

A Cross-sectional Survey on the Use of Magnification Device in Mainstream Dental Practice

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ABSTRACT

This study was conducted to explore the characteristics of general dental practitioners who use magnification, their perception of using the devices routinely and to identify factors affecting the decision to use magnification aids. In this survey, respondents were approached via convenience sampling in six dental conferences from northern, central, and southern regions of Malaysia. A total of 582 dentists completed the self-administered questionnaire survey which consisted of items on demographics, pattern of magnification device use and perceptions associated with use of the devices. Respondents were mostly females (64.9%), from the urban setting (48.9%), government-employed (59.0%), and did not have any post-graduate qualifications (95.2%). Only one-quarter (24.9%) of the respondents used magnification devices in their clinical practice. Dental loupe without illumination is the most common device employed (43.7%), followed by dental loupe with illumination (32.5%) and dental operating microscope (23.8%). Factors that were associated with magnification use were gender, years of practice, practice setting, postgraduate qualification, and prior training (Fisher's exact test, $p < 0.005$). The main reasons cited for using magnification devices were related to visual acuity (91.1%) and body posture (8.9%) while the main reasons for not using such devices were cost (38.5%) and lack of exposure (34.8%). Mainstream dental practitioners in this study are inclined towards the use of magnification devices if the price is within acceptable range. There is a need to make such devices affordable and to include their use in the training of dental students.



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1. INTRODUCTION

The necessity for acute visual ability during clinical work requires dentists to adopt the use of magnification devices as bridging tools between the naked eyes and the microscope. The use of such devices has been shown to enhance dentists' visualization and improve their working posture [1]. Furthermore, recent studies support the use of dental operating microscope (DOM) and loupes in the ability to significantly improve clinical outcomes and this is especially applicable for procedures requiring visual enhancement of the surgical field such as endodontics [2- 4]. Dentists in the United Kingdom and the United States demonstrate

an increasing use of magnification devices [5- 8], but at the same time Turkish dentists (85.8%) especially those who served in the public institutions remain resistant to this practice [9]. Across the globe, higher users are among dentists with more than fifteen years' experience, and those who are clinical trainers [7], [10]. Among factors that encourage clinicians to use magnification devices are exposure to these devices at conferences, peer influence, and awareness on the benefits of using such technology [1]. Alternatively, factors that dissuade its usage are increased treatment time, steep learning curve, issues with infection control, and positional difficulties especially when treating the mandibular molars [1].

In Malaysia, there are 10,817 active dentists in 2019, out of which 66% were working in the public sector, and only 1.6% of dentists were clinical specialists [11]. Out of these clinical specialists, there are even fewer specialists in endodontics, and therefore most of the endodontic treatment is performed by mainstream dental practitioners [12]. As such, this study explores the characteristics of dentists who use magnification, their pattern of use, and their perception towards routine use. Identifying enabling factors and barriers towards magnification use will be useful in the planning of dental curriculum as well as continuous professional development updates for existing dentists.

2. MATERIALS AND METHODS

2.1 Setting and design

A cross-sectional questionnaire study was designed for this research. Respondents were approached via convenience sampling in six dental conferences held in 2018, sampled from the northern, central, and southern regions of West Malaysia as well as East Malaysia. The inclusion criteria for the respondents are dentists practicing in Malaysia with valid Malaysian Dental Council Registration Numbers while the exclusion criteria are those who do not perform any endodontic treatment. The questionnaire was conducted face-to-face and self-administered by the respondents. Participation was voluntary and written informed consent was obtained once the respondents had read and understood the study information sheet.

2.2 Sample size calculation

The sample size was determined using the Creative Research Systems Sample Size Calculator. (<https://www.surveysystem.com/sscalc.htm>) with Type I error rate set at 0.05 and the power of the study at 80%. 501 respondents were required to satisfy the requirement for analysis of a cross-sectional study. The sample size was increased by more than 15% to account for potential non-responses due to participant ineligibility and incomplete responses [13].

