Assessment of Knowledge, Attitude and Practice based Survey on the Use of Ultrasonics in Endodontics among General Practitioners and Endodontists of Nepal

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ABSTRACT

Introduction: Endodontic practice has seen a massive technological leap over the past few decades which have improved the prognosis of the treatment performed. Ultrasonics simplifies complex endodontic procedures like navigating calcified canals and removing obstructions. Ultrasonic endodontic treatment, for both primary and permanent teeth, streamlines procedures, minimizing appointments, patient stress, and expenses. Ultrasonic irrigation enhances root canal cleaning, leading to improved endodontic success.

Objective: The study aims to determine the knowledge, practice, and attitude of ultrasonics in endodontics among the general practitioners, endodontics postgraduates and endodontists of Nepal.

Methods: A self-administered questionnaire containing questions regarding the knowledge, attitude, and practice of ultrasonics in endodontics was distributed to 151 general practitioners, postgraduates and endodontists working in Nepal. Data was collected and entered in Microsoft Excel sheet and analysis was done using Statistical Package of Social Sciences (SPSS) software version 16. Descriptive statistical analysis was done using mean, proportion and percentage.

Results: Although 96% of dentists knew about ultrasonic endodontics, only 25% used it routinely. Common uses included; irrigation 65% and removing blockages 60%. Most of them (68.9%) preferred 3% or less sodium hypochlorite as passive activation of irrigation solution by ultrasonics. High equipment cost (71%) and heat generation (35%) were major usage barriers.

Conclusions: In the present study, we found that the majority of the participants were well aware of the use of ultrasonics in endodontics and had adequate knowledge regarding the working principle and the type of ultrasonics used. But they don't use it routinely in their practice.

Keywords: *Calcification, endodontics, irrigation, piezoelectric, ultrasonics.*

INTRODUCTION

The use of ultrasonics or ultrasonic instrumentation was first introduced into dentistry for cavity preparation using an abrasive slurry, and it aids in thorough cleaning of teeth which helps in bonding of the laminates to tooth.[1] The concept of ultrasonics in Endodontics was introduced by Richman in 1957.[2] Ultrasonics is used for various procedures in endodontics such as refinement of access and troughing canals that are occluded by calcification and prevention of perforation. It gives a better view of access, helps in removing calcification, removal of separated instruments, biomechanical preparation of root canal, intracanal activation of irrigants causing destruction of the bacteria, for retrograde root preparation and filling during surgery.[3-10] Ultrasonics in endodontics is widely accepted for permanent teeth due to its advantages like improved cleaning and reduced pain, is equally beneficial

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for primary teeth, enhancing medication diffusion and addressing the challenges of their complex anatomy.[11] It is also an important tool in the current concept of minimally invasive dentistry.[12] It is also being used in surgical endodontics which include procedures such as root end resection and microsurgeries. Ultrasonics thus plays a key role in the successful outcome of endodontic therapy. As the use of ultrasonics in endodontics is cropping up and many new techniques and machines have been put into use, this study is aimed to assess the knowledge, attitude and practice of ultrasonics in endodontics among endodontists, postgraduate students in endodontics and general practitioners.

METHODS

This observational, descriptive, cross-sectional questionnaire-based study was conducted among endodontists, postgraduate students in endodontics and general practitioners working in Nepal from 21st July to 20th August, 2023. Ethical clearance was obtained from Institutional Review Committee of Kathmandu Medical College and Teaching Hospital, Kathmandu, Nepal (Reference No: - 25062023/05). A self-administered questionnaire consisting of 23 questions regarding ultrasonics in endodontics was distributed to the randomly selected participants and filled form was collected for analysis. Pre-testing was done among 10% of the sample before the start of the study. Those involved pre-testing were not included in the final sample.

The sample size was calculated by taking prevalence as 89% from study done by Singh et al.[11] using the formulae mentioned below.

Sample size (n) = z^2pq/e^2,
where {p = awareness of endodontist (89%)[11]; q = 100-p =11; z = 1.96 at 95% CI; e = Margin of error = 5%}

$n = z^2pq/e^2$

$= (1.96)^2 \times 89 \times 11/ (5)^2$

$= 3760.92/25$

$=150.43$

= 151 samples

In this study, only dentists who gave written informed consent were included. Dentists who were not willing to participate in the study, never been engaged in dental jobs, under influence of drugs or under psychiatric medication were not included in the study.

