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Dentists' Perceptions, Ethical Beliefs, and Clinical Practices Related to Regenerative Therapy in Melaka, Malaysia

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Abstract

Introduction: The aim of present study was to assess the knowledge, ethical beliefs, and clinical practices of regenerative dental therapy among private practitioners in Melaka, Malaysia. Methods: A validated questionnaire was used to conduct a cross-sectional survey involving 114 private practitioners who were randomly selected. Following ethical approval, the questionnaire was made available online. SPSS version 25.0 was used to analyze data from 103 respondents. Chi-square and Fisher's exact tests were performed. $P < 0.05$ was considered significant. Results: Among the participants, 66.02% agreed that regenerative endodontic therapy should be an essential component in dentistry; however, only 23.3% reported performing these procedures. 87.38% preferred preserving teeth and dental tissues over implants for future regenerative use, although 55.34% believed that regenerative treatments yield better outcomes than implants or prostheses. A significant correlation was observed between gender and treatment outcomes ($P = 0.015$), between years of clinical experience and the readiness to preserve dental tissues ($P = 0.001$), and between economic perceptions of treatment and the desire to preserve dental tissues ($P = 0.000$).Conclusion: A fair level of awareness and positive attitude towards regenerative dental therapy was observed among private practitioners in Melaka, Malaysia, but they reported limited clinical experience. To further enhance the knowledge, clinical skills, and application of regenerative dentistry in Malaysia, continuing professional education and training is crucial.

Keywords: *Regenerative dental therapy, awareness, perception, private dental practitioners, Malaysia, questionnaire study*

Introduction

The human body possesses a remarkable ability for self-repair and regeneration. Advances in tissue engineering and biomaterial science have expanded this potential by enabling the regeneration or replacement of diseased tissues with biologically architected constructs, including teeth and supporting oral structures, to restore

essential function and aesthetics.[1] Regenerative dentistry is an interdisciplinary field combining engineering and life sciences and aims to develop biological substitutes that restore, maintain, and improve oral tissue function.[2] The fundamental triad of regenerative therapy: stem cells, scaffolds, and signalling molecules, forms the basis of contemporary tissue-engineered approaches. Within dentistry, regenerative concepts have already been translated into several clinical disciplines, such as guided bone regeneration in periodontics, sinus augmentation in oral and maxillofacial surgery, and revascularization therapy in endodontics.[3]

Globally, however, knowledge and practical adoption of regenerative approaches remain inconsistent. Surveys conducted in Saudi Arabia on the knowledge and attitude towards stem cells reported limited understanding among dental graduates[4], similar studies carried out in Nigerian and Pakistani dentists similarly revealed moderate awareness but inadequate clinical training and infrastructure to support the implementation of regenerative procedures[5,6] In India, studies by Mayya et al.[7], Naik et al.[8], and Goyal et al.[9] indicated a positive attitude among practitioners toward regenerative endodontics but noted substantial gaps in protocol knowledge and hands-on exposure. Al-Shahrani et al.[3] further highlighted that only one-third of Saudi clinicians had received training in regenerative dentistry, despite growing interest in integrating these therapies into clinical practice.

Previous research carried out by Jamal. H et al. in 2020[2] and 2022[10] advocated for the systematic integration of regenerative dentistry into dental education to prepare future clinicians for biological evidence-based treatment. In developing nations like Pakistan, Khawaja et al. observed that although more than 90% of respondents were aware of regenerative dentistry, limited training, high costs, and lack of institutional support continued to impede routine practice.[6]

Based on the systematic review by Xuan et al,[11] limited studies have been conducted on the development, characterization, and clinical application of regenerative materials in Malaysia across universities and research institutions. To the best of our knowledge, no previous studies have evaluated private practitioners' perspectives on regenerative approaches in Malaysia. Therefore, the present study aimed to assess the awareness and perception of regenerative dental therapy among private dental practitioners in Melaka, Malaysia, through a self-administered questionnaire, and to identify potential educational and practical barriers to its implementation.

