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ORIGINAL ARTICLE

# A Comparison between Inferior Alveolar Nerve Block and Crestal Anesthesia in Children Undergoing Dental Extraction Procedure

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**ABSTRACT**
**Objective:** To evaluate the efficacy of crestal anesthesia compared to the inferior alveolar nerve block (IANB) in 6–9-year-old children undergoing tooth extraction. **Material and Methods:** This case-control study was conducted on 70 children who needed bilateral mandibular primary molar extractions. The Faces Pain Scale was used to determine the efficacy of the anesthetic technique. Demographic data, onset time of anesthesia, duration of anesthesia, and blood pressure were also recorded. The data were analyzed using SPSS 25 and analytical tests: t-test, chi-squared test, and one-way ANOVA. The level of significance was set at p<0.05. **Results:** The efficacy of the IANB was significantly higher than the crestal anesthesia (p<0.05). The duration of IANB anesthesia was significantly more than the crestal anesthesia (p<0.05). The two anesthetic techniques showed no significant differences in pediatric blood pressure as a determinant of the pain evoked in children during the injection (p>0.05). **Conclusion:** Crestal anesthesia proved an effective method to extract primary molars. However, further studies are necessary to confirm this.

**Keywords:** Anesthesia; Tooth, Deciduous; Nerve Block; Tooth.

## Introduction

Pain control is an important issue in dentistry, especially in the behavior management of children. Appropriate pain management and local anesthesia technique can reduce a child's fear and apprehension and ultimately build trust between the child, parents, and dentist [1,2].

Due to the high mineral density of mandibular bone, which reduces the effectiveness of infiltration anesthesia, the inferior alveolar nerve block (IANB) is the primary method used to achieve mandibular analgesia [2]. In certain cases, however, this nerve block fails to achieve profound analgesia, mainly due to technical errors in the local anesthetic administration technique used by the dentist, inadequate mouth opening, local pathological changes such as infection in the mandibular nerve branch, and anatomic variations. Furthermore, there are some complications related to the IANB, such as paresthesia, muscle pain and trismus, paralysis, diplopia, abducent nerve palsy, hematoma formation, undesired soft and/or hard tissue anesthesia with possible patient-induced injury, difficulty in hemostasis in patients with bleeding disorders, and necrosis of the skin of the chin. In addition, some of the rare complications related to this nerve block technique are a reduction in visual acuity due to atrophy of the optic nerve and the recently reported third molar agenesis [3-5]. Due to the abovementioned complications, alternative techniques have been recommended to replace the IANB technique. Some of them are as follows: intrapulpal, intraosseous, crestal anesthesia, and intraligamentary injections [2].

The present study focuses on crestal anesthesia (CA), a method midway between intraosseous anesthesia and infiltration techniques. Crestal anesthesia is a local anesthetic technique introduced to dentistry in 1994 by Giffin, which relies on the distribution of the anesthetic solution through the porous crestal alveolar bone into the medullary bone [2,6,7].

When reviewing the success rate of crestal anesthesia as a primary injection, success rates range from 29% to 90% based on the type of anesthetic solution used, the type of dental procedure carried out, the pulpal status of tooth, and the outcome measurement tool like visual analog scale (VAS) or the electric pulp test (EPT) [8]. Overall, the efficacy of crestal anesthesia is similar to intraosseous injection, and both of these techniques are more successful than intraligamentary injection [6].

Crestal anesthesia provides the advantage of only anesthetizing one tooth with its surrounding soft tissue, reducing the risk of postoperative self-injury (cheek and lip biting), which is particularly common in children after the IANB [6]. Also, when this technique is carried out, the local anesthetic dosage is reduced, bleeding is minimized at the surgical site, the onset of action is minimized to <30 seconds and almost no positive blood aspiration is detected [6,9,10-12]. On the other hand, some of the disadvantages stated for this technique are the limited period of pulpal anesthesia, pain evoked by the insertion of the needle into crestal bone, discomfort related to the leakage of solution into the oral cavity during the anesthetic procedure, and the possible need for multiple punctures to perform the technique [6,9,10,13].

According to Gazal et al. [6], crestal anesthesia is a possible first choice to achieve adequate anesthesia for tooth extractions and dