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Research Article

Comparison of Acupuncture with Ibuprofen for Pain Management in Patients with Symptomatic Irreversible Pulpitis: A Randomized Double-Blind Clinical Trial



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Abstract

Emergency pain management in symptomatic irreversible pulpitis commonly includes use of nonnarcotic analgesics. Acupuncture has been used in dentistry to alleviate pain after tooth extraction. The aim of this randomized, double-blind, placebo controlled clinical trial was to evaluate and compare the efficacy of acupuncture therapy and ibuprofen for pain management in such patients. A total of 157 patients participated in this study and were randomly assigned to three groups, Group I—classical acupuncture with placebo tablet, Group II—sham acupuncture with placebo tablet, and Group III—sham acupuncture with ibuprofen. Before commencement of the experiment, initial pain assessment was done using a HP-VAS scale. Treatment was done by first operator, while pain assessment was done by the second operator who was blinded to the procedure performed. Acupuncture needles were inserted for 15–20 minutes at acupoints for classical acupuncture and at nonacupoints for sham acupuncture. Posttreatment pain assessment was carried out at 15, 30, 45, and 60 minutes intervals. Follow-up analysis was recorded at 12, 24, and 48 hours using VAS verbal scale. The mean final HP VAS values for Group I showed statistically significant lower pain values when compared with groups II and III

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(p < 0.05), with no significant difference between groups II and III. Follow-up analysis showed Group I with higher percentage of no pain, which was statistically significant when compared with other two groups. It can be concluded that classical acupuncture is more effective in pain relief (faster and prolonged) than analgesics.

1. Introduction

Pain is one of the most common reasons patients seek dental treatment [1]. Pain of pulpal origin (irreversible pulpitis) is most feared among patients due to its intensity and severity [2]. This severity is most likely because of increased exudative (acute) forces that cause an increase in the intrapulpal pressure within the closed, unyielding pulpal space that surpasses the threshold limits of sensory fibers [3]. Since pain is subjective and is influenced by various factors other than local factors such as physical and psychological, standardizing and quantifying pain is very challenging [4]. This is particularly true for endodontic pain in patients with symptomatic irreversible pulpitis and/or apical periodontitis. Once the diagnosis is done, initiation of endodontic therapy is the first treatment option, which may not be always possible during emergency situations. Therefore, a pain management strategy is employed that usually involves pharmacological drugs such as nonnarcotic analgesics and opioids. The most commonly used nonnarcotic analgesics are ibuprofen, paracetamol, and aspirin. Although nonsteroid antiinflammatory drugs (NSAIDs) such as ibuprofen are extremely effective having both analgesic and antiinflammatory actions, it has several undesirable side effects [1]. Moreover, these oral medications may have lower absorption rate and/or take a longer time to act [5].

Nonpharmacological approach such as acupuncture has been used in dentistry to reduce anxiety during treatment to alleviate postoperative pain after tooth extraction [6]. Acupuncture is the stimulation of specific points on the skin, usually by the insertion of one or more specialized needles. The principle of acupuncture is based on vital force or energy known as "Qi" (pronounced as "chee"), which circulates between the organs along channels called "meridians". The acupuncture points are located along these meridians and are thought to correspond to physiological and anatomical features such as peripheral nerve junctions [7].

In dentistry, acupuncture has been used in the management of temporomandibular disorders, facial pain, postoperative pain, especially when the use of NSAIDs is contraindicated because of concomitant systemic medication or gastric ulceration. [6,8-10]. Lao et al (1999) showed that acupuncture is superior over placebo acupuncture in preventing postoperative pain that arises due to dental extractions [6]. Gross and Morse. attempted a preliminary clinical study in 1976 in which acupuncture was used for analgesia in 10 endodontically involved teeth. The results showed only one of the cases allowed pain-free pulpal extirpation and instrumentation, while no analgesia resulted in two cases [11]. Selden and Allentown (1978) conducted a clinical study on the effect of acupuncture stimulation on pain perception modification for various conditions encountered in dental practice [12]. They found that acupuncture was effective in relieving pain of dental origin, and more than 90% patients had relief from pain for short and longer duration as well.

