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Dentistry Section

Distribution and Radiographic Assessment of Post-retained Restorations: A Retrospective Study from Saudi Arabia

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ABSTRACT

Introduction: Restoring endodontically treated teeth with significant coronal loss often requires intraradicular posts to provide retention for core build-up and definitive prostheses. The long-term success of these restorations depends on adherence to radiographic criteria such as optimal post-length, post-width, and adequate apical gutta-percha. Limited evidence exists regarding the prevalence and radiographic characteristics of post-retained restorations in the study population.

Aim: To assess the distribution and radiographic quality of post-retained restorations in a selected patient cohort.

Materials and Methods: This retrospective study analysed patient records and radiographs obtained between April 2019 and October 2024 This retrospective study was conducted at the Department of Paediatric Dentistry and Orthodontics Sciences, College of Dentistry, King Khalid University, Abha, Saudi Arabia. The retrospective study analysed patient records and radiographs obtained between April 2019 and October 2024. A total of 625 radiographs were screened and 71 teeth with post-retained restorations from 61 adult patients, who met the inclusion criteria. Orthopantomogram (OPG), periapical, and bitewing radiographs were evaluated for tooth type, arch, post-type, post-length, post-width , and the remaining gutta-percha. Radiographic analysis was performed by a single examiner and descriptive statistics were calculated using Statistical Package for Social Sciences (SPSS) (p-value<0.05).

Results: Most post-retained restorations occurred in males (60.6%) and individuals aged 36-45 years (34.4%). The premolars (39.4%) were the most frequently restored teeth, followed by the molars (33.9%). Glass Fiber Posts (GFP) constituted the majority (80.3%). However, most restorations showed deviations from the ideal guidelines, with 67.6% having a 1:3 post-length and 70.4% demonstrating a 1:3 post-width. Over half of the teeth retained more than 5 mm of apical gutta-percha, whereas 15.5% exhibited overfilled or unacceptable apical conditions.

Conclusion: Post-retained restorations were most common in middle-aged adults, particularly in the premolars and mandibular molars. Despite the predominant use of fiber posts, substantial deviations from the recommended radiographic standards were observed. These findings highlight the need for improved clinical training and strict adherence to evidence-based prosthodontic protocols.

Keywords: Dental, Prevalence, Quality of post, Radiography

INTRODUCTION

Restoring endodontically treated teeth, especially those with a significant loss of coronal structure, presents a considerable challenge in clinical dentistry. The long-term success of these teeth largely depends on the quality of the final restoration, which must safeguard the remaining tooth structure, establish an effective coronal seal, and reinforce both function and aesthetics [1,2]. When the coronal tooth structure is insufficient to support a core for indirect restoration, intraradicular posts and cores are frequently used to provide the necessary retention and support for the definitive prosthesis. The post, seated within the prepared root canal, retains the core build-up, which then serves as a foundation for the final crown. This system aims to distribute occlusal stresses along the root, potentially decreasing the risk of coronal fracture [3].

The decision to place a post and the selection of the appropriate post system are influenced by multiple factors, including the amount of remaining tooth structure, morphology of the root canal, and functional demands on the tooth [4]. Various post systems are available, such as custom-made cast metal posts and prefabricated posts made of metal or fiber-reinforced composites. Although cast posts have a long history of clinical use, fiber posts have gained popularity because of their aesthetic properties and mechanical characteristics such as an elastic modulus similar to that of dentin, which may lead to a more even distribution of stress and a reduced risk of root fracture [1,5]. Despite these advancements, the use of posts remains debatable. Some studies suggest that post placement might weaken the root structure by removing radicular dentin during post space preparation, while other studies have indicated that teeth restored with posts and cores may face a higher risk of failure, particularly when serving as abutments for removable partial dentures [6]. Furthermore, teeth with posts are more frequently associated with apical periodontitis than endodontically treated teeth without posts [7].

The success of post-retained restorations relies on adherence to the established prosthodontic principles. Several crucial radiographic criteria have been developed to assess the quality of post- and core-restorations. These include the post's length, which should be adequate for retention without compromising the apical seal; the post's width, which should not exceed one-third of the root width to preserve tooth structure and minimise fracture risk; and the presence of an adequate apical seal of at least 3-5 mm of gutta-percha to prevent microleakage [8]. The presence of a ferrule, defined as a circumferential ring of sound tooth structure at the gingival margin, has also been identified as a critical factor for the long-term success of post-retained restorations [4].

