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# Evaluating The Effectiveness of Pressure Application in Modulating Pain Response During Local Anesthetic Delivery: A Behavioral Approach to Enhance Patient Comfort

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**KEYWORDS**

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Local Pressure,

Greater palatine nerve block,

LI4 Point,

Pain Perception

**ABSTRACT:**

**Aim:** The study aimed to compare the efficacy of Acupressure and Local pressure application technique in reducing pain perception during Greater palatine nerve block (GPNB) administration in children.

**Methodology:** A randomized, controlled, split-mouth crossover trial was conducted with 24 healthy children aged 6-9 years requiring bilateral GPNB. Participants were randomized to receive either acupressure using an Aculief device at the LI4 point for 3 minutes (Group A) or light pressure with a cotton bud at the injection site for 2 minutes (Group B) prior to the first GPNB. Interventions were switched at the second visit after a minimum 3-day washout period. The primary outcome was subjective pain measured using the Wong-Baker Faces Pain Rating Scale (WBS). The secondary outcome was objective behavioral pain assessed via the Sound, Eye, and Motor (SEM) scale by a blinded examiner. Data was analyzed using independent t-tests in SPSS version 23.

**Results:** The mean WBS score was significantly lower in Group A compared to Group B (2.67 vs. 4.58, $p \leq 0.000$). Similarly, the mean total SEM score was significantly lower in Group A (4.42 vs. 7.71, $p \leq 0.000$), with significant reductions in all individual SEM components. The results indicate that acupressure was associated with lower self-reported pain and more favorable observed behavior during injection.

**Conclusion:** Acupressure at the LI4 point is significantly more effective than local pressure application in reducing both subjective pain perception and negative behavioral responses during greater palatine nerve block administration in children aged 6-9 years.

## Introduction

The administration of local anesthesia (LA) is the fundamental procedure in pediatric dentistry, yet it remains a significant source of anxiety and distress for young patients. The fear and anticipation of needle-related pain can lead to uncooperative behavior, making the procedure challenging for the clinician and creating a negative dental experience for the child. This initial negative encounter can foster long-term dental anxiety, potentially impacting the child's willingness to seek future dental care.[1] Therefore, effective and non-pharmacological strategies to minimize procedural pain are essential for improving the patient comfort and fostering

Traditional approaches to manage this discomfort often rely on topical anesthetics to desensitize the mucosa. While beneficial, topical anesthetics do not address the deep pressure and distention pain associated with the fluid volume of the injection, indicating a need for complementary techniques.[2] Consequently, there is a persistent need for simple, cost-effective and non-pharmacological adjuncts that can be seamlessly integrated into clinical practice to enhance patient comfort

Two distinct mechanical approaches have emerged to

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mitigate the injection pain. One specific technique is acupressure, a non-invasive derivative of acupuncture, which involves the application of sustained pressure to specific anatomical points, known as acupoints and other is the application of pressure at exact site of injection prior to and during the procedure.[3,4] Both techniques are believed to work through Gate Control Theory of pain, proposed by **Melzack and Wall**.[5]

In the context of pain management, acupressure is also thought to modulate pain perception through complex neurophysiological mechanisms, including the stimulation of endogenous opioid release and the activation of descending pain inhibitory pathways. A commonly targeted acupoint for dental and facial pain is the Large Intestine 4 (LI4), located on the dorsum of the hand between the first and second metacarpal bones.[4]

While both acupressure and pressure applications are grounded in mechanoreceptor stimulation, their application sites differ significantly. Pressure application acts locally at the site of the noxious stimulus, while acupressure exerts its effect systemically from a distant site. Several studies have investigated these techniques individually with promising results; however, direct comparisons of their efficacy, particularly in the Pediatric dental population receiving LA injections, are limited. Therefore, this study was aimed to evaluate the effectiveness of these two pressure application techniques in modulating the pain response during local anesthetic delivery, utilizing a combined assessment of subjective self-reporting and objective behavioral observation.

## Methodology

The present *In Vivo* research protocol was approved by the Institutional Ethical Committee (Pr.731/IEC/2025) and clinically registered with CTRI/2025/11/097537. Prior to initiation, the study's objectives and procedures were thoroughly explained to all participants and written informed consent was obtained from each patient or their legal guardian. The study design adhered to the CONSORT guidelines for clinical trials. **(Fig: 1)**

Sample size was determined using G*Power 3.1.9.4 soft power analysis to determine the necessary sample size for a study. With an alpha (α) error probability set at 0.05, a desired statistical power of 80% and medium effect size of 0.6, the analysis indicated that a total sample size of 24 participants is required to achieve adequate power for detecting the hypothesized effect.