The molecular mechanism of acupuncture needling involves the release of molecules such as opioids, cholecystokinin ocatapeptide, 5-hydroxytryptamine, noradrenalin, gamma-aminobutyric acid (GABA), and substance P [13]. These molecules block the incoming pain information through the release of neurotransmitters such as serotonin, norepinephrin, GABA which reduces pain subsequently [14,15]. A recent study by Leung et al (2005) showed increased analgesia with activation of A δ -type afferents by acupuncture. Further studies have shown that C fibers also have a role in acupuncture analgesia.[13,16].

However, there are no studies evaluating the use of acupuncture for preoperative pain management in endodontics. Hence, the aim of this randomized double-blind placebo controlled clinical study was to evaluate and compare the efficacy of acupuncture in alleviating pain in patients with symptomatic irreversible pulpitis as compared to ibuprofen medication at different time intervals and follow-up over a period of 48 hours.

2. Materials and methods

The study was designed as a randomized double-blind clinical trial. The study protocol was presented to the Institutional Ethical Committee, SRM Dental College, SRM University and approval was obtained (File No: SRMU/M&HS/SRMDC/2010/M.D.S-PG Student/304). A total of 157 patients within the age group of 18–49 years participated in this study. These patients reported to the Department of Endodontics with moderate to severe pain (HP-VAS > 54) and were diagnosed as having symptomatic irreversible pulpitis. The risks and benefits of the acupuncture procedure and of their participation in the study were explained and written informed consent was obtained from each patient.

Exclusion criteria included periapical pathology, history of previous medications, patients of American Society of Anesthesiologists (ASA) class III and above, pregnant or lactating women, and patients with history of gastritis, asthma, and allergy to NSAIDs.

Once the diagnosis of symptomatic irreversible pulpitis was done, preoperative pain was evaluated using HP-VAS scale. The Heft-Parker combined metric scale (HP-VAS) that provides the patients with multiple cues for pain determination was used in this study [17]. To interpret the data, the HP-VAS (a 170 mm line with several descriptive terms) was divided into four categories:

No pain: corresponds to 0 mm on the scale.

Mild pain: defined as more than 0 but less than or equal to 54 mm.

Moderate pain: pain greater than 54 but less than 114 mm.

Severe pain: corresponds to pain equal to or greater than 114 mm [4].

Assuming drop outs at around 10%, the sample size for each group was set at 52 based on a power calculation (Instat+ v 3.36; California, USA (GraphPad Software, Inc.)), which indicated that a sample size of 46.9 volunteers would provide 90% power ($\alpha = 0.05$, $\beta = 0.10$, standard deviation. = 22.4) to detect a difference of 15% in the success rate between classical acupuncture and ibuprofen medication one hour after treatment.

In this randomized double-blind clinical trial, investigator A, who was not related to the study screened the patients and allocated them to the groups. Since all the patients received needle pricks and medication, they were blinded to the treatment protocol. Investigator B, who is an endodontist and a licensed acupuncturist, performed the treatment for patients of all the groups. The third investigator C, who was blinded to the treatment received by the patients performed the preoperative and postoperative pain assessments.

The patients were randomly assigned to the three experimental groups by restricted randomization procedure as follows: Group I (n = 53)—classical acupuncture with placebo tablet (CA-PL), Group II (n = 52)—sham acupuncture with placebo tablet (SA-PL; negative control), and Group III (n = 52)—sham acupuncture with ibuprofen (SA-IBU; positive control). According to the restricted shuffled approach, 157 specially prepared cards with the specified treatment protocol based on the groups were made and sealed in individual opaque envelopes and shuffled. The investigator A randomly assigned the patients to the groups by picking up an envelope from the pile.