Numerous studies have radiographically assessed the quality of post and core restorations performed by dental students and general practitioners in various regions, often revealing a high prevalence of technical errors and lack of adherence to established guidelines [3,5,8]. These investigations underscore the importance of continuous evaluation and education to enhance the quality of care provided. While several such studies have been conducted globally, including in Saudi Arabia and the United Arab Emirates, there are limited data on the prevalence and quality of post-retained restorations, specifically within the population examined in this study [1,3,4,6]. Understanding the current trends and standards of practice in this area is essential for pinpointing areas for improvement in dental education and clinical practice.

Therefore, its primary objective is to determine the frequency of post and core restorations and evaluate their radiographic quality based on established criteria for post-length, width, and apical seal. This research offers valuable insights into the current state of clinical practice regarding the restoration of endodontically treated teeth and provides a foundation for future investigations and educational initiatives focused on improving the quality and longevity of these vital dental restorations. By identifying common errors and shortcomings, the present study will contribute to broader academic discussions and offer evidence-based recommendations for enhancing clinical outcomes in restorative dentistry. Hence, the present study aimed to investigate the prevalence of teeth with post-retained restorations using radiographic analysis of a population sample.

MATERIALS AND METHODS

This retrospective study was conducted at the Department of Paediatric Dentistry and Orthodontics Sciences, College of Dentistry, King Khalid University, Abha, Saudi Arabia. It involved screening of patient records and the corresponding oral radiographs acquired between April 2019 and October 2024. It was approved by the Institutional Review Board of the College of Dentistry at King Khalid University (2024-25/028) Ethical Approval No. IRB/KKUCOD/ETH/2024-25/08 Dated on 19/12/2024.. The study planning, data extraction, and analysis were conducted between December 2024 and March 2025.

Inclusion criteria:

- Patients aged more than 18 years from both genders;
- Properly restored root canal-treated tooth;
- Records and oral radiographs were screened from April 2019 to October 2024;
- Medically fit.

Exclusion criteria:

- Patients who were under the age of 18 years
- Patients' radiographs that contained errors and defects
- Cases with incomplete root formation
- Teeth on repeated radiographs for the same patient were not counted and
- Subjects with failed endodontic treatment.

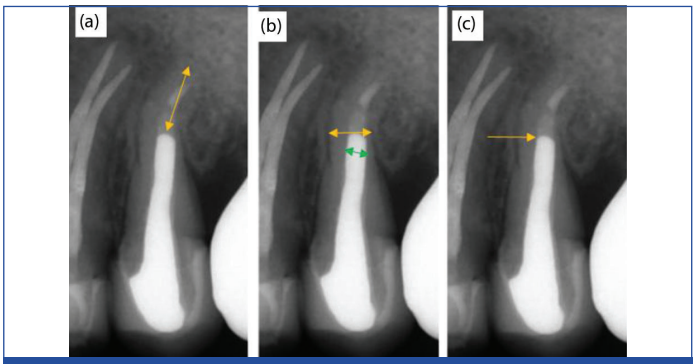
Sample size: The total number of screened radiographs of teeth with and without post-restorations was 625. Of these radiographs, 71 had post-retained restorations.

Study Procedure

Collected data included age, gender, arch, type of tooth, type of post, post-length, post-width, and Gutta-Percha (GP) condition. The types of oral radiographs used were OPG, bitewing, and periapical radiographs. Radiographs were examined and viewed on a 19-inch computer monitor display with a resolution of 1280×1024 pixels. The identification of posts on the radiographs was performed by a single investigator.

Evaluation parameters included the following data:

- Arch and type of tooth involved.
- Post-type: GFP, Custom-made Post (CP) and prefabricated metal post.
- Post-width in relation to root diameter. (ideal post diameter or width using fractional ratios relative to the root diameter) are1/3, ½ and 1/1 [3].
- Post-length in relation to crown and root length.
- Radiographic condition of the remaining GP: (i) 3 to 5 mm of GP apical to the post end; (ii) More than 5 mm of GP apical to the post end; (iii) Extrusion of GP beyond the apex (overfilling); (iv) Unsatisfactory condensation (Unacceptable) of GP [3].
- Presence or absence of space between the end of the post and GP [Table/Fig-1].