2.3 Questionnaire development and testing

The questionnaire developed was in English language and consisted of three parts: Part A – demographic data and past exposure to training with magnification devices, Part B – pattern and perception of use among dentists who used magnification, and Part C – perception on magnification among dentists who do not employ magnification. To ensure face validation of the questionnaire, a focused group discussion was done with a group of clinical postgraduate students from various dental specialties followed by content validation by two dental specialists (Endodontology and Dental Public Health). Several items were amended to improve on the sentence structure, wording, and page layout. Test-retest reliability was then conducted on another group of postgraduate students with a week apart. The intra-observer agreement was excellent ($\kappa = 0.972$).

2.4 Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences, software version 22.0 for

Windows (IBM; SPSS Inc., Chicago, IL, USA). Descriptive analysis was used to define the characteristics of the variables using numbers and percentages. To establish an association between groups, the chi-square test or Fisher's exact test was performed, and statistical significance was recognized when $p < 0.05$.

3. RESULTS

Completed questionnaires were received from 582 respondents, however, 40 were rejected due to ineligibility to participate giving only 542 valid respondents (91.9% response rate). Table 1 showed the characteristics of the respondents. They were mostly females (64.9%), from the urban setting (48.9%), government-employed (59.0%), and did not have any post-graduate qualifications (95.2%). Only one-quarter (24.9%) of the respondents used magnification devices for endodontic treatment. When compared with non-users of magnification devices (Table 2), users tended to have had more years of practice ($p < 0.001$). In addition, the use of magnification was significantly higher among males (34.2%) as compared to females (19.9%) ($p < 0.001$). With regards to the practice setting, the highest users were from urban settings and the highest non-users were from rural settings - these differences were found to be significant ($p < 0.0083$, post-hoc Bonferroni test). There were significantly more magnification users in private practice than those in the government. Furthermore, there was also a significantly higher proportion of magnification users among those who had undergone specialist training, those who had training in magnification during undergraduate studies, and those who had attended short courses on magnification ($p < 0.001$).

Table 3 describes the patterns of magnifications used. The most common magnification device used was dental loupes without LED light (43.7%) followed by dental loupes with LED light (32.5%) and DOM (23.8%). Among those who used magnification devices for endodontics, 46.7% of them used magnification only for selected procedures. The most common procedure performed under magnification was to locate canal orifices (42.5%), followed by cleaning and shaping (22.3%) and canal obturation (14.9%). The most common reason (91.1%) cited for using magnification devices was to enhance visual acuity, while the remaining stated ergonomic reasons. With regards to the benefits of applying magnification, the most frequently cited advantage was improved quality of clinical work (38.4%), followed by higher confidence in clinical procedures (30.8%) and reduced musculoskeletal strain (20.9%).

In contrast, Table 4 illustrates non-users' responses to magnification devices. The most common reason cited for not using magnification devices is its high cost (38.5%), followed by a lack of exposure to the technology (34.8%) and not managing endodontic cases frequently (11.3%). However, most of them (94.8%) were willing to use magnification devices if there is no financial constraint with 73.7% of them preferred loupes with LED light.

4. DISCUSSION

This study was designed to investigate the patterns of magnification use among mainstream dental practitioners whereby its findings will be used to enable effective design of related educational programs. Additionally, the behaviour and perspective of dental practitioners in adopting this technology can be better explained and this information can be used for CPD courses and workshops. This study however was conducted using a convenience sampling method and therefore could possibly under-represent magnification device users who were not at any of the conferences which formed the sampling frame. We found that only about a quarter of study respondents used some form of magnification device. This proportion is lower than countries such as the United Kingdom [10], the United States [14], Belgium [15], and Saudi Arabia [16]. There were more users among males and private practitioners, reflecting the higher proportion of male dental practitioners in the private sector as listed in the Malaysian Dental Council

Registrar's Report for 2019 [11]. In addition, practitioners in the urban area were more inclined to use magnification devices. This inclination could be explained by a higher demand for endodontic treatment among urban dwellers which can be related to their lifestyle, working environment, and quality of life [17]. This demand for dentists to provide a higher standard of dental care may have caused practitioners to adopt the use of magnification devices. Furthermore, private dentists have the liberty to choose their own clinical armamentarium unlike their public sector counterparts who are dependent on government resource allocation and purchasing procedures. Another observation is that exposure to magnification devices during undergraduate studies and participation in short courses on magnification appear to promote the adoption of the said devices in clinical practice. There was no apparent influence of postgraduate training on the use of magnification in this sample perhaps due to the small number of specialists captured in the sampling frame.