The acupuncture procedure was carried out with special sterile, solid, silver needles (Suzhou Tianxie Acupuncture Instruments Co. Ltd., Jiangsu, China) that are much thinner than hypodermic needles. In classical acupuncture, patients received needle pricks at acupoints Hegu (LI 4), Jiache (St 6), Xiaguan (St 7), and Yifeng (SJ 17). These points were chosen based on a previous study Lao et al (1995), and the locations and indications of which are given in Table 1. The depth of penetration of needles for LI 4 was

0.1–0.5 cun and for St 6, St 7, and SJ 17 it was 0.3, 0.5, and 1.0 cun, respectively [6].

In sham acupuncture, patients received needle pricks at nonacupoints [18]. The needle pricks for both acupoints and nonacupoints were given on the same side as the involved tooth. The acupuncture procedure was performed for a period of 15 minutes; after which, the patients were given oral medication according to their groups. Placebo tablets given in groups I and II were similar in size, shape, and color to ibuprofen (Tab. Brufen 400 mg; Abbott Healthcare Products Ltd., Goa, India). This entire procedure ensured that all patients received both acupuncture (classical or sham) and oral medication (ibuprofen or placebo) so as to standardize the treatment protocol [18].

Posttreatment pain was evaluated at 15, 30, 45, and 60 minutes using HP-VAS scale [4]. Values of less than 54 were kept as success criteria for immediate posttreatment evaluation and follow-ups. The total number of patients without pain even at 48 hours was considered as desirable secondary outcome.

However, if a patient did not have pain relief even after 1 hour following treatment, emergency endodontic procedure was performed. Follow-up pain analysis for rest of the patients was done over 12, 24, and 48 hours period via telephone using VAS scale analysis as no pain, mild, moderate, or severe pain.

Statistical Analyses: All the values were recorded and analyzed statistically using SPSS software (version 17) (International Business Machines Corp., New York.). The data were tested for normality using Kolmogorov—Smirnov test and found that all the data were not normally distributed. The baseline parameters such as age, sex, and initial HP-VAS pain score among the three groups and the final HP-VAS scores at various time intervals (within group and inter group) were analyzed using appropriate nonparametric tests.

3. Results

The baseline comparisons namely age and initial HP-VAS values among the three groups were analyzed using Krus-kal–Wallis test, and the gender comparison was done using Chi-square test. There was no significant difference in the age and initial HP-VAS values (p = 0.339 and p = 0.151, respectively). However significant difference in the gender distribution existed among the groups (p = 0.019). All the

Table 1 Acupoints selected in this study.									
International code	Name in pinyin	Location	Indication						
LI 4	Hegu	Web between forefinger and thumb on the dorsal aspect of the hand.	Distal point for front of the head, face, special sense organs, and front of neck						
St 6	Jiache	The most prominent point of the masseter muscle felt on clenching the jaws	Toothache, facial paralysis, trigeminal neuralgia, parotitis, trismus, and spasm of masseter muscle						
St 7	Xiaguan	In the depression on the lower border of zygomatic arch.	Toothache, facial paralysis, trigeminal neuralgia, arthritis of mandibular joint.						
SJ 17	Yifeng	The highest point of depression behind the ear lobe, between the angle of the mandible and the mastoid process.	Ear disorders and facial paralysis.						

above occurrences are purely due to the random allocation of the patients (Table 2).

The final mean HP-VAS values at 15, 30, 45, and 60 minutes for CA-PL were significantly lower than groups II and III. However, there was no statistical significant difference between the values of groups II and III at all time intervals (Table 3).

Follow-up evaluation: Of the 53 patients in Group I, two did not respond to follow-up calls. Of 52 patients in groups II and III, four and five patients, respectively, had severe pain even 60 minutes after the treatment protocol and hence emergency root canal procedure was initiated for these nine patients. One patient each from groups II and III reported with pain after 24 hours, and endodontic treatment was performed for them. Hence, a total of 13 patients were excluded from the follow-up evaluation. Patients were instructed to rate their pain on a VAS pain score at 12,

24, and 48 hours after the procedure. The following criteria were outlined for the patients to rate their pain: 0, no pain: 1–3, mild pain: 4–6, moderate pain: 7–9, severe pain. [19,20].