[Table/Fig-1]: Illustrative measurement made on radiographs: a) Showing the amount of remaining gutta-percha apical to the post; b) Showing the post-width compared to root width; c) Showing no gap between the post and remaining gutta-percha.

The types of oral radiographs used were OPG, bitewing, and periapical radiographs. A mix of OPG and periapical and bitewing radiographs was used to ensure the accurate and comprehensive identification of post-retained restorations. OPGs provide a full-arch overview for initial detection, while periapical images offer a detailed evaluation of the post-length, width, and apical seal. Bitewings supplemented the visibility of the posterior teeth, where overlapping structures may occur. Using multiple radiograph types improved the diagnostic accuracy and ensured a more reliable assessment across all tooth regions.

STATISTICAL ANALYSIS

The collected data were analysed using the SPSS. The descriptive analysis involved calculating frequencies with percentages. An expert statistician conducted statistical analyses.

RESULTS

A total of 71 teeth featuring post-retained restorations were included in this radiographic study. The analysis of demographic data and the distribution of these restorations are presented below.

The age of the patient sample ranged from 18 to 56 years. The highest prevalence of post retention restorations was observed in the 36-45 age group, which accounted for 21 individuals (34.4%) of the total sample. This was followed by the 46-55 age group with 17 individuals (27.8%). The youngest age group (18-25 years) had the lowest prevalence of 4.9% [Table/Fig-2]. Regarding gender, the study found a higher prevalence of post-retained restorations in males. Of the 61 patients, 37 (60.6%) were male and 24 (39.4%) were female.

Parameters	n (%)
Age (in years)	
18-25	3 (4.9%)
26-35	11 (18%)
36-45	21 (34.4%)
46-55	17 (27.8%)

56 and above	9 (14.7%)
	61 (100%)
Gender	
Males	37 (60.6%)
Females	24 (39.4%)

[Table/Fig-2]: Prevalence of post-restorations according to age and gender. Number of patients=61

Distribution of post-retained restorations in the dental arch: An analysis of the 71 teeth with post-retained restorations revealed that the premolars were the most frequently restored teeth, accounting for 28 cases (39.4%). This was closely followed by molars in 24 cases (33.9%) and anterior teeth in 19 cases (26.7%) [Table/Fig-3]. When examining the distribution by specific tooth location, a higher number of restorations was found in the mandibular (lower) arch than in the maxillary (upper) arch. The mandibular arch contained 42 (59.2%) restorations, whereas the maxillary arch contained 29 (40.8%) restorations. The most frequently restored tooth types were the Lower Right (LR) molars 11 (15.4%), followed by the Lower Left (LL) molars 10 (14.1%), and the LL premolars 9 (12.6%). In the maxillary arch, the Upper Right (UR) anterior teeth showed the highest prevalence 8 (11.2%) [Table/Fig-4].

Location of teeth in the arch	n (%)
Anterior teeth	19 (26.7%)
Premolars	28 (39.4%)
Molars	24 (33.9%)
Number of teeth with post and core	71 (100%)

[Table/Fig-3]: Prevalence of post restorations according to the location of teeth in the arch.

Tooth type	n (%)
UR molars	2 (2.8%)
UR premolars	6 (8.4%)
UR anteriors	8 (11.2%)
UL anteriors	7 (9.8%)
UL premolars	5 (7.04%)
UL molars	1 (1.4%)
LL molars	10 (14.08%)
LL premolars	9 (12.6%)
LL anteriors	3 (4.2%)
LR anteriors	1 (1.4%)
LR premolars	8 (11.2%)
LR molars	11 (15.4%)

[Table/Fig-4]: Prevalence of post-restorations according to tooth type.

Overall parameters of frequency and percentage in relation to the type of post, post-length, post-width, and the condition of GP [Table/Fig-5]. The table shows that most restorations used GFPs 57 (80.3%), indicating a strong preference for fiber systems. However, the majority of posts demonstrated suboptimal dimensions, with 48 (67.6%) having inadequate 1:3 post-length and 50 (70.4%) showing 1:3 post-width, both falling short of the recommended standards. Out of 71 evaluated teeth, the majority 60 (84.5%) had either acceptable or ideal GP conditions (with the "more than 5 mm" group) being the most prevalent. Only a small proportion exhibited undesirable outcomes such as overfilling or poor condensation (a combined 11 (15.5%), which reflect technical shortcomings during obturation or post space preparation. In most cases, 50 (70.42%) showed no space between the GP and the post-end, while up to 21 (29.58%) of cases presented with a detectable space. Overall, these findings highlight frequent deviations from the ideal post-length, width and apical seal, emphasising the need for improved clinical precision.