Methodology

Ethical approval was obtained from the Research Ethics Committee, Manipal University College Malaysia (MUCM/FOD/AR/B8/E C-2021(07). This study is a cross-sectional questionnaire-based survey conducted from July 2022 through the end of data collection in January 2023. This online survey used the validated questionnaire adopted from Al-Shahrani et al.[3] with some modifications made to meet the targeted population[5]. The self-administered questionnaire consists of 4 sections; the first section consists of 1 question related to participants' Demographic Information, the second and third sections consist of 4 questions on participants' Professional Status and Ethical Opinion, Belief & Judgement, respectively, and 7 questions related to participants' Clinical Practice regarding regenerative therapy in dentistry in the fourth section. 114 participants were randomly selected from private dental practitioners in Melaka, and the self-administered online questionnaire was distributed to them via their email addresses after approval from the Human and Ethics Committee of Manipal University College Malaysia. Informed consent was obtained from each participant. The data collected were analyzed using SPSS version 25.0 (Statistical Package for the Social Sciences). Descriptive statistics were done to get the frequencies (n) and percentages (%), while inferential statistics were done by using Pearson's Chi-square test and Fisher's Exact test to identify significant correlations. A two-sided $P<0.05$ was considered statistically significant in 95% confidence intervals.

Results

The descriptive statistic of this survey is presented in Table 1. Of the 114 private dental practitioners randomly selected, 103 provided informed consent to participate in this cross-sectional questionnaire-based study.

Demographic information

Out of 103 (90.35%) participants, 30.10% (n=31) were male and 69.90% (n=72) were female. (Table 1)

Table 1: Sociodemographic profile and professional status

Variable		n (%)
Gender	Male	31 (30.1)
	Female	72 (69.9)
Specialty	Endodontist	0
	Pedodontist	0
	General Practitioners	92 (89.32)
	Post-graduate	2 (1.94)
	Other specialties	9 (8.74)
Years of clinical practice	0-10	69 (66.99)
	11-20	22 (21.36)
	>20	12 (11.65)
Frequency of reading scientific journals	Rarely	34 (33.01)
	Occasionally	48 (46.6)
	Randomly	17 (16.5)
	Never	4 (3.88)
Attending continuing education in stem cells and/or regenerative dental treatments?	Yes	18 (17.48)
	No	85 (82.52)

Professional status

Among all the private dental practitioners, most responses (89.32%, n=92) were from general practitioners, and the remaining 1.94% (n=2) and 8.74% (n=9) were from post-graduates and dental practitioners from other specialties, respectively. Most participants (66.99%, n=69) had less than 10 years of clinical experience, while the remaining 33.01% had more than 10 years; only 11.65% (n=12) had been working for more than 20 years. Occasional reading of scientific journals was done by 46.6% (n = 48), whereas 3.88% (n=4) had never read it. More than half of the participants (82.52%, n=85) had never attended courses on stem cells and/or regenerative dental treatments, while the remaining 17.48% (n=18) had. (Table 1)

Ethical Opinion, Belief & Judgment

Most of the participants (66.02%, n=68) believed that regenerative therapy should be incorporated into dentistry, and 87.38% (n=90) were willing to save teeth & dental tissue for future regenerative dental treatment. More than half of the participants (55.34%, n=57) were opinionated that regenerative dental treatment would be a better treatment option when compared to implant or prosthesis placement and the results showed that there is a significant difference between the two genders (*P=0.021*), and more than half of the participants (62.14%, n=64) also had an opinion that stem cells & regenerative treatments should be tested on animals before clinical testing, unlike 15 of them (14.56%) who had believed otherwise. There is a significant difference regarding this opinion between practitioners with different years of clinical experience (*P=0.001*). (Table 2)

