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Effect of Continuous Ultrasonic Irrigation on Postoperative Pain in Cases in Symptomatic Apical Periodontitis After Single Visit Endodontic Treatment

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Author`s Contribution

[1]Study Design, Data Collection [2]Supervision, Study Design & Final Approval, [3]Statistical Analysis, [4]Statistical Analysis & Proof Reading, Supervision, Discussion [5]Writing Final Approval, [6]Manuscript Writing, Data Analysis Proof Reading

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ABSTRACT

Objective: To examine and evaluate the efficacy of Continuous Ultrasonic Irrigation (CUI) in comparison to Syringe Irrigation (SI) with regards to the reduction of postoperative pain.

Methodology: The clinical investigation was carried out at the Department of Operative Dentistry, Liaquat University of Medical and Health Sciences, Jamshoro, for a period of six months, starting from January 2021 and ending in June 2021. The study involved a total of 90 patients, and its objective was to assess pain levels experienced by the participants 24 hours and seven days after the surgical procedure. The Heft Parker Visual-Analogue Scale was utilized as the tool for pain measurement.

Results: CUI yielded superior outcomes in terms of statistically significant postoperative pain reduction at the 24-hour when compared to syringe irrigation. Nevertheless, it was shown that syringe irrigation demonstrated more efficacy in mitigating postoperative discomfort on the seventh day. The findings also revealed statistically significant disparities in pain intensity between the two cohorts at the 24-hour mark and on the seventh day, with notable variations in pain levels based on gender.

Conclusion: The efficacy of continuous ultrasonic irrigation in lowering postoperative pain was shown to be higher at the 24-hour mark, whereas syringe irrigation demonstrated greater effectiveness at the 7-day postoperative period.

Keywords: Continuous Ultrasonic Irrigation, Dental Procedures, Endodontic Treatment, Heft Parker Visual-Analogue Scale, Oral Health, Pain Management, Patient Comfort, Postoperative Pain, Root Canal Therapy, Syringe Irrigation.

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Introduction

Root canal therapy is an essential dental treatment that aims to alleviate pain and preserve damaged or infected teeth. The procedure entails the removal of inflammatory or necrotic tooth pulp, followed by root canal cleaning, shape, and filling. By removing infection, avoiding reinfection, and stimulating the healing of periapical tissues, root canal therapy maintains oral health by preventing the spread of infection to neighboring teeth and supporting structures.[1] Hence, successful and efficient root canal therapy is essential for maximizing patient satisfaction, minimizing the need for additional procedures, and guaranteeing long-term dental health.[2] It is of the utmost importance to manage postoperative pain after root canal therapy to ensure patient comfort, satisfaction, and overall dental health. Poor pain management can have a detrimental impact on a patient's view of dental care, raise their anxiety, and discourage them from pursuing additional treatment.[3] Effective pain management, on the other hand, can result in favorable treatment outcomes, increased patient compliance, and strengthened dentist-patient relationships, thereby encouraging patients to maintain regular dental checkups

and follow-up appointments and fostering a proactive approach to oral health.[4]

Endodontic therapy, often known as root canal treatment, is a multi-step dental operation designed to save infected or damaged teeth. Initially, a clinical examination and radiography are utilized to establish the necessity of treatment. To enhance patient comfort, local anaesthetics is applied, followed by access preparation using a dental dam to maintain sterility. The dentist removes inflamed or necrotic tooth pulp, cleans, and forms the root canals with mechanical equipment and irrigation solutions, and then fills the canals with a biocompatible material such as gutta-percha. The tooth is then replaced with a filling or a crown, and the patient is provided with postoperative care instructions and scheduled follow-up appointments. Inflammation, insufficient cleaning and shaping, over instrumentation, overfilling or underfilling, high occlusion, preexisting problems, missing canals, instrument separation, and transferred pain can all contribute to postoperative pain following root canal therapy. These issues must be addressed to minimize patient suffering, increase patient happiness, and assure long-term therapeutic success.

During root canal treatment, irrigation helps to clean, remove debris, lubricate, remove the smear layer, break down tissue, and cool the toot[5]. Conventional syringe irrigation (SI) is easy, cheap, and flexible, but it doesn't clean complex tissue well enough, doesn't get rid of the smear layer completely, could cause extrusion, and moves around unevenly.[6] Other types of irrigation, like continuous ultrasound irrigation (CUI), may be better at cleaning, disinfecting, getting rid of smear layers, and lowering the risk of extrusion and pain after surgery. In endodontics, ultrasonic technology has several benefits, such as easier entry and better visibility, faster shaping and removal of obstacles, and less operator fatigue.[7,8] CUI uses sound energy to actively move the irrigation solution, which helps it get deeper into the root canal system and spread out more evenly. This can make it harder to clean, disinfect, get into hard-to-reach areas of the body, remove the smear layer, raise the risk of extrusion, disrupt the biofilm, and even cause more pain after surgery.[9] However, additional studies on the therapeutic efficacy of these interventions are necessary to enhance the outcomes of root canal therapy.

During the root canal therapy procedure, irrigation plays a crucial role in facilitating tissue breakdown, providing lubrication, assisting in debridement, ensuring disinfection, and aiding in the cooling process. Conventional syringe irrigation (SI) is a straightforward, cost-effective method but comes with limitations, including challenges in adequately cleaning intricate anatomical structures, incomplete removal of smear layers, the risk of extrusion, and limited agitation. Alternative irrigation techniques, such as continuous ultrasonic irrigation (CUI), offer potential benefits by minimizing the risk of extrusion and postoperative discomfort while enhancing cleaning, disinfection, and removal of smear layers. The incorporation of ultrasonic technology in endodontics brings various advantages, including improved access and visibility, efficient shaping and removal of obstacles, and a reduction in operator fatigue.[7,8] Continuous Ultrasonic Irrigation (CUI) employs ultrasonic energy to actively stir the irrigation solution, thereby improving its penetration and dispersion throughout the root canal system. This enhances various aspects, including cleansing, disinfection, penetration into challenging anatomy, removal of smear layers, minimizing extrusion risk, disrupting biofilm, and potentially reducing postoperative discomfort. However, further investigation is necessary to thoroughly evaluate the clinical effectiveness of these procedures and optimize outcomes in root canal therapy.

The purpose of this study is to evaluate the effectiveness of syringe irrigation (SI) and continuous ultrasonic irrigation (CUI) in minimizing postoperative pain after single-visit root canal therapy. There is great potential for improving patient care and advancing endodontic treatment through the comparison of CUI and SI. Finding the best irrigation method for reducing postoperative pain can improve patient comfort and treatment effectiveness.

Methodology

This study was done from January 2012 to June 2021, with permission from the Research Ethics Committee of Liaquat University of Medical & Health Sciences Under Letter No. LUMHS/REC/-10. Its goal was to compare the effectiveness of continuous ultrasonic irrigation (CUI) and syringe irrigation (SI) in preventing postoperative pain after single-visit root canal therapy. Symptomatic apical periodontitis was identified by severe, localized pain that didn't go away and got worse when the patient bit down. This was confirmed by percussion and periapical radiolucency at the tip of the tooth, which was visible on periapical images. The Heft Parker Visual-Analogue Scale (0–10) was used to measure pain 24 hours and 7 days after surgery. In one-visit endodontic treatment the root canal system is cleaned, shaped, and sealed all in one visit.

The sample size of 90 was determined using a simple random sampling procedure in accordance with the concept of a randomized clinical study (45 in each group).The sample size was calculated using formula of two sample t-test considering parameters from our pilot study with 1.96 for 5% significance level, power of 80% and mean reduction of pain in group 1 to be 30 and 25 in group 2 at ratio of 1:1.

The inclusion criteria for the study were patients of either gender aged between 18 and 60 years with symptomatic apical periodontitis on their mature permanent molars. Exclusion criteria included teeth with periapical abscesses, periodontally damaged teeth, and individuals who had taken any medication, particularly analgesics and antibiotics, within the previous week.

Using a VAS scale, the preoperative pain score was reported. A local anaesthetics containing 2% lidocaine and 1:100,000 adrenaline was injected, and a rubber dam was used to isolate the afflicted tooth. The working length was assessed using an apex locator (E PEX) and confirmed by radiograph after gaining access. Root canals were prepared with the ProTaper rotary file system (M3 PRO GOLD), and 3% NaOCL was used for simultaneous irrigation (CANASOL).