Data was collected and entered in Microsoft Excel Sheet and analyzed in Statistical Package of Social Sciences (SPSS) version 20 (IBM Corp., Armonk, N.Y., USA). Descriptive statistical analysis was done using mean, proportion and percentage.

RESULTS

A total of 151 general practitioners, endodontics postgraduate students and endodontists of Nepal were included in the study. Among them, 93(61.6%) were female and 58(38.4%) males with the majority 78(51.7%) of the participants in the 23–30-year age group. Majority (57.6%) of the participants were general dentists followed by endodontists (26.5%) and endodontics postgraduate students (15.9%) (Table 1).

Based on the knowledge on the usage of ultrasonics in endodontics, 96% of them were aware of the use of ultrasonics in endodontic therapy. Regarding procedures in which ultrasonics is commonly used in endodontics, 77.5% of them opted for irrigation, 62.3% for removal of calcification in pulp chamber, 55.6% for retrieval of broken instruments, 43.7% for defining access preparation, 41.1% for troughing canal and 35.8% for periapical surgery. About three-fourth (75.5%) of the participants chose piezoelectric as preferred type of ultrasonics in endodontics and 74.2% of participants were aware that both acoustic streaming and cavitation are the working principle of ultrasonics in endodontics. Similarly, 64.9% of the participants knew that the frequency of irrigation is 25-30Hz (Table 2).

Half of the participants (50.3%) agreed, and 45.7% strongly agreed that the use of ultrasonics modifies the outcome of root canal therapy. Similarly, 52.3% of the participants strongly agreed and 43.7% agreed that ultrasonic activation of irrigants is more effective in reducing bacterial biofilm compared to conventional needle irrigation. Approximately 50.3% of participants perceived ultrasonics as moderately effective, whereas

Table 1. Demographic characteristics of the Participants

S.N.	Demographic Factor	Category	n (151)	%
1	Age	23-30 years	78	51.7
		31-40 years	53	35.1
		41-50 years	19	12.6
		More than 50 years	1	0.7
2	Gender	Male	58	38.4
		Female	93	61.6
3	Specialty	General Dentist	87	57.6
		PGs in Endodontics	24	15.9
		Endodontist	40	26.5
4	Clinical Experience	Less than 5 years	72	47.7
		5-10 years	50	33.1
		10-20 years	26	17.2
		Above 20 years	3	2.0
5	Type of clinical practice	Private	74	49
		Corporate	5	3.3
		Academic organization	61	40.4
		Social welfare		
		Both academic and private	11	7.3
6	Number of root canal treatment done per month	Less than 5	16	10.6
		5-10	39	25.8
		10-50	80	53
		More than 50	16	10.6

Table 2. Responses regarding knowledge

S.N.	Cognitive variables	Responses	n (151)	%
7	Awareness of the use of the ultrasonics in Endodontic therapy	Yes	145	96
		No	6	4
8	Procedures in which ultrasonics commonly used for Endodontics	Remove calcification in pulp chamber	94	62.3
		Troughing canals	62	41.1
		Irrigation	117	77.5
		Retrieval of broken instruments	84	55.6
		Periapical surgery	54	35.8
		Defining access preparation	66	43.7
9	Preferred type of ultrasonics in Endodontics	Magnetostrictive	37	24.5
		Piezoelectric	114	75.5
10	Working Principle of ultrasonics	Cavitation	5	3.3
		Acoustic Streaming	34	22.5
		Both	112	74.2
11	Frequency of ultrasonic unit	15-20 kHZ	41	27.2
		25-30 kHZ	98	64.9
		1-6kHz	12	7.9

45.7% regarded them as highly effective for retrieving broken instruments from the root canal.

Regarding the limitations of ultrasonics, 70.9% of the participants considered cost as major factor preventing regular use, 35.1% considered heat generation as a major concern, and 23.2% regarded the use of ultrasonics during root canal to be time consuming (Table 3).