Clinical Practice

Twenty-three participants (23.3%) used various materials in their regenerative procedures, but only 19 (18.45%) had a successful outcome. There is a significant difference between males and females regarding the outcomes of regenerative therapy (*P=0.015*). A larger proportion of participants (82.52%, n=85) had encountered fewer than 10 cases involving avulsed or traumatized teeth. This is like cases involving peri-radicular lesions (34.95%, n=36). Apart from that, most participants chose calcium hydroxide application, followed by MTA apical plug and obturation material backfilling, as the optimal treatment for necrotic immature teeth (45.60%, n=47). Approximately half of the participants (47.75%, n=49) believed that regenerative dental treatment is safe and reliable, and they would recommend it to their patients; however, there was a significant difference between practitioners with different years of clinical practice (*P=0.027*). Most participants (36.89%, n=38) believed that the cost of regenerative treatment in dentistry should

exceed that of current therapy, and there was a significant difference on this matter between practitioners with different years of clinical practice (*P=0.000*). (Table 2)

Table 2: Ethical opinions, belief, judgement and clinical practice.

Question	n (%)			
6. Should regenerative therapy be incorporated into dentistry?	Yes 68 (66.02)	No 1 (0.97)	Maybe 34 (33.01)	-
7. Would you be willing to save teeth and dental tissue for future regenerative dental treatment?	Yes 90 (87.38)	No 0	Unsure 13 (12.62)	-
8. Do you think that regenerative dental treatment will be a better treatment option than implant/prosthesis placement?	Yes 57 (55.34)	No 1 (0.97)	Unsure 45 (43.69)	-
9. Do you think stem cells and regenerative treatments should be tested on animals prior to clinical testing?	Yes 64 (62.14)	No 15 (14.56)	Unsure 24 (23.3)	-
10. Do you use any type of regenerative procedures in your practice, such as membranes, scaffolds, bioactive materials or grafts?	Yes 24 (23.3)	No 79 (76.7)	-	-
11. What is your assessment of regenerative dental treatment outcomes?	Successful 19 (18.45)	Unsuccessful 1 (0.97)	Not sure 83 (85.58)	-
12. What percentage of cases in your practice involves avulsed or traumatized teeth?	<10 85 (82.53)	11-25 12 (11.65)	26-50 5 (4.85)	>50 1 (0.97)
13. What percentage of cases in your practice involves peri-radicular lesions?	<10 36 (34.95)	11-25 26 (25.24)	26-50 30 (29.13)	>50 11 (10.68)
14. What do you consider to be the optimal treatment for immature necrotic teeth?	Calcium hydroxide apexification	Calcium hydroxide application followed by MTA apical plug and backfilling with obturation material	MTA apical plug and back-fill with obturation material	Tribiotic paste and pulpal regeneration
15. What would make you most likely recommend stem cell and regenerative dental treatments to your patients?	If it is the most effective treatment option 40 (38.83)	It is safe and reliable 49 (47.57)	If it is the most cost-effective option 9 (8.73)	I would never recommend it 5 (4.9)
16. What should be the cost for regenerative dentistry	Equal to current treatment 29 (28.16)	More than current treatment 38 (36.89)	Less than current treatment 8 (7.77)	Unsure 28 (27.18)

Table 3: Association between dental practitioners' gender and ethical opinion, belief and judgement on regenerative therapy.

Question	Total n (%)	Male n (%)	Female n (%)	*P-value*
6. Should regenerative therapy be incorporated into dentistry?				
Yes	68 (66.0)	21 (20.4)	47 (45.6)	
No	1 (1.0)	0	1 (1.0)	0.999[b]
Maybe	34 (33.0)	10 (9.7)	24 (23.3)	
7. Would you be willing to save teeth and dental tissue for future regenerative dental treatment?				
Yes	90 (87.4)	27 (26.2)	63 (61.2)	
No	0	0	0	0.999[b]
Not sure	13 (12.6)	4 (3.9)	9 (8.7)	
8. Do you think that regenerative dental treatment will be a better treatment option than implant/prosthesis placement?				
Yes	57 (55.3)	23 (22.3)	34 (33.0)	
No	1 (1.0)	0	1 (1.0)	0.021[b]
Not sure	45 (43.7)	8 (7.8)	37 (35.9)	
9. Do you think stem cells & regenerative treatments should be tested on animals prior to clinical testing?				
Yes	64 (62.1)	24 (23.3)	40 (38.8)	
No	15 (14.6)	1 (1.0)	14 (13.6)	0.053[a]
Not sure	24 (23.3)	6 (5.8)	18 (17.5)	