Patients were put into two groups by picking them at random. In group A, ultrasonic treatment was used to give the cleaned root canal its final rinse. In group B, which was the control group, a syringe was used. In the CUI group, the irrigating solution was turned on with the Poultra PiezoFlow (Dentsply Tulsa Dental Specialties, Tulsa, OK, USA) suggested by the manufacturer. The needle was run with a power setting of 5. The needle's stopper was placed 1 mm short of binding in the tubes, but no further than 75% of the working length. The PiezoFlow activation needle was connected to a syringe with 15 ml of 5.25 percent NaOCl, and the dormant needle was put into the canal. The water flow started before it was turned on. During activation, the needle was moved up and down in the canal by itself, while the stopper kept the entry depth at the same level. In the SI group, tubes were flushed with 15 ml of 5.25 percent NaOCl using a 27-gauge needle placed 2 mm from the working length. The tubes were dried with paper points and sealed with a gutta-percha cone that came with the ProTaper system. The hole in the canal was filled in with a temporary filling material (Cavit). The pain level 24 hours and seven days after treatment was measured with a visual analogue scale (0 means no pain, 1-3 means mild pain, 4-7 means moderate pain, and 8-10 means serious pain). On the seventh day of aftercare, a permanent restoration was put in.

Using version 20 of SPSS, the mean and standard deviation were determined for quantitative data such as age. Frequency and percentage calculations were performed on qualitative factors like gender, pre- and postoperative discomfort, and tooth type. The chi-square test was used to compare the two groups' efficacy at a P value of less than 0.05. Age and gender were two confounding characteristics that were controlled for through stratification.

Results

The results were analyzed, and the mean age, standard deviation (SD), minimum age, and maximum age were calculated for both groups. The P-value was found to be 0.241, which indicates no significant difference in the age distribution between the two groups. Table I & II.

Table I: Descriptive statistics of age of both study groups. (n=90)

Study Groups	Statistics			P-Value
	Mean±SD (Years)	Minimum (Years)	Maximum (Years)	
Group A (n=45)	34.28±10.08	21	54	0.241
Group B (n=45)	32.00±9.21	19	45	

Table II: Patients' distribution according to gender among study groups

Gender	Study Group		P Value
	Group A n(%)	Group B n(%)	
Male	21(46.7%)	24(53.3%)	0.524
Female	24(53.3%)	21(46.7%)	

Figure 1 displays the pain scores for Group A and Group B before, 24 hours after, and 7 days after surgery. Before surgery, both groups had similar mean pain scores (Group A: 6.95, Group B: 7.44), with no significant difference (P = 0.113). At 24 hours post-surgery, Group A showed a lower mean pain score (2.71) compared to Group B (4.00), indicating significant pain relief (P = 0.001). However, at 7 days post-surgery, Group B exhibited a lower mean pain score (2.17) than Group A (2.55), suggesting better pain reduction (P = 0.010). In summary, continuous ultrasonic irrigation was more effective in lowering pain 24 hours after surgery, while syringe irrigation was superior at 7 days post-surgery. Pain levels before surgery were comparable between the two groups.

Figure 2 compares post-operative pain severity between Group A and Group B at 24 hours and the 7th day. At the 24-hour mark, Group A had 35 patients with no severe pain, while Group B reported mild discomfort in 21 patients, moderate pain in 22, and severe pain in 2, showing a statistically significant difference (P-value = 0.007). By the 7th day, Group A had 37 patients with mild pain, no moderate or severe pain, and 8 with no pain. In contrast, Group B had 34 patients with mild pain, 8 with moderate pain, no severe pain, and 3 with no pain, with a statistically significant difference (P-value = 0.006) in pain severity between the groups.

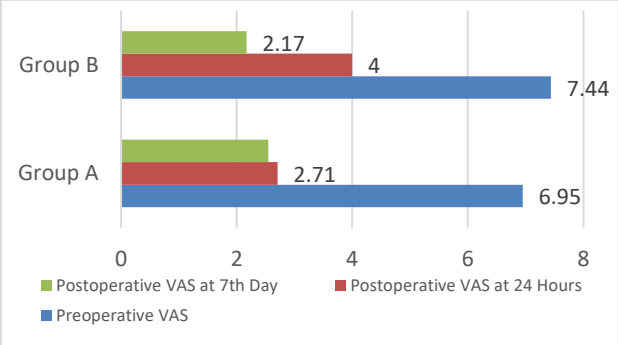

Figure 1 mean VAS scores for both groups (Group A and Group B) at three different time points: preoperative, postoperative at 24 hours, and postoperative at the 7th day.

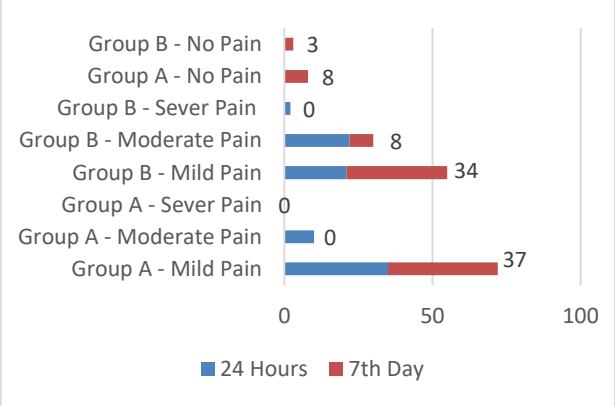

Figure 2. Comparison of the severity of post-operative pain (mild, moderate, and severe) between the two study groups (Group A and Group B) at two different time points (24 hours and the 7th day).