In Group I, 96.07% of patients had no pain for 12 hours, with maximum number of patients in the "no pain" or "mild pain" category even after 48 hours. Only one patient had moderate pain in CA-PL at 48 hours. This was statistically significant compared to groups II and III (p = 0.000). More patients in Group III had moderate to severe pain, though not statistically significant than Group II (Table 4).

4. Discussion

Acupuncture is an age-old method for pain relief, which has been tried in medical field to alleviate pain in

Table 2 Demographic distribution among groups.

Demographic distribution	CA-PL	SA-PL	SA-IBU	р
No. of patients	53	52	52	
Male + female	33 + 20	21 + 31	27 + 25	p = 0.019
Mean age (\pm SD)	$\textbf{31.28} \pm \textbf{10.19}$	$\textbf{33.78} \pm \textbf{11.58}$	$\textbf{30.22} \pm \textbf{8.39}$	p = 0.339

CA-PL = classical acupuncture with placebo tablet, SA-PL = sham acupuncture with placebo tablet, SA-IBU = sham acupuncture with ibuprofen, SD = standard deviation.

Table 3	Mean ((±SD)	ΗP	VAS	scores	of	three	grou	ps at	15	, 30	, 45,	, and	60 minutes	ί.
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Groups		HP VAS scores							
	Initial	Final 15 min	Final 30 min	Final 45 min	Final 60 min				
CA-PL	$_{\text{A}}$ 101.32 \pm 18.86 $^{\text{a}}$	$_{\text{A}}$ 57.68 \pm 30.36 $^{\text{b}}$	$_{\sf A}$ 42.94 \pm 26.03 ^{b,c}	$_{A}$ 30.26 \pm 24.17 ^{c,d}	$_{\rm A}$ 18.94 \pm 21.16 ^d				
SA-PL	$_{\sf A}$ 99.56 \pm 20.75 $^{\sf a}$	$_{ m B}$ 93.22 \pm 22.31 $^{ m a,b}$	$_{\rm B}$ 82.26 \pm 29.39 $^{\rm b,c}$	$_{\sf B}$ 70.08 \pm 33.94 ^{c,d}	$_{ m B}$ 57.8 \pm 35.53 $^{ m d}$				
SA-IBU	$_{\text{A}}$ 106.56 \pm 21.69 $^{\text{a}}$	$_{\text{B}}$ 99.16 \pm 20.02 $^{\text{a}}$	$_{\rm B}$ 92.98 \pm 24.74 $^{\rm a}$	$_{\rm B}$ 79.08 \pm 25.29 $^{\rm b,c}$	$_{\rm B}$ 66.58 \pm 24.80 $^{\rm c}$				

CA-PL = classical acupuncture with placebo tablet, SA-PL = sham acupuncture with placebo tablet, SA-IBU = sham acupuncture with ibuprofen, SD = standard deviation.

1. Horizontal rows—Friedman with Dunn's multiple comparison *post hoc* test was used to analyze the existence of statistical significance within the group at various time intervals. Values sharing same superscripts (lower case) denote no statistical significance.

2. Vertical columns—Kruskal—Wallis with Dunn's multiple comparison *post hoc* test was used to analyze the existence of statistical significance among the three groups at each time interval. Values sharing same subscripts (upper case) denote no statistical significance.

Table 4	Percentage of patients categorized by VAS score during follow-up at 12, 24, and 48 hours.								
Group	Time period (h)	Percentage (%) of patients with							
		No pain	Mild pain	Moderate pain	Severe pain				
CA-PL	12	96.07	3.93	_	_				
	24	94.12	5.88	5.88 —					
	48	60.78	37.25	1.97	_				
SA-PL	12s	39.58	45.84	14.58	_				
	24	31.25	50.0	16.67	2.08				
	48	16.67	43.75	29.17	8.30				
SA-IBU	12	27.66	51.06	21.28	_				
	24	21.28	39.0	36.17	4.26				
	48	14.89	34.04	40.42	8.51				

CA-PL = classical acupuncture with placebo tablet, SA-PL = sham acupuncture with placebo tablet, SA-IBU = sham acupuncture with ibuprofen.

conditions such as arthritis, migraine, back pain, neck pain, etc. During acupuncture needling, the effects observed are both subjective and objective. The important subjective effect is the feeling of a peculiar sensation of numbness and fullness that develops at the site of stimulation, known as "de Qi". This sensation is essential for successful acupuncture analgesia. The objective effects of acupuncture include increased pain threshold, sedation, homeostatic or regulatory effect, immune enhancement, psychological effect, and motor recovery [21].