Table 4: Association between dental practitioners' gender and clinical practice on regenerative therapy

Question	Total	Male, n (%)	Female, n (%)	*P-value*
10. Do you use any type of regenerative procedures in your practice, such as membranes, scaffolds, bioactive materials or grafts?				
Yes	24 (23.3)	10 (9.7)	14 (13.6)	0.204[a]
No	79 (76.7)	21 (20.4)	58 (56.3)	
11. What is your assessment of regenerative dental treatment outcomes?				
Successful	19 (18.4)	10 (52.6)	9 (8.7)	0.015[b]
Unsuccessful	1 (1.0)	1 (1.0)	0	
Not sure	83 (80.6)	20 (19.4)	63 (61.2)	
12. What percentage of cases in your practice involves avulsed or traumatized teeth? (%)				
<10	85 (82.5)	27 (26.2)	58 (56.3)	0.682[b]
11-25	12 (11.7)	2 (1.9)	10 (9.7)	
26-50	5 (4.9)	2 (1.9)	3 (2.9)	
>50	1 (1.0)	0	1 (1.0)	
13. What percentage of cases in your practice involves periradicular lesions? (%)				
<10	36 (35.0)	14 (13.6)	22 (21.4)	0.385[a]
11-25	26 (25.2)	5 (4.9)	21 (20.4)	
26-50	30 (29.1)	8 (7.8)	22 (21.4)	
>50	11 (10.7)	4 (3.9)	7 (6.8)	
14. What do you consider to be the optimal treatment for immature necrotic teeth?				
$Ca(OH)_2$ apexification	19 (18.4)	5 (4.9)	14 (13.6)	0.877[a]
$Ca(OH)_2$ + MTA + backfill	47 (45.6)	13 (12.6)	34 (33.0)	
MTA + backfill	19 (18.4)	7 (6.8)	12 (11.7)	
TAP + pulpal regeneration	18 (17.5)	6 (5.8)	12 (11.7)	
15. What would make you most likely recommend stem cell & regenerative dental treatments to your patients?				
Most effective	40 (38.8)	13 (32.5)	27 (26.2)	0.548[b]
Safe & reliable	49 (47.6)	12 (11.7)	37 (35.9)	

Most cost effective	9 (8.7)	4 (3.9)	5 (4.9)	
Never recommend	5 (4.9)	2 (1.9)	3 (2.9)	
16. What should the cost for regenerative dentistry be?				
= current	29 (28.2)	5 (4.9)	24 (23.3)	0.083[a]
> current	38 (36.9)	17 (16.5)	21 (20.4)	
< current	8 (7.8)	2 (1.9)	6 (5.8)	
Not sure	28 (27.2)	7 (6.8)	21 (20.4)	

Table 5: Association between years of clinical practice and ethical opinion, belief, and judgement on regenerative therapy among dental practitioners.

Question	Total	0-10, n (%)	11-20, n (%)	>20, n (%)	*P-value*
6. Should regenerative therapy be incorporated into dentistry?					
Yes	68 (66.0_	49 (47.6)	14 (13.6)	5 (4.9)	0.083[b]
No	1 (1.0)	0	0	1 (1.0)	
Maybe	34 (33.0)	20 (19.4)	8 (7.8)	6 (5.8)	
7. Would you be willing to save teeth and dental tissue for future regenerative dental treatment?					
Yes	90 (87.4)	66 (64.1)	16 (15.5)	8 (7.8)	0.001[b]
No	0	0	0	0	
Not sure	13 (12.6)	3 (2.9)	6 (5.8)	4 (3.9)	
8. Do you think that regenerative dental treatment will be a better treatment option than implant/prosthesis placement?					
Yes	57 (55.3)	40 (38.8)	11 (10.7)	6 (5.8)	0.835[b]
No	1 (1.0)	1 (1.0)	0	0	
Not sure	45 (43.7)	28 (27.2)	11 (10.7)	6 (5.8)	
9. Do you think stem cells & regenerative treatments should be tested on animals prior to clinical testing?					
Yes	64 (62.1)	40 (38.8)	15 (14.6)	9 (8.7)	0.667[b]
No	15 (14.6)	10 (9.7)	4 (3.9)	1 (1.0)	
Not sure	24 (23.3)	19 (18.4)	3 (2.9)	2 (1.9)	