Parameters		n (%)
Type of post	Custom-made post	6 (8.5)
	Glass Fiber Post (GFP)	57 (80.3)
	Metal prefabricated post	8 (11.3)
	Total	71 (100)
Post-length	1: 1	7 (9.9)
	1: 2	16 (22.5)
	1: 3	48 (67.6)
	Total	71 (100)
Post-width	1: 1	7 (9.9)
	1: 2	14 (19.7)
	1: 3	50 (70.4)
	Total	71 (100)
GP condition	3 to 5 mm	21 (29.6)
	>5 mm	39 (54.9)
	Over filling	4 (5.6)
	Unacceptable	7 (9.9)
	Total	71 (100)

[Table/Fig-5]: Overall parameters of frequency and percentage in relation to the type of post, post-length, post-width, and the condition of GP.

DISCUSSION

The present study aimed to evaluate the prevalence and distribution of post-retained restorations in a specific patient cohort. The findings indicated a higher prevalence among male patients and within the 36-45 year age demographic, with premolars and molars accounting for the majority of restored teeth.

The demographic characteristics of the sample, which exhibited male predominance, offer an interesting point for comparison. This observation diverges from the largest comparable study by Alawami S and Eldarrat A in the United Arab Emirates (UAE), which reported no statistically significant sex-based difference in prevalence among 879 patients [1]. Other regional investigations have yielded varying results. A study from Saudi Arabia found no major gender differences in post-placement quality; however, men had more biological issues like cavities and gum disease [5]. A study in India found that teeth with posts were more often removed from female patients, though the starting rate was not recorded [9]. These findings suggest that while the incidence of post placement may be similar or marginally higher in one gender, the failure rates and underlying causes of failure could differ. The discrepancy observed in the present study might be attributable to specific socio-behavioural factors, differential access to dental care, or a greater incidence of tooth loss stemming from trauma or parafunctional habits within the male population of the sample [10]. The consistent peak in the 36-45 year age group closely mirrors the UAE study, which similarly identified this cohort as having the highest number of teeth with posts [1]. This consistency across geographically distinct populations represents a robust finding, likely reflecting the cumulative need for complex restorative interventions in adulthood, subsequent to years of dental pathology, extensive restorations, and eventual failure of prior treatments [11].

The finding that premolars represent the most frequently restored tooth type is strongly supported by international literature. This observation aligns consistently across various studies, with a radiographic analysis conducted in Yemen reporting an almost identical figure of 41.2% for premolars [2]. Other investigations done in the UAE and Saudi Arabia also indicated a substantial rate of post-retained restorations in premolars, ranging from 16.07% to 24.55% across different arch locations [1,4]. This preference for post placement in premolars is clinically justifiable. Premolars frequently exhibit minimal coronal dentin after extensive caries, trauma, and subsequent crown preparation, thereby necessitating a post for adequate core retention [12,13]. Their anatomical characteristics, including smaller pulp chambers and less

intrinsic tooth structures, further contribute to this requirement [4]. Additionally, premolars are particularly vulnerable to biomechanical failure because of their thin tapered roots and associated developmental grooves [14]. They are subjected to significant and complex lateral forces during mastication, which are amplified by their position in the dental arch, increasing their susceptibility to cusp deflection and fracture [15,16]. Normal masticatory forces in the premolar region can vary from 222 to 445 N, potentially escalating to 800 N under parafunctional habits such as clenching [14,16].

The high prevalence of post-retained restorations in molars is well documented, reflecting the substantial occlusal loads that these teeth endure [11]. While molars typically possess larger pulp chambers capable of providing sufficient retention for direct restorations, a post becomes indispensable when there is a significant loss of tooth structure [4,17]. This is particularly true for mandibular molars, which are commonly restored with posts [1].