With regards to the type of magnification device used, many of the respondents used dental loupes without LED light due to its affordability. The level of magnification provided by loupes is sufficient for mainstream dental practice because the field and depth of view are suitable across various types of restorative dental work. The devices are used selectively for certain endodontics procedures, but particularly for location of sclerosed root canal. A greater degree of magnification offers a higher chance to locate additional canals which will determine the success of the treatment [4], [18]. In addition, other stages in endodontics such as pre-endodontic restoration, cavity access, canal shaping and cleaning, obturation, and post-endodontic restoration may be perceived to be less critical in need of magnification. More specialists in this study prefer to use microscope in endodontics because they treat more complex cases hence the use of magnification devices with higher visual power would be required. Meanwhile, dental loupes, which is considered as higher-end best practice, is preferred by private practitioners probably because they have the autonomy to make purchase decisions. The use of magnification in dental practice is essentially for the purpose of enhancing visual acuity but this study also found a small proportion of the respondents who claimed to use it for ergonomic benefits. This finding could foreshadow the existence of practitioners who are suffering from some form of musculoskeletal disorders. Regional surveys among dental students, dental auxiliaries, and dental surgeons reported the prevalence of musculoskeletal pain ranging from 44.9% to 79.5% [19], [20]. Considering the possible impact of musculoskeletal disorder on one's duration of professional career, awareness of ergonomic health ought to be cultivated from the start of undergraduate training. Respondents perceived that improved technical quality and confidence in performing endodontics procedures, concurring to other similar studies [12], [21], [22]. These advantages were not unexpected as better visual details permit precision and accuracy in performing intricate procedures.

The most common reason reported for non-use was the high cost of the devices as they need to be imported thus incurred additional cost for imported medical devices. This finding is similar to reports from even developed countries [10]. The range of pricing is wide as determined by the quality of magnification, product specification, and design. As an example, in Malaysia, a pair of dental loupes costs from USD430 to USD1900, while LED illumination may incur an additional USD480 to USD950. Moreover, a dental operating microscope can cost from USD14000 to USD28500. Private practitioners who do not regularly perform intricate clinical procedures may not find purchasing such devices to be a worthwhile investment. Meanwhile, in the public sector, the purchase of any clinical equipment is based on priority and availability of resources for the wider population. In addition to that, any equipment that is perceived to be perused by public sector specialists can only be purchased for that particular specialist. Unsurprisingly, most dentists are willing to use magnification device in their practice should there be no financial constraint, citing loupes with an LED light as their preferred device. This indicates that most dentists were aware of the additional benefit of illumination to be used with magnification.

5. Conclusion

Mainstream dental practitioners in this study are inclined towards the use of magnification devices if the price is within acceptable range. The earlier the exposure to visual enhancement, the wider appreciation of its attribute and shall encourage its advocacy as one of the standard equipment in clinical dental practice. Correct use of magnification aids and its benefits should be incorporated in dental education and training to produce a more competent generation of future dentists and specialists. Future research in the area of magnification device use can be expanded to the relationship and impact between ergonomics and the use or non-use of magnification devices. Factors associated with ergonomics such as height and workload intensity are also worthy areas to be examined.

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7. Conflict of Interest

The authors declare that there is no conflict of interests in the conduct of the study and in the preparation of this manuscript

8. Author contributions

SAB, LJF and TMD conceptualised and designed the study. SAB and TMD defined the intellectual content, and LJF conducted the questionnaire survey. All authors analysed and interpreted the data. LJF drafted the manuscript, SAB and TMD substantively revised the manuscript. All authors approved the submitted version of the manuscript and agreed both to be personally accountable for the author's own contributions and the resolution documented in the literature.