Table 6: Association between years of clinical practice and clinical practice on regenerative therapy among dental practitioners in Melaka

Question	Total	0-10, n (%)	11-20, n (%)	>20, n (%)	*P-value*
10. Do you use any type of regenerative procedures in your practice, such as membranes, scaffolds, bioactive materials or grafts?					
Yes	24 (23.3)	15 (14.6)	6 (5.8)	3 (2.9)	0.938[b]
No	79 (76.7)	54 (52.4)	16 (15.5)	9 (8.7)	
11. What is your assessment of regenerative dental treatment outcomes?					
Successful	19 (18.4)	10 (9.7)	6 (5.8)	3 (2.9)	0.158[b]
Unsuccessful	1 (1.0)	0	1 (1.0)	0	
Not sure	83 (80.6)	59 (57.3)	15 (14.6)	9 (8.7)	
12. What percentage of cases in your practice involves avulsed or traumatized teeth? (%)					
<10	85 (82.5)	56 (54.4)	21 (20.4)	8 (7.8)	0.114[b]
11-25	12 (11.7)	8 (7.8)	0	4 (3.9)	
26-50	5 (4.9)	4 (3.9)	1 (1.0)	0	
>50	1 (1.0)	1 (1.0)	0	0	
13. What percentage of cases in your practice involve periradicular lesions? (%)					
<10	36 (35.0)	20 (19.4)	10 (9.7)	6 (5.8)	0.543[b]
11-25	26 (25.2)	20 (19.4)	5 (4.9)	1 (1.0)	
26-50	30 (29.1)	20 (19.4)	6 (5.8)	4 (3.9)	
>50	11 (10.7)	9 (8.7)	1 (1.0)	1 (1.0)	

14. What do you consider to be the optimal treatment for immature necrotic teeth?					
$Ca(OH)_2$ apexification	19 (18.4)	10 (9.7)	5 (4.9)	4 (3.9)	0.348[b]
$Ca(OH)_2$ + MTA + backfill	47 (45.6)	31 (30.1)	11 (10.7)	5 (4.9)	
MTA + backfill	19 (18.4)	15 (14.6)	4 (3.9)	0	
TAP + pulpal regeneration	18 (17.5)	13 (12.6)	2 (1.9)	3 (2.9)	
15. What would make you most likely recommend stem cell & regenerative dental treatments to your patients?					
Most effective	40 (38.8)	26 (25.2)	10 (9.7)	4 (3.9)	0.027[b]
Safe & reliable	49 (47.6)	37 (35.9)	7 (6.8)	5 (4.9)	
Most cost effective	9 (8.7)	5 (4.9)	4 (3.9)	0	
Never recommend	5 (4.9)	1 (1.0)	1 (1.0)	3 (2.9)	
16. What should the cost for regenerative dentistry be?					
= current	29 (28.2)	21 (20.4)	8 (7.8)	0	0.000[b]
> current	38 (36.9)	31 (30.1)	5 (4.9)	2 (1.9)	
< current	8 (7.8)	1 (1.0)	5 (4.9)	2 (1.9)	
Not sure	28 (27.2)	16 (15.5)	4 (3.9)	8 (7.8)	