Twenty-four healthy children (n=24), aged 6 to 9 years, were enrolled from the outpatient department. Eligibility was determined based on the following criteria. Participants must be within the specified age range, should provide written parental consent and child assent and require a bilateral greater palatine nerve block for a dental procedure in the upper arch (e.g., pulpectomy or extraction). They must have no

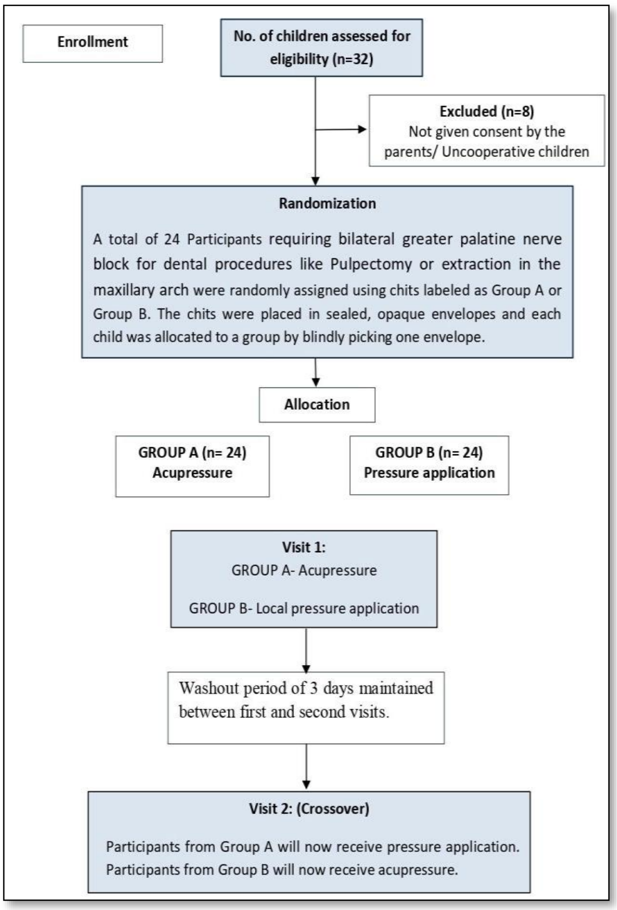


**Fig: 1 Consort Flow Diagram**

prior history of dental local anesthesia administration and exhibit cooperative behavior, defined as a score of Grade III (Positive) or IV (Definitely Positive) on the Frankl's Behavior Rating Scale. The exclusion criteria encompass children with special health-care needs, known allergic or hypersensitivity to local anesthetics (specifically lignocaine or adrenaline), the presence of cutaneous lesions, rashes, or swelling on the dorsum of either hand near the Hegu (LI4) acupressure point and/or a diagnosed underlying vascular or significant hypersensitivity disorder

**Randomization and Allocation**

A simple randomization sequence was used to allocate participants. Chits labeled (Group A: Acupressure or Group B: Pressure application) were concealed within sealed, opaque envelopes. Participants were allocated to a group by blindly selecting one envelope at enrollment. The

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study employed a split mouth design involving 24 children requiring bilateral greater palatine nerve block (GPNB) for dental procedures like Pulpectomy or extraction in the maxillary arch. The allocated intervention was administered prior to GPNB at the first visit (Group A: Acupressure; Group B: Pressure application). At the follow-up visit for the other side, the interventions were switched between groups.

**Intervention Protocol**

**Visit 1:**

Group A: The Aculief acupressure device is applied to LI4 point for duration of 3 minutes, immediately followed by administration of the Greater Palatine Nerve Block (GPNB). The LI4 point was located between the thumb and index finger at highest point of the muscle bulge between the first and second metacarpal bones. (Fig: 2A)

Group B: Light pressure was applied using sterile cotton bud at posterior palate adjacent to the maxillary second molar in the soft tissue depression associated with greater palatine foramen for approximately 2 mins, followed by the administration of LA. (Fig: 2B)

**Washout Period:**
A minimum washout period of 3 days was maintained between the first and second visits to eliminate any carry-over effect.

**Visit 2 (Crossover):**
Participants initially in Group A will now undergo the pressure intervention (pressure with a cotton bud for 2 minutes) followed by GPNB on the contralateral side.

Participants initially in Group B will now undergo the acupressure intervention (Aculief device for 3 minutes) followed by GPNB on the contralateral side.

**Outcome Measures**

Subjective Pain Perception was measured using Wong–Baker Faces Pain Rating Scale (WBS) [6] **(Fig: 3)** immediately after the local anesthesia injection. The child was asked to point to the face that best describes their pain during the injection. The Objective Pain Perception (Behavioral) was assessed using the Sound, Eye and Motor (SEM) scale. [7] **(Table: 1)**

**Table 1: Sound, Eye and Motor (SEM) scale**

| ***Parameters*** | **Comfort (Score 1)** | **Mild discomfort (Score 2)** | **Moderate discomfort (score 3)** | **Painful (score 4)** |
|---|---|---|---|---|
| *Sound* | No sound | Non-specific sound | Verbal complaint, louder sound | Verbal complaint, shouting, crying |
| *Eye* | No sign | Dilated eye without tears | Tears, sudden eye movements | Crying, tears all over the face |
| *Motor* | Relaxed body and hand status | Muscular contraction, contraction of hands | Sudden body and hand movements | Hand movement for defense, turning the head to opposite side. |

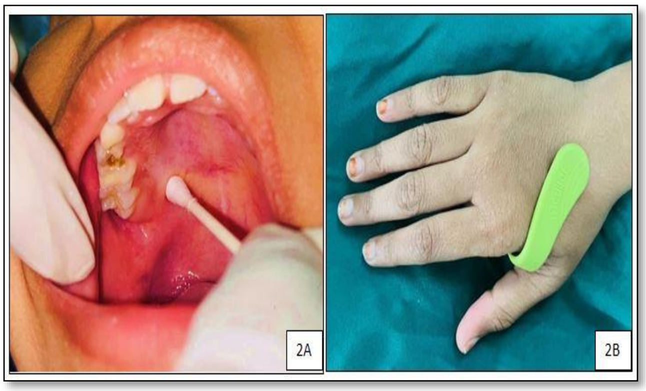


**Fig: 2A Application of pressure using sterile cotton bud**

**Fig: 2B Application of Aculief Acupressure Device at LI4 point**

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**Fig: 3 Wong- Baker Faces Pain Rating (WBS) Scale**

A trained and calibrated examiner, who was blind to the group allocation, observed and scored the child's behavior during the injection procedure.

**Data Collection**

All data, including demographic details, Frankl's score, WBS scores and SEM scores for both visits were recorded in a pre-designed proforma. The data was then entered into a statistical software package

**Results**

The data was analyzed using the SPSS (Statistical Package for the Social Sciences, IBM Co., Armonk, NY, USA) version 23 software. Statistical comparisons of mean values were done using the independent t-test appropriately. $P \leq 0.05$ was considered statistically significant.

**Table 2** showed the comparison of Wong–Baker pain scores between the two groups. Children in Group A reported lower level of perceived pain than those in Group B. The difference observed between the groups was statistically significant, confirming that the intervention used in Group A had superior pain-relieving effect. This indicates that the technique employed in Group A was more effective in reducing discomfort compared to Group B.

The comparison of Sound (S), Eye (E) and Motor (M) components between Group A and Group B was represented in **Table 3**. Analysis revealed that Group A achieved statistically significant reductions in the Sensory, Emotional and Motor scores relative to Group B. The lower scores on the SEM scale represent a more positive behavioral state, which represented that the intervention in Group A was associated with superior overall behavioral response in the children

**Graph 1** showed the total mean score of the Wong Baker and SEM Scale between Group A and Group B, found to be 2.67 and 4.58, 4.42 and 7.71 respectively, which was highly significant ($P \leq 0.000$), showing that the Aculief technique is more effective than pressure application in reducing pain during LA.

**Table 2: Comparison of the Wong–Baker mean scores for Group A and Group B**

| G | N | S (Sensory) | E (Emotional) | M (Motor) | Total | SD | t-value | P-value |
|---|---|---|---|---|---|---|---|---|
| A | 24 | 1.80 | 1.50 | 1.12 | 4.42 | 1.876 | -7.156 | 0.000* |
| B | 24 | 2.90 | 2.60 | 2.21 | 7.71 | 1.248 | | |