Our results showed that classical acupuncture provided faster pain relief when compared to sham acupuncture and ibuprofen. This effect was more pronounced in females when compared to males. The science behind how acupuncture works, involves the peripheral and central biasing mechanisms.

The mechanism of acupuncture analgesia was first reported by LeBars et al (1979), known as diffuse noxious inhibitory control. According to diffuse noxious inhibitory control, a noxious stimulus applied to any region of the body can induce immediate suppression of pain transmission in neurons of the trigeminal caudalis and/or the spinal dorsal horn [22].

The clockwise and anticlockwise rotation of the acupuncture needles causes percutaneous stimulation of Abeta sensory fibers that results in local inhibition of nociception through the gate theory. This in turn blocks the transmission of the stimulated smaller A δ and C fibers, thus, decreasing the central perception of pain [23,24].

Other concept based on the central biasing mechanism is as follows: acupuncture may alter the metabolism of substrates involved in both the ascending facilitatory pathways (N-methyl-D-aspartate receptors, substance P, and interleukin-1) and the descending inhibitory pain pathways (endogenous opioids, serotonin, and norepinephrine) [13]. Therefore, simultaneous stimulation of the smaller fibers, during acupuncture needling results in activation and release of opioids, including β -endorphins, encephalins, and dynorphins which are endogenous peptides that bind to μ -, δ -, and κ -receptors from the brain stem into the blood to create analgesia [14,15,25–27]. These endogenous peptides block the incoming pain information through the release of neurotransmitters such as serotonin, norepinephrin, GABA which reduces pain subsequently [14,15].

Sham acupuncture with placebo also showed some reduction in pain. This may be attributed to the fact that sham acupuncture also produces therapeutic response. Needle insertion even at distant sites (other than acupoints) can also activate the noxious inhibitory control, activating common areas of the brain [18]. Patients of Group III experienced pain relief only at 45 minutes [24]. The mechanism of action of ibuprofen is due to inhibition of cyclooxygenase, which reduces the synthesis of arachidonic metabolites such as prostaglandins and thromboxane [1].

5. Follow-up

Our secondary objective was to evaluate the duration of analgesia over a period of 48 hours. Of the total 157 patients in the study, four patients from SA-PL and five from SA-IBU reported severe pain after 1 hour of the procedure. Hence emergency endodontic treatment was initiated for these patients. One patient each from both the above groups reported with pain after 24 hours, hence root canal treatment was performed. Moreover, two patients of CA-PL did not respond to the follow-up calls. Therefore, a total of 144 patients were included in the follow-up.

It was found that about 95% of CA-PL patients reported no pain even after 24 hours; whereas in groups II and III, the percentages were 31% and 21%, respectively (Table 1). About 37% of patients in SA-PL developed moderate to severe pain at 48 hours. This percentage was higher in SA-IBU (49%). Among the groups, statistically significant pain relief was thus observed in CA-PL (p < 0.05); however, there was no significant difference noted between groups II and III.

6. Limitations

Only trained acupuncturist will be able to perform the procedure. Follow-up pain assessment through phone call, though routinely followed may not be considered very reliable.

Therefore, it can be concluded that the patients treated with classical acupuncture had faster pain relief that was sustained over a longer period of time. Though earlier studies have shown that acupuncture may not be practical as a routine procedure in endodontic therapy, this study suggests that classical acupuncture may be a very effective alternative for management of acute pain in patients with symptomatic teeth.

7. Summary

Classical acupuncture is a safer and more effective alternative to analgesics for management of pain in patients with symptomatic irreversible pulpitis.

Disclosure statement

The authors certify that there are no conflicts of interest with any financial organization regarding the materials discussed in this manuscript.

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