater tendency toward non-extraction planning among participants who favored clear aligners for a given case. This interpretation was also consistent with the exploratory general-practice findings in the present survey: greater clear-aligner use was associated with more frequent use of distalization and expansion, whereas greater fixed-buccal use showed inverse associations with both strategies.

One possible explanation is that clinicians consider the biomechanical demands of extraction-space closure when selecting an appliance. Survey data indicate that orthodontists regard root movement and translation as among the more challenging movements with clear aligners and that clinicians are more selective about using aligners for biomechanically demanding treatment [21]. Systematic reviews have likewise identified limitations in the predictability of some tooth movements with clear aligners [11], and more recent evidence specifically examining premolar-extraction space closure has reported less-than-planned anterior retraction, unwanted tipping, and limitations in bodily movement and anchorage control [22]. These considerations may partly explain why clinicians favoring clear aligners were more likely to choose non-extraction approaches when such treatment was clinically defensible. This should not be interpreted as an effect of the appliance itself, however. Appliance preference may also reflect broader treatment philosophy, familiarity with extraction mechanics, or preferred space-gaining strategies. Because participants were not asked why they selected a particular appliance, the biomechanical explanation remains a plausible interpretation rather than a mechanism demonstrated by the present data.

Several limitations should be considered. Cases were presented in a fixed order, so order or contrast effects cannot be excluded. Although order effects cannot be excluded, the relatively stable mandibular second-premolar selection across cases argues against a uniform sequence-related shift toward second-premolar extraction. The localized characteristics were not introduced against an identical intraoral baseline across all scenarios, and the magnitude of the image modifications differed. Between-case differences therefore cannot be attributed exclusively to a single modified characteristic. No formal manipulation check was performed, so the extent to which participants consciously recognized each intended modification is unknown. A formal response rate could not be calculated because the exact number of orthodontists who received or opened the invitation was unavailable, and self-selection may have influenced the participating sample. Finally, the findings represent responses to standardized digital scenarios rather than observed treatment decisions in routine clinical practice.

Despite these limitations, the findings suggest that borderline orthodontic treatment planning may be better understood as a series of related decisions rather than as a single extraction preference. General practice patterns provided the clinician-level background, whereas the standardized cases revealed case-specific adjustments in appliance preference, extraction planning, and tooth selection. The most consistent distinction was that localized intraoral characteristics were more closely associated with which tooth was selected, whereas case-specific appliance preference was more closely associated with the broader extraction versus non-extraction decision. Future studies using randomized or counterbalanced case presentation, a common intraoral baseline, and prospectively calibrated feature modifications could examine this distinction more directly.

Conclusions

This survey showed a general preference for first-premolar extraction alongside case-specific variation in treatment planning. Localized intraoral characteristics were more closely associated with which tooth

was selected for extraction than with whether extraction was chosen. Higher clear aligner preference was associated with non-extraction planning, whereas higher fixed buccal preference was associated with extraction planning. Gingival-level and crown-size characteristics were also associated with greater selection of maxillary second premolars. Overall, extraction decision, tooth selection, and appliance preference appear to represent related but distinct components of treatment planning in borderline orthodontic cases.

Declarations

Competing interests

The authors declare no competing interests.

Ethics approval

The study protocol, including the survey instrument and digitally modified case images, was approved by IRB (25-3.1T/83).

Consent for publication

Not applicable.

Generative AI disclosure

After manuscript preparation, the authors used ChatGPT (OpenAI) to assist with language editing and grammar checking. The authors critically reviewed and verified all AI-assisted content and take full responsibility for the final manuscript.

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Author Contribution

E.C.F. contributed to the conceptualization and design of the study, development of the survey and case materials, data collection, data analysis and interpretation, preparation of figures and tables, and drafting of the manuscript. K.K. contributed to the study methodology, review and refinement of the survey instrument, interpretation of the findings, and critical revision of the manuscript. A.M.E. contributed to the study conception and methodology, interpretation of the findings, supervision, and critical revision of the manuscript. S.A. contributed to the study conception and methodology, interpretation of the findings,

supervision, and critical revision of the manuscript. All authors reviewed and approved the final manuscript.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Figures

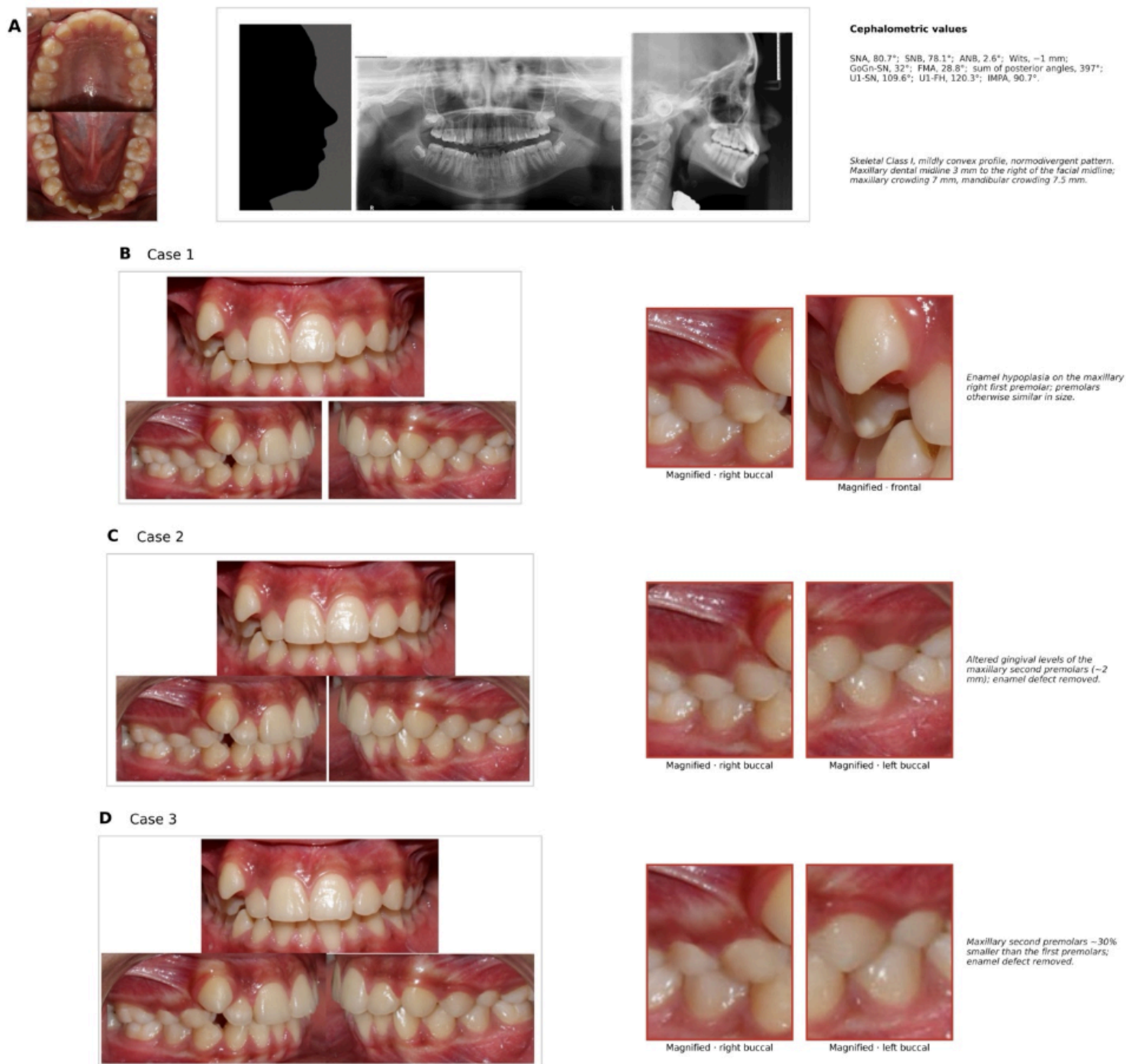


Figure 1

Standardized diagnostic background and localized maxillary intraoral characteristics. (A) Common diagnostic background shared across all scenarios. (B) Case 1 retained an enamel defect on the maxillary right first premolar. (C) Case 2 had the enamel defect removed and altered gingival levels of the maxillary second premolars. (D) Case 3 had the enamel defect removed and reduced maxillary second-premolar crown dimensions