Only 25.2% of the participants used ultrasonics for every root canal therapy they perform. Almost 64.9% of the participants used ultrasonics in root canal irrigation, 59.6% in removal of pulp chamber calcification/pulp stones, 40.4% in broken instrument retrieval and 35.8% in troughing canals. Around 69.5% of the participants had noticed positive outcome/reduction in post-operative pain while using ultrasonic activated irrigation and disinfection of root canal than the conventional needle irrigation. Around 68.9% of the participants preferred 3% or less sodium hypochlorite, 23.8% opted for >3% sodium hypochlorite, 11.3% chose chlorhexidine, 10.6% preferred EDTA and 9.3% favored sodium chloride as irrigants for activation of ultrasonics. Similarly, 67.5% of the participants activate the irrigants for less than a minute and 27.2% of them activate the irrigants for more than a minute while using ultrasonic in each root canal. Almost 81.5% of them considered ultrasonics as a necessary armamentarium during root canal treatment (Table 4).

Table 3. Responses regarding attitude

S.N.	Cognitive variables	Responses	n (151)	%
12	The use of ultrasonics modifies the outcome of root canal therapy	Strongly agree	69	45.7
		Agree	76	50.3
		Neither agree nor disagree	6	4
		Disagree		
		Strongly agree		
13	Ultrasonic activation of irrigants reduces the bacterial biofilm when compared to conventional needle irrigation	Strongly agree	79	52.3
		Agree	66	43.7
		Neither agree nor disagree	6	4
		Disagree		
		Strongly agree		
14	Effectiveness of ultrasonics in retrieval of broken instruments from the root canal	Very effective	69	45.7
		Moderately effective	76	50.3
		Not effective	6	4
15	Do you think the use of ultrasonics during root canal is time consuming?	Yes	35	23.2
		No	116	76.8
16	Is heat generation a major concern in using ultrasonics?	Yes	53	35.1
		No	42	27.8
		May be	56	37.1
17	Is cost a major factor for not using ultrasonics units regularly?	Yes	107	70.9
		No	44	29.1

Table 4. Responses regarding practice

S.N.	Cognitive variables	Responses	n (151)	%
18	Do you use ultrasonics for every root canal therapy you perform	Yes	38	25.2
		No	113	74.8
19	For what procedure do you use ultrasonic in your practice while performing root canal?	Removal of pulp chamber calcification/pulp stones	90	59.6
		Troughing canals	54	35.8
		Broken instrument retrieval	61	40.4
		Root canal irrigation	98	64.9
20	Have you noticed positive outcome/reduction in post operative pain while using ultrasonic activated irrigation and disinfection of root canal than the conventional needle irrigation?	Yes	105	69.5
		No	14	9.3
		Not significant	32	21.2
21	What irrigants do you prefer for activation by ultrasonics?	3% or less sodium hypochlorite	104	68.9
		>3% sodium hypochlorite	36	23.8
		Sodium chloride	14	9.3
		Chlorhexidine	17	11.3
		EDTA	16	10.6
22	How long do you activate the irrigants using ultrasonics in each root canal?	< 1 minute	102	67.5
		>1 minute	41	27.2
		Time is not a factor	8	5.3
23	Is ultrasonic a necessary armamentarium during root canal therapy?	Yes	123	81.5
		No	6	4
		May be in future	22	14.6

DISCUSSION

Ultrasonics has become an increasingly integral part of endodontic therapy, enhancing treatment outcomes and providing a crucial aid in challenging scenarios. Its versatility has led to its adoption in a wide range of procedures, from locating and accessing canal orifices to debridement, shaping, obturation, the removal of foreign materials, and even surgical applications.[2]

The findings of the present study, conducted within the context of limited published research on the awareness, knowledge, and utilization of ultrasonics in endodontics.[12-14] In the present study, 96% of the participants were aware of the use of ultrasonics in endodontic therapy, participants' familiarity with ultrasonics highlights the modern application of these tools in dentistry, which have evolved significantly since their introduction in the 1950s. Due to their enhanced visualization, operative convenience, and precise cutting ability, ultrasonic instruments are now widely and efficiently used, with considerable potential for further advancement.[13,15] This awareness surpasses the 89.1% reported by Arun N.[12] The enhanced visualization, convenience, and precision of ultrasonics contribute to their widespread and efficient use, with potential for further advancement. Specifically, 75.5% preferred piezoelectric ultrasonics slightly less than Arun N (78.2%)[12], while 74.2% understood acoustic streaming and cavitation, lower than Arun N (82.2%)[12] and Mulumoodi RS (76.5%).[14] Similarly, 64.9% of participants correctly identified the irrigation frequency as 25-30Hz, significantly higher than Mulumoodi RS (30%)[14] and Arun N (44.1%).[12]