Associations Between Demographic Variables and Study Domains

Further analysis was conducted to explore associations between demographic characteristics and practitioners' responses (Tables 3–6). A significant association was observed between gender and reported treatment outcomes ($P = 0.015$), with male practitioners reporting higher success rates for regenerative procedures than female practitioners. years of clinical experience also significantly influenced practitioners' perspectives. Practitioners with over ten years of experience demonstrated a markedly greater willingness to preserve teeth and dental tissues for future regenerative treatments ($P = 0.001$). They also reported greater acceptance of animal testing prior to clinical application ($P = 0.027$*). Furthermore, experience was significantly correlated with perceptions of treatment costs ($P = 0.000$), with senior practitioners more likely to acknowledge the increased material and procedural expenses associated with regenerative therapies. No significant association was found statistically between academic qualification and practitioners' ethical opinions or clinical practice of regenerative techniques ($P > 0.05$). However, practitioners with postgraduate training generally demonstrated greater awareness of regenerative protocols, even though the difference did not reach statistical significance.

Overall, the inferential findings suggest that practitioner experience and gender are key factors influencing awareness, ethical stance, and perception toward regenerative dental therapy among private practitioners in Melaka.

Discussion

This study aimed to assess the current level of awareness among private dental practitioners in Melaka towards regenerative therapy. Regenerative therapy represents a paradigm shift in endodontic practice and has shown high potential. It has been incorporated into practice in many countries. However, in Malaysia, there is a paucity of research on this topic, and to date, no studies have explored the opinions and perspectives of private dental practitioners on regenerative therapy. This study thus provides a timely and valuable baseline for understanding the current awareness of regenerative endodontic practices in the Malaysian private dental sector. This study adopted the questionnaire from Al-Shahrani et al.[3] with a few modifications made to meet the target population.[5] Most of the participants approached for this study were general practitioners in private dental clinics in Melaka with less than 10 years of clinical experience. 34% of the participants occasionally

read scientific journals to stay updated on recent advances in dentistry. However, very few of them had attended continuing education in stem cells and regenerative dental treatments. Similar findings were presented by Al-Shahrani et al.[3], who found that most participants had not received continuing education. Naik et al.[8], also reported that, although there was an increased interest, practitioners lacked knowledge of disinfection procedures and scaffold properties, which could be due to limited training. Another study by Khawaja et al.[6] showed that 91.7% of participants were aware of regenerative treatment protocols, and 66.7% agreed that inadequate training was the barrier to clinical practice. Further, Mayya et al.[7] reported that only 44.8% of the endodontists surveyed demonstrated adequate knowledge of regenerative endodontic procedures, even though 86.5% believed that such therapies should be a fundamental part of dentistry. Among participants, 66.02% agreed that regenerative therapy should be incorporated into dentistry, and 87.38% were willing to preserve teeth and dental tissue for future regenerative dental treatment. There was a significant difference in opinion among practitioners with different years of experience. Similar results were reported by Al-Shahrani et al.[3] and Al-Qahtani et al.[12]

Most of the participants believed that regenerative dental treatment was a better option than implant/prosthesis placement. This was consistent with the findings of Goyal et al.[9], who reported that Indian practitioners preferred regenerative endodontic approaches over prosthetic alternatives because of the biomechanical advantages of natural dentition.

Among the participants, 62.14% supported animal testing before clinical trials for stem cell and regenerative therapies. This indicated their awareness that initial animal trials should be conducted before initiating new treatment approaches to ensure safe and effective treatment outcomes.[13] This highlights that Malaysian dentists understood that scientific validation and regulation of new treatments are essential before widespread clinical use is implemented. The study by Naik et al.[8], emphasized that even though practitioners were aware of the ethical considerations in implementing new treatments, they lacked significant understanding of the research steps required before clinical application.