9. Ethical Policy and Institutional Review board statement

This study has been approved by the Universiti Kebangsaan Malaysia Research and Ethics Committee (UKM PPI/111/8/JEP-2017-670). All the procedures have been performed as per the ethical guidelines laid down by Declaration of Helsinki 2013.

10. References

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Table 1 Characteristics of Study Respondents (Total=542 respondents)

Characteristic	Number (%)
Gender	
Male	190 (35.1)
Female	352 (64.9)
Practice Setting	
Urban	265 (48.9)
Semi-urban	151 (27.9)
Rural	94 (17.3)
Not specified	32 (5.9)
Practice Institution	
Government	320 (59.0)
Private	222 (41.0)
Post-graduate Qualification	
Yes	26 (4.8)
No	516 (95.2)
Use of Magnification Device	
Yes	135 (24.9)
No	407 (75.1)

Table 2 Characteristics of Magnification Users and Non-users

	Users Number (%)	Non-users	p-value
Gender			
Male	65 (34.2)	125 (65.8)	p < 0.001*
Female	70 (19.9)	282 (80.1)	
Practice Setting			
Urban	85 (32.1)	180 (67.9)	p < 0.001*
Semi-urban	41 (27.2)	110 (72.8)	
Rural	4 (4.3)	90 (95.7)	
Practice Institution			
Government	51 (16.0)	269 (84.0)	p < 0.001*
Private	84 (37.8)	138 (62.2)	

Postgraduate Qualification				
Yes		17 (65.4)	9 (34.6)	p < 0.001*
No		118 (22.9)	398 (77.1)	
Trained in Magnification				
During Undergraduate Education	Yes	27 (40.3)	40 (59.7)	p = 0.002*
	No	108 (22.7)	367 (77.3)	
Trained in Magnification				
During Postgraduate Education	Yes	12 (80.0)	3 (20.0)	p = 0.182
	No	4 (50.0)	4 (50.0)	
Attended Short Courses on Magnification				
Yes		33 (71.7)	13 (28.3)	p < 0.001*
No		102 (20.6)	393 (79.4)	

* Indicated statistically significant differences (p < 0.05)

Table 3 Patterns of Magnification Devices Use

Items	Number (%)
Type of device	
DOM †	32 (23.8)
Loupes with LED Light	44 (32.5)
Loupes without LED Light	59 (43.7)
Procedures using magnification	
All procedures	72 (53.3)
Only certain procedures	63 (46.7)
Pre-endo restoration	2 (1.4)
Cavity access	22 (14.8)
Canal identification	63 (42.5)
Cleaning & Shaping	33 (22.3)
Obturation	22 (14.9)
Post-endo restoration	6 (4.1)
Reason for Using Magnification Device	
To enhance visual acuity	123 (91.1)
To improve body posture	12 (8.9)
Perceived Benefits of Using Magnification Device	
Reduced musculoskeletal strain	63 (20.9)
Improved quality of clinical work	116 (38.4)
Higher confidence in clinical procedures	93 (30.8)
Better trust from patients	30 (9.9)

† DOM= Dental Operating Microscope

Table 4 Non-users' Response to Magnification Device

Item	Number (%)
Reasons Not Using Magnification Device	
Insignificant improvement in the quality of clinical work	24 (3.5)
Lack of exposure to technology	237 (34.8)
Devices are expensive	262 (38.5)
Endodontic cases are infrequently managed	77 (11.3)
Physical discomfort: (Headache, vertigo)	51 (7.5)
Steep learning curve	30 (4.4)
Consider Using Magnification If There Is No Financial Constraint?	
Yes	386 (94.8)
No	19 (4.7)
Not specified	2 (0.5)
Which Magnification Device?	
Dental Operating Microscope	73 (17.9)
Loupes without LED light	34 (8.4)
Loupes with LED light	300 (73.7)