Conversely, the lower frequency of post-retained restorations in anterior teeth is consistent with the principle that aesthetic considerations primarily guide treatment decisions in the aesthetic zone. In this region, non post options are generally preferred when clinically feasible [18]. Restorations of anterior teeth must withstand significant bending moments and contend with a comparatively small surface area available for bonding [19]. The heightened emphasis on achieving naturalistic aesthetics in the aesthetic zone further mandates the selection of restorative materials, such as zirconia and lithium disilicate, which can endure substantial stress levels without compromising aesthetic appeal [19]. Less invasive alternatives, such as veneers, are frequently considered more beneficial for endodontically treated anterior teeth than for full-coverage crowns, whenever appropriate [20,21].

The present radiographic study investigated the prevalence and distribution of post-retained restorations within a Saudi Arabian patient cohort and found that post placement was most common among males and predominantly in the 36-45 year age group. Premolars were the most frequently restored teeth, followed by molars and anterior teeth. Compared with previously published research, several points of agreement and divergence emerge, strengthening the external validity of the findings while highlighting unique population-specific characteristics. Regarding demographic trends, the current study observed a higher prevalence of post-retained restorations among male patients. This contrasts with the findings of Alawami S and Eldarrat A, who reported no significant gender differences in post-prevalence among 879 patients in the UAE [1]. This variation may stem from population-dependent factors, including differences in healthcare utilisation or oral health behaviour. However, both studies consistently identified the 36-45 year age group as having the highest frequency of post-treated teeth, suggesting that mid-adulthood is a critical period when accumulated restorative needs culminate in more complex rehabilitation procedures.

The tooth distribution patterns in the present study closely parallel the findings of several international studies. Premolars represented the most frequently restored teeth (39.4%), consistent with the findings of Alawami S and Eldarrat A, Issa AA et al., Nimigean VR et al., and Calapaj M et al., all of whom similarly identified premolars as the predominant tooth type requiring post placement [1,2,4,6]. The anatomical characteristics of the premolars, including smaller pulp chambers and thinner dentinal walls, make them more susceptible to extensive structural loss, thereby increasing the likelihood that a post is required for core retention. The present study also found a relatively high number of posts in molars, in agreement with the distribution trends reported by Almutairi AR and Mathar MI and Alshehri T et al., where molars formed the second most common group receiving post-restorations [3,5]. This finding is clinically logical, given the substantial occlusal forces borne by molars and their greater susceptibility to structural compromise following endodontic therapy.

When comparing radiographic quality parameters, the present study primarily focused on prevalence and distribution but also assessed post-type, post-length, post-width, and remaining gutta-percha. Most posts fell within the 1:3 category for both length and width, which deviates from ideal standards recommending a minimum length of two-thirds of the root or equal to the crown height. Similar deficiencies in radiographic quality have been widely reported in earlier studies. For instance, Issa AA et al., identified a high prevalence of inadequate post-length and insufficient apical seal, whereas both Almutairi AR and Mathar MI and Calapaj M et al., reported that the majority of posts placed by students failed to meet the ideal radiographic criteria [2,3,6]. Alshehri T et al., further highlighted that operator experience significantly influences radiographic outcomes, with undergraduate students demonstrating the highest deviation rates [5]. This trend suggests that inadequate training, limited clinical exposure, and variations in supervision may have contributed to technical inaccuracies. Although the present study did not specifically evaluate the operator level, the observed distribution of suboptimal post dimensions implies that similar challenges may be present, emphasising the need for improved instructional strategies in prosthodontic and endodontic education.

Another area of comparison relates to the post-type. The current study reported a predominance of GFPs (80.3%), which reflects contemporary trends favouring fiber-reinforced composite posts owing to their favourable biomechanical and aesthetic properties. Comparable studies, particularly recent ones [2,5], have also documented the widespread use of prefabricated fiber posts, demonstrating a shift away from traditional cast posts. This change is consistent with global trends and underscores clinicians' preference for materials with elastic moduli similar to dentin, potentially reducing the risk of root fractures. Similar studies from the literature have been compared in [Table/Fig-6] [1-5,8].