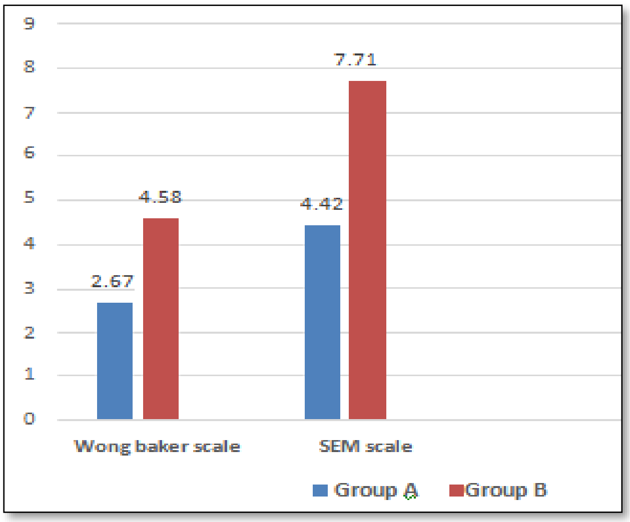
**P-value <0.05 considered a significant, independent t-test**

**Table 3: Comparison of the SEM Scale mean scores for Group A and Group B**

| Groups | N | Mean | Std | t- value | P-value |
|---|---|---|---|---|---|
| Group A | 24 | 2.67 | 1.274 | -5.265 | 0.001* |
| Group B | 24 | 4.58 | 1.248 | | |

**P-value <0.05 considered as significant, independent t-test**

**Graph 1: Comparison of the Wong–Baker and SEM mean scores for Acupressure and Pressure application group**




**Discussion**

The quest to mitigate procedural pain in dentistry remains a cornerstone of patient-centered care, particularly for anxiety-provoking interventions like local anesthetic administration. This study focused on evaluating a simple, non-pharmacological behavioral intervention; the pre-application of pressure as a modulator of the pain response during one of dentistry's most challenging procedure, the greater palatine nerve block (GPNB)

The greater palatine nerve block (GPNB), essential for hard palate anesthesia, is notably painful due to the firm palatal mucosa, often exacerbating dental anxiety. [8] Utilizing the sensitive palatal mucosa as a model, a within-subject design was employed in 24 pediatric patients requiring bilateral anesthesia. This approach allowed direct comparison of analgesic efficacy while controlling for inter-individual pain threshold variation.

This study enrolled children aged 6–9 years. This cohort was selected as younger children may have limited capacity for reliable self-reporting using standardized pain scales and a tendency to overestimate pain intensity. Furthermore, children in this age group frequently demonstrate lower tolerance for the discomfort of local anesthesia injections.

To optimize methodological rigor, a double-blind, split-mouth design was implemented. Double-blinding was maintained as neither the pediatric participants (aged 6–9 years) nor the assessment observer knew the intervention assigned to each side. The split-mouth approach, with treatments randomly allocated to contralateral quadrants, effectively controlled for inter-subject variability in anatomy and physiology. This control was especially valuable for mitigating the inherent subjectivity of pediatric pain perception. [9]

Pain was assessed through both subjective and objective measures. Subjective pain was measured using the Wong-Baker FACES Pain Rating Scale (WBFPS). This scale was selected for its developmental appropriateness for young children, strong psychometric properties and documented preference within this age group; its pictorial format facilitates self-report of perceived pain intensity. **Bieri et al**.[10] found that this assessment method could be properly used in children younger than 9 years of age. The objective assessment pain was performed using the Sound, Eyes and Motor (SEM) scale.[11]

This study evaluated the efficacy of two non-pharmacological interventions in managing pain and distress during local anesthetic (LA) administration in pediatric patients. The results shown that the Aculief technique employed in Group A was significantly more effective in mitigating both the subjective experience of pain and the observable signs of distress compared to the pressure application method used in Group B.

The most direct indicator of a patient's experience is their self-reported pain. In this study, the Wong-Baker FACES Pain Rating Scale served as this crucial subjective measure. The primary outcome, as measured by the Wong–Baker FACES Pain Rating Scale, revealed a statistically significant reduction in self-reported pain among children in Group A. The lower pain scores in the Aculief group suggest that this technique offers a superior analgesic effect. This finding can be theoretically grounded in the Gate Control Theory of Pain.[5] The Aculief technique, which applies targeted pressure to specific acupoint (likely the LI4 point), is believed to stimulate large-diameter sensory nerve fibers. This stimulation effectively "closes the gate" in the spinal cord to the transmission of small-diameter pain fibers (activated by the needle prick), thereby inhibiting the perception of pain. [9] In contrast, the non-specific, diffuse pressure applied in Group B may provide a less potent neuromodulatory effect, resulting in higher perceived pain.

This aligns with study done by **Farsi N et al.**[12] who also found that acupressure at the LI4 point was significantly more effective than distraction or placebo in reducing dental injection pain in children. **Rarani SA et al.**[13] investigated the effect of acupressure at the P6 and LI4 points on anxiety levels among soldiers in the Iranian military and found that the Acupressure can reduce soldier's anxiety at the acupressure points, especially at the LI4 point. They observed a significantly greater reduction in post-intervention anxiety scores in the acupressure group compared to the control group. This suggests that products

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designed to stimulate the LI4 point, such as Aculief, may be beneficial for anxiety reduction.