Figure 3 provides a comparative analysis of postoperative pain severity between Group A and Group B at 24 hours and the 7th day, categorized by gender. For males at 24 hours, Group A showed 16 with mild pain, 5 with moderate pain, and none with severe pain, while Group B had 9 with mild pain, 13 with moderate pain, and 2 with severe pain (P = 0.025). In females at 24 hours, Group A had 19 with mild pain, 5 with moderate pain, and none with severe pain, whereas Group B had 12 with mild pain, 9 with moderate pain, and none with severe pain. On the 7th day for males, Group A had 4 with no pain, 17 with mild pain, and none with moderate pain, while Group B had 1 with no pain, 21 with mild pain, and 2 with moderate pain (P = 0.018). Among females on the 7th day, Group A showed 4 with no pain, 20 with mild pain, and none with moderate pain, while Group B had 2 with no pain, 13 with mild pain, and 6 with moderate pain.

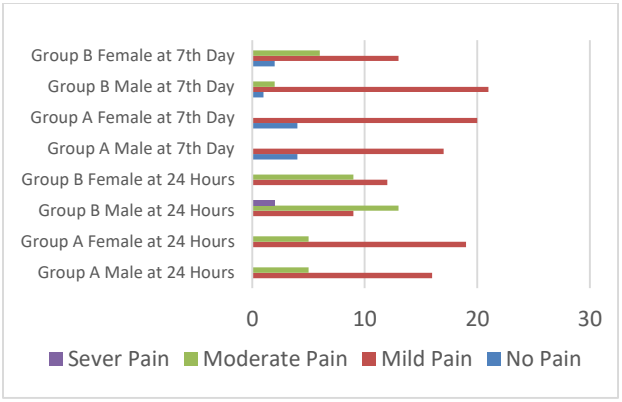

Figure 3. Comparison of the severity of postoperative pain between two study groups (Group A and Group B) at 24 hours and the 7th day, further categorized by gender.

Discussion

Root canal therapy is a necessary dental treatment since it not only alleviates the severe pain of dental infections but also saves teeth, stops the spread of infection, and prevents tooth loss. Since postoperative pain is a major factor in deciding patient comfort and satisfaction, a comparison of Continuous Ultrasonic Irrigation and Syringe Irrigation is crucial for enhancing patient care and advancing the field of endodontics.[10] The utilization of the Heft Parker Visual-Analogue Scale for pain evaluation in this research is warranted owing to its remarkable responsiveness to alterations in pain, its capacity to capture subjective pain encounters, its patient-centric methodology, its provision of quantifiable data for analysis, its well-established validity and reliability, and its straightforward administration process.[11] The characteristics render it a fitting instrument for evaluating postoperative pain within the framework of root canal therapy and for comparing the efficacy of various irrigation methodologies.

Continuous Ultrasonic Irrigation (CUI) was more effective than Syringe Irrigation (SI) at reducing postoperative pain at 24 hours. This could be due to several factors and processes related to these two irrigation methods and the time right after surgery. The ultrasonic waves can successfully move debris, remove tissue remnants, and break up biofilms in the canal, which may reduce the

inflammatory reaction. With ultrasonic activation, the irrigation fluid can get deeper into the root canal and be spread out more evenly. This may lead to a more thorough cleaning, which could lower the number of germs and reduce inflammation after surgery.[12,13] CUI has been shown to be successful at getting rid of the smear layer, which is a thin layer of debris and dentin particles that form during root canal instrumentation. By removing the smear layer, it may be easier to get to the tubules and seal the root canal filling better.[14] This could make the pain after endodontic treatment less severe. One benefit of CUI is that it might make it less likely for the irrigant to leak out past the tip of the tooth. When irrigants leak into periapical tissues, it can cause pain after root canal treatment. The controlled and directed flow of irrigation in CUI may have helped lower the chance of extrusion. When compared to the more powerful syringe irrigation, CUI's gentle and controlled irrigation process may have caused less damage to the periapical tissues and less pain after treatment.[15] Patients may have felt less pain because they thought CUI was a better way to treat them. This psychological factor can affect how much pain a person feels and is often linked to good patient results.[16] It's important to remember that how well irrigation methods work to reduce post-op pain depends on the patient, the complexity of the root canal anatomy, the skill of the operator, and other factors. Also, the study found that CUI was more effective at 24 hours after surgery, but SI was more effective at 7 days after surgery. This suggests that pain control may change over time.