Endodontic disease is fundamentally a biofilm-mediated infection, characterized by the surface-associated growth of a complex microbial community within the root canal system, a comprehensive understanding of the biofilm concept is paramount; this understanding is not only essential for elucidating the pathogenic potential of the root canal microbiota, but also serves as the foundational basis for the development and implementation of advanced disinfection protocols designed to effectively eradicate these resilient microbial biofilms, thereby achieving successful management of endodontic disease.[16]

Effective endodontic treatment hinges on thorough disinfection of the root canal system. While instrumentation plays a crucial role, it leaves over half of the canal walls untouched, necessitating robust irrigation protocols. Conventional manual needle irrigation, however, suffers from limited irrigant penetration, typically reaching only 0-1.1mm beyond the needle tip, thus compromising the removal of debris and the smear layer.[10] To overcome this, activation of irrigation solution has been developed. Passive ultrasonic irrigation (PUI) stands out as the current gold standard, leveraging cavitation and acoustic streaming to enhance dispersion of irrigation solution, leading to superior disinfection and smear layer removal compared to manual methods.[17] In the present study, 52.3% of the participants strongly agreed and 43.7% agreed that ultrasonic activation of irrigants reduces the bacterial biofilm when compared to conventional needle irrigation which is comparable to the findings of the study done by Arun N (50% and 41.6%)[12]. Nearly half of the participants (50.3%) felt ultrasonics moderately effective in retrieval of broken instruments from the root canal which is comparable to the finding of the study done by Arun N (52.5%).[12] There is in vitro evidence that application of ultrasonics to metal posts, even with adequate water-spray cooling, can lead to rapid increases in temperature of the root surface, causing damage to the periodontal ligament.[18,19]

Regarding limitation in using ultrasonics, 70.9% considered cost as major factor for not using ultrasonics regularly, 35.1% considered heat generation as a major concern in using ultrasonics and 23.2% considered use of ultrasonics during root canal to be time consuming whereas heat generation (34.2%) and cost of the ultrasonic unit (64.4%) were a major concern in the study by Arun N.[12]

Ultrasonic devices are increasingly vital in endodontics, simplifying complex procedures like locating hidden canals and removing obstructions, removal of separated instruments in the canal.[20]

In the present study, 25.2% of the participants use ultrasonics for every root canal therapy they perform which is higher than the finding of the study done by Arun N (22.8%).[12] Majority (64.9%) of the participants used ultrasonics in root canal irrigation and 59.6% in removal of pulp chamber which is comparable to the findings of the study done by Arun N where most of the participants used ultrasonics for removal of pulp chamber calcification/ pulp stones (36.1%) and root canal irrigation (30.6%).[12] Around 69.5% of the participants had noticed positive outcome/ reduction in post operative pain while using ultrasonic activated irrigation and disinfection of root canal than the conventional needle irrigation which is higher than that reported in a study by Arun N (47.53%).[12]

Sodium hypochlorite (NaOCl), as an endodontic irrigant, is typically employed in concentrations ranging from 0.5% to 6%. While higher concentrations demonstrably enhance the eradication of bacterial biofilms within the root canal system, they also present a heightened risk of cytotoxicity, particularly if the solution inadvertently extrudes into the periapical tissues. Therefore, activation of sodium hypochlorite is an essential step for cleaning the root canal. To achieve this application of ultrasonic vibration to the irrigant solution enhances the effect of NaOCl without resorting to potentially harmful high concentrations.[21] In the present study 68.9% of them preferred 3% or less sodium hypochlorite as irrigants for activation of ultrasonics which is higher than the findings of the study done by Arun N (61.4%).[12] Almost (67.5%) of the participants activate the irrigants for less than a minute which is higher than the finding of the study done by Arun N (60.9%).[12]

CONCLUSIONS

In the present study, we found that the majority of the participants were well aware of the use of ultrasonics in endodontics and had adequate knowledge regarding the

working principle and the type of ultrasonics used. But they don't use it routinely in their practice. This would be due to the cost of the ultrasonic unit and heat generation. This study was limited by a relatively small sample size, which restricts the ability to generalize the results to a broader population. Additionally, open-ended questions may have introduced interviewer bias during response interpretation. In the future, research should include a larger sample of dental practitioners, taking into account their specialties, age groups, and level of experience. Additionally, continuing dental education (CDE) programs are recommended to enhance practitioners' understanding and awareness of the application of ultrasonics in endodontic procedures.

Conflict of Interest: None

JNAPD

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