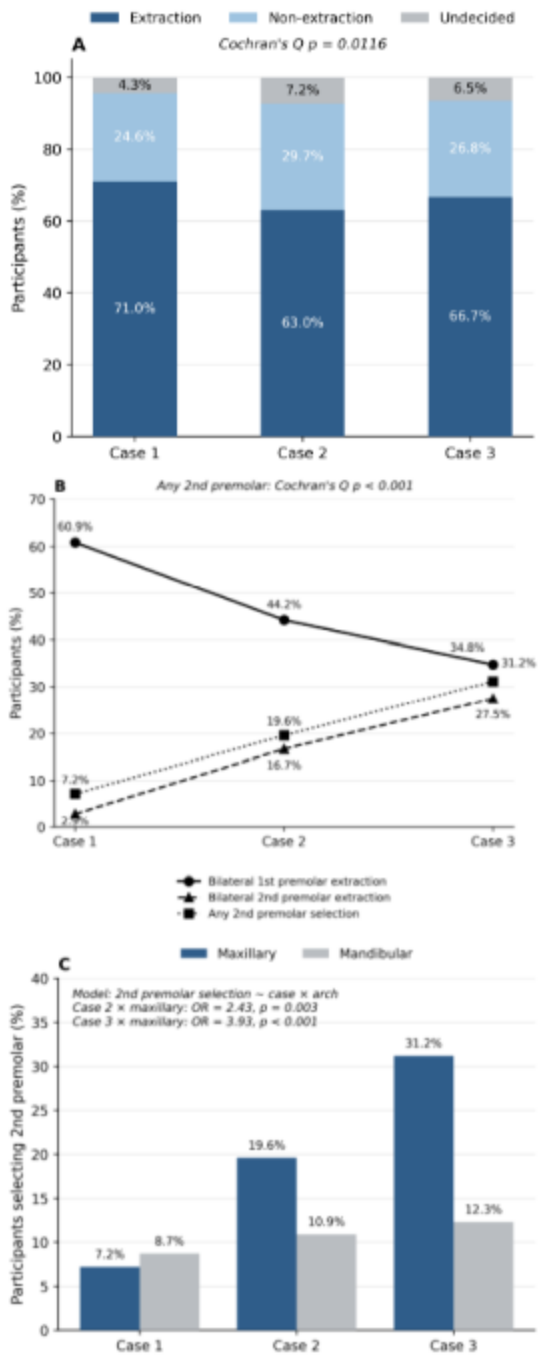


Figure 2

Case-based treatment decisions. (a) Extraction, non-extraction, and undecided responses across cases. (b) Maxillary extraction-tooth patterns across cases. (c) Maxillary and mandibular second-premolar selection across cases

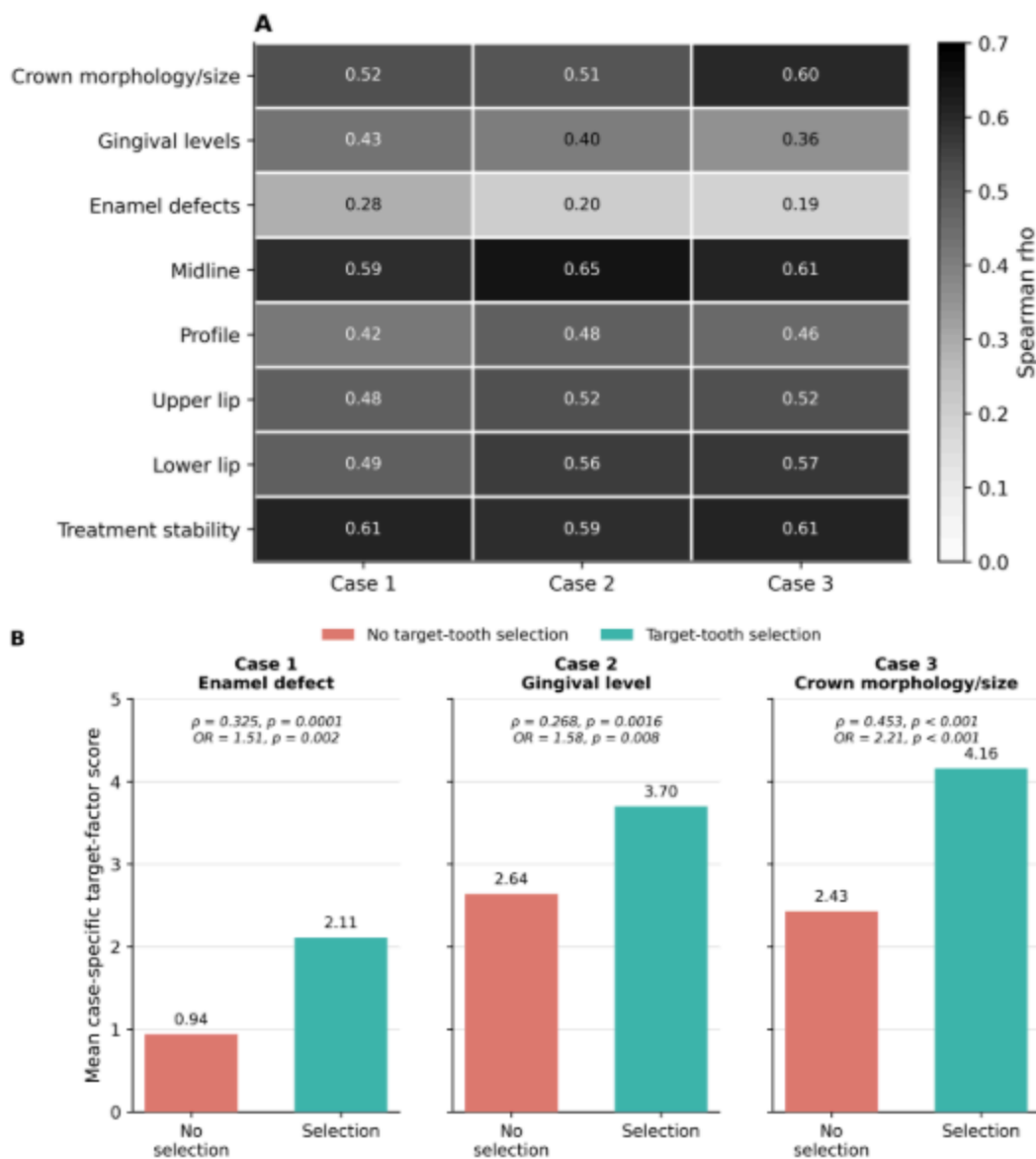


Figure 3

Case-specific planning-factor ratings and feature-consistent tooth selection. (a) Spearman correlations between general and corresponding case-specific planning-factor ratings. (b) Mean case-specific target-feature ratings according to feature-consistent tooth selection

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryTables.docx](#)
- [SupplementaryAppendix.pdf](#)