S. No.	Author's name and year	Place of study	Sample size	Objective	Parameters assessed	Conclusion
1	Alawami S and Eldarrat A (2024) [1]	United Arab Emirates	879 patients	To determine the prevalence and distribution of teeth with intraradicular posts	Tooth type, arch location, demographic factors	Prevalence highest in adults aged 36-45; no significant gender differences; premolars most frequently restored with posts
2	Issa AA, (2024) [2]	Sana'a, Yemen	524 radiographs	To radiographically evaluate the quality of post-crown restorations	Post-length, post-width, apical seal, type of post	High prevalence of inadequate post-length and insufficient apical seal; premolars most commonly restored
3	Mathar MI and Almutairi AR, (2020) [3]	Qassim University, Saudi Arabia	310 radiographs	To assess the radiographic quality of posts placed by dental students	Post-length, width, remaining gutta-percha, adaptation	Majority of posts did not meet ideal radiographic criteria; need for improved training
4	Alshehri T et al., (2024) [5]	Jazan University, Saudi Arabia	450 radiographs (4-year retrospective)	To compare post placement quality at different educational levels	Post-length, width, apical seal, type of post, operator level	Overall high rate of radiographic errors; undergraduate students showed most deviations

5	Nimigean VR et al., (2012) [4]	Bucharest, Romania	312 radiographs	To evaluate prevalence and radiographic characteristics of post-retained restorations	Tooth type, post-type, post adaptation	Premolars were the most frequently restored teeth; frequent errors in post-length and adaptation
6	Meshni AA et al., (2018) [8]	Jazan University, Saudi Arabia	286 radiographs	To assess radiographic quality of post-core restorations	Post-length, diameter, apical seal, remaining tooth structure	High proportion failed to meet ideal radiographic criteria; emphasised training and adherence to guidelines
7	Current study	College of Dentistry, King Khalid University, Saudi Arabia	625 radiographs screened; 71 teeth met criteria	To assess the prevalence, distribution, and radiographic quality of post-retained restorations in adult patients	Tooth type, arch, post-type, post-length, post-width, remaining GP (3-5 mm, >5 mm, overfilling, unacceptable), presence/absence of space	Most cases occurred in males and individuals aged 36-45; premolars most frequently restored; Glass Fiber Posts (GFP) predominantly used; majority showed suboptimal post-length and width; over half retained >5 mm GP; 15.5% showed overfilling or unacceptable GP condition; 70% showed no space between post end and GP

[Table/Fig-6]: Comparative overview of published studies on the prevalence and radiographic evaluation of post-restrained restorations.

Overall, the present study aligns closely with previously published findings regarding tooth type distribution, demographic trends, and technical shortcomings in post placement. However, unique aspects such as gender distribution and the high prevalence of posts in mandibular molars highlight population-specific restorative patterns. These comparisons underscore the importance of reinforcing clinical guidelines, improving radiographic evaluation skills, and enhancing student training to ensure the long-term success of post-retained restorations.

Limitation(s)

The present study has several limitations that should be considered when interpreting the results. First, the retrospective design relied solely on existing two-dimensional radiographs, which prevented the assessment of important clinical factors, such as ferrule presence, remaining tooth structure, and periodontal status. Second, the sample was limited to a single Institution with a relatively small number of post retention restorations, restricting the generalisability of the findings. Third, radiographic evaluation was performed by a single examiner, raising the possibility of observer bias owing to the lack of interexaminer reliability assessment. Finally, the study did not track clinical outcomes over time, making it impossible to correlate radiographic quality with long-term success or failure.

CONCLUSION(S)

The present study found that post-retained restorations were most prevalent among middle-aged male patients, with premolars and mandibular molars comprising the majority of the treated teeth. GFPs were the most frequently used, although many restorations did not meet the ideal radiographic criteria for post-length, width, or apical seal. The current study findings highlight the persistent gaps in clinical execution, despite clear prosthodontic guidelines, and emphasise the need to strengthen clinical training and radiographic assessment skills among practitioners. The key takeaway is that while post placement is common, significant deviations from ideal standards remain, underscoring the need for improved adherence to evidence-based restorative protocols. Future research should prioritise prospective clinical studies that correlate radiographic findings with clinical examinations, specifically to assess ferrule quality and periapical health. These investigations need to track restorations longitudinally to determine survival rates and failure modes, while simultaneously investigating the impact of various post materials. Furthermore, studies should extend to exploring the underlying clinician decision-making processes to provide a holistic view of treatment outcomes.

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