The present study's findings reveal that male practitioners reported higher success rates in regenerative procedures *(P = 0.015)* compared to female participants. This could be due to differences in experience or confidence in performing these procedures. Similar differences were noted by Hatipoğlu et al.[14] in their multi-country study, where male clinicians performed more regenerative procedures, possibly due to greater academic involvement or access to training. Only 23.3% of practitioners in the current study reported performing regenerative procedures, such as bone grafting or scaffold placement. This could be due to barriers in accessibility to materials, patients, and training, particularly among general practitioners. Most participants (85.58%) were uncertain of the treatment outcomes, once again highlighting the need for clinical training and hands-on workshops. Similar results have been observed in studies by Al-Shahrani et al.[3] and Sede et al.[5], indicating that regenerative dental practice remains confined mainly to specialized settings. Khawaja et al.[6] reported that despite high awareness, only 28.9% of respondents had performed regenerative endodontic procedures and 32.8% used guided tissue regeneration, confirming a gap between awareness and practice. Lee et al.[15] also reported that, while 60% of endodontists had attempted regenerative procedures, most had performed fewer than three procedures annually.

Among the private dental clinics in Melaka, most participants had fewer than 10% of cases involving avulsed or traumatized teeth and peri-radicular lesions, with 82.53% and 34.95%, respectively. This may be because most participants (66.99%) had less than 10 years of clinical practice. A similar demographic pattern was observed by Mayya et al.[7] When selecting the treatment plan for necrotic immature teeth, most participants,45.60% chose calcium hydroxide application, followed by an MTA apical plug and backfilling with obturation material. This shows that the participants were

aware of the benefits of calcium hydroxide and MTA. This finding is supported by studies by Al-Shahrani et al.[3] and reinforced by Naik et al.[8], who also found that MTA apical plug placement is the preferred treatment among general practitioners despite limited knowledge of regenerative alternatives.

4.9% of participants said they would never recommend stem cell and regenerative treatments to their patients, indicating that most practitioners recognize the potential benefits of this approach and would suggest it when appropriate. It was observed that economic considerations significantly influence the acceptance of regenerative therapy; about 36.89% of participants believed that regenerative treatments should be priced higher than traditional methods, and 27.18% lacked certainty. This disparity revealed a lack of knowledge related to the long-term financial benefits of regenerative procedures. Some practitioners felt that these treatments were premium, while others were uncertain about affordability and patient acceptance. Khawaja et al.[6] reported that 52.9% of respondents identified high cost as a significant barrier to taking up regenerative treatment, due to economic and infrastructural challenges in developing countries. Mayya et al.[7] and Goyal et al.[9] also noted the institutional and financial limitations that affect the practice of regenerative procedures.

In summary, the present study reveals a significant knowledge and training gap that hinders the use of regenerative procedures in clinical practice, even though many participants understand the role of regenerative endodontics. A desperate need for organised professional training is evident, as only 17.48% of participants had participated in stem cell- or regenerative dentistry courses. This finding is similar to reports from previous studies by Al-Shahrani et al.[3], Mayya et al.[7], and Naik et al.[8], where most dentists reported limited experience with regenerative concepts. The survey report by Jamal et al,[10] also recommends structured integration of regenerative biology, tissue engineering, and molecular principles into the dental curriculum to prepare dental graduates for the application of regenerative endodontics in clinical practice.

The present research is among the first regional studies to assess private practitioners' perspectives on regenerative dentistry in Malaysia. Compared to studies conducted in Saudi Arabia[2,3,4], Pakistan[6], Nigeria[5], India[7,8], and the multi-country analysis by Hatipoğlu et al.[14], our research shows that Malaysian dentists display comparable levels of awareness but face similar challenges in clinical practice. Promoting regenerative dentistry in Malaysia requires strengthening institutional policies and collaboration, as well as improving professional education.

The current study is limited by reliance on subjective data and regional focus. Hence, future multicentric longitudinal assessments throughout Malaysia could effectively measure the depth of knowledge and implementation of regenerative practices.

Conclusion

Private dental practitioners in Melaka had moderate awareness of regenerative therapy and were willing to preserve teeth and dental tissue for future regenerative treatments. However, they had limited exposure to this approach in their clinical practice; therefore, more training and continuing education should be made accessible to everyone, including general practitioners, to enhance awareness and understanding of this treatment option and help them deliver effective treatment plans for their patients.

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