Pain levels were different for men and women in our study, which suggests that irrigation techniques worked differently for men and women in treating post-surgery pain. Several things could be causing these differences between men and women: There is a lot of evidence that biological and chemical differences between men and women can affect how they feel and react to pain. For example, estrogen has sometimes been linked to a greater ability to feel pain, while testosterone may have pain-relieving qualities.[17] These changes in hormones may have had something to do with how people felt and talked about pain. Some studies[18] show that, on average, women have lower pain thresholds than men. Lower pain thresholds can make it easier for female people to feel and talk about pain. Pain perception can be affected by things like worry and making a big deal out of pain. How men and women dealt with and talked about their pain after surgery may have been affected by gender-specific psychological factors, such as coping techniques and attitudes toward pain. Sociocultural factors[19] can also influence how people feel pain. How men and women talk about pain may be affected by cultural norms and gender roles. For example, some cultures expect men to downplay pain and women to seek more support and care when they are hurting. When dealing with pain, men and women may have different ways of coping. These ways to deal with pain can change how and how much pain is felt. For example, women may be more likely to look for pain relief or tell a health care worker that they are in pain. The way each person reports pain can affect how accurate and consistent the measurements are. Pain levels stated by men and women could be different because of differences in how men and women evaluate and talk about their pain. It's important to realize that these differences in how much pain men and women feel are complicated and caused by many things. Even though the study found these differences, more research is needed to learn more about the processes and possible interactions between biological, psychological, and sociocultural factors that cause them. Also, doctors and nurses should know about these differences in how men and women feel pain so they can give their patients personalized and effective ways to deal with pain.

The results of the present study show some variation when compared to those of other investigations. Clinical research into the impact of ultrasonic and sonic activation of root canal irrigants on postoperative pain was conducted by Carver et al.[20] According with the conclusion drawn from the cited study, they found that continuous ultrasonic irrigation (Group A) was more successful than syringe irrigation at lowering postoperative pain after 24 hours (Group B). Another research by Van der Sluis et al.[21] found that ultrasonic irrigation was more successful than syringe irrigation at removing the smear layer, which may have an impact on postoperative discomfort. This lends credence to the given study's conclusion that continuous ultrasonic irrigation is superior in minimizing postoperative pain 24 hours after the procedure. Postoperative pain was studied by Pasqualini et al,[22] who examined the effectiveness of manual dynamic activation, CanalBrush, and passive ultrasonic irrigation. The authors found that passive ultrasonic irrigation resulted in significantly less postoperative discomfort than the other two approaches, lending credence to the earlier observation that continuous ultrasonic irrigation was more beneficial after 24 hours. In contrast to the present study's findings, which showed a significant difference in pain reduction between the two groups at both time points, Chen et al.[23] compared the effectiveness of continuous ultrasonic irrigation and syringe irrigation in reducing postoperative pain and found no significant difference

between the two techniques at 24 hours or at the 7th day. Saber and Hashem[24] analyzed how various irrigation activation procedures affected postoperative pain in root canal therapy patients. Further supporting the given study's finding that continuous ultrasonic irrigation was more effective in reducing postoperative pain at 24 hours, they reported that ultrasonic activation of the irrigant resulted in less pain after surgery than manual dynamic activation and passive ultrasonic irrigation.

To advance our comprehension of pain management in root canal therapy, further research in the realm of endodontics and irrigation techniques should delve into comparing various irrigation protocols, examining the long-term persistence of postoperative pain, elucidating the role of operator expertise and technique standardization, investigating patient-specific factors beyond gender, incorporating advanced imaging and pain assessment modalities, conducting multicenter collaborative studies with diverse patient populations, assessing patient-reported outcomes and quality of life, and evaluating the cost-effectiveness of irrigation techniques. These research avenues can collectively provide a more holistic and evidence-based perspective on optimizing pain management strategies in root canal therapy, thus enhancing patient satisfaction and treatment success.

Conclusion

In conclusion, the study aimed to compare the effectiveness of continuous ultrasonic irrigation and syringe irrigation in preventing postoperative pain after single-visit root canal treatment. The main findings revealed that continuous ultrasonic irrigation was more effective in reducing postoperative pain at 24 hours, while syringe irrigation showed greater effectiveness at the 7th day postoperative.

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