Similar findings were noticed in studies done by **Sandhyarani B et al** [14] using low-level laser on acupoint LI4, in eliminating pain while administration of LA and concluded that acupressure is effective in reducing pain during LA administration. They found that the device is simple, safe, non-invasive and easy to apply. **Pushpasanthy M et al** [9] found that Aculief acupressure was more effective than cryotherapy at eliminating pain, providing a simple, safe and non-invasive method. Similar study done by **Sajadi F** [15] concluded that acupressure plays a promising role in conventional treatment, easy to apply, safe and non-invasive.

The behavioral assessment using the SEM scale further substantiates the efficacy of the acupressure intervention. Group A showed significantly lower scores across the Sensory, Emotional and Motor domains which reflect a notably more cooperative and less distressed behavioral state. Thus less discomfort, lower anxiety and diminished physical resistance are critical in pediatric dentistry, where patient behavior directly influences procedural safety and efficacy. These findings align with **Şahiner CN et al.**[16] who reported similar behavioral improvements using distraction techniques. This suggests that acupressure, a behavioral modulation method effectively mitigates not only the sensory experience of pain but also the anticipatory anxiety and involuntary movements that challenge dental injections.
None of the children in the study were observed crying during the administration of local anesthesia, highlighting effectiveness of both techniques in effectively reducing pain. Similar results were seen in a study conducted by **Milani SA et al.**[17] where application of local pressure to the buccal mucosa before administration of anesthesia reduced pain during injection. Similarly **Barnhill BJ et al.**[18] concluded that applying pressure before an injection serves as a useful technique for minimizing intramuscular injection pain. This method is a straightforward and easily learned maneuver.

The total mean score of the SEM Scale between group A and B was found to be 4.42 and 7.71 respectively, which was highly significant ($P \leq 0.000$), showing that the Aculief technique is more effective than cotton bud technique in reducing pain during LA. Similarly, study conducted by **Jalali S et al.**[19] stated that applying acupuncture at the LI4 point before endodontic treatment enhanced the effectiveness of inferior alveolar nerve block for mandibular molars, with a mean Wong–Baker Faces Pain Score of 2.3.

In the present study, mean pain scores of Aculief device were 2.67 on the Wong–Baker Faces Pain Scale and 4.42 on SEM Scale, which were consistent with the findings of **Sandhyarani B et al.** [14] where low-level laser therapy on the LI4 point reduced pain to 2 and 3.9 on the respective scales.

Pain management during local anesthetic administration is essential for establishing patient trust and ensuring comfort throughout dental treatment. The observations of the current study suggest that acupressure can be considered as an effective nonpharmacological technique to reduce injection pain. As a technique derived from acupuncture principles, acupressure offers analgesia while typically avoiding the side effects associated with conventional pharmacological interventions. A specifically designed manual device, shaped like a clip, is used to apply sustained pressure to the LI4 acupoint (Hegu). The analgesic effect of stimulating this point is attributed to “hyperstimulation analgesia”, a process consistent with the “Gate Control Theory of pain”. This theory suggests that the non-painful pressure signal interferes with and inhibits the neural transmission of sharp pain from the injection site

Although both the acupressure device and the pressure application interventions may offer symptomatic relief of anxiety. This study is constrained by certain limitations that include the variable standardization of needle depth due to anatomical differences and administration technique, as well as the inherent subjectivity of pain and anxiety perception in children. The study is also limited by its small sample size and lack of long-term follow-up, restricting the statistical power and generalizability of the findings. To establish its efficacy and reliability, further studies with larger sample size, more objective outcome measures and controlled designs are unequivocally required.

## Conclusion

There was decreased pain perception with both the methods. However, the statistically significant reduction in both subjective pain scores (Wong-Baker Faces Scale) and objective behavioral distress scores (SEM scale) confirm the superior analgesic and anxiolytic effect of the acupressure intervention.

This evidence suggests that incorporating a brief, pre-injection acupressure protocol using a simple device like the Aculief can be a valuable and practical adjunct to enhance patient comfort and cooperation during potentially painful dental procedures, thereby improving the overall clinical experience for pediatric patients.

Based on this evidence, we recommend the integration of the technique into standard pediatric dental pain management protocols as a simple, safe, effective, child

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friendly and non-pharmacological adjunct to improve patient care and ensure better cooperation during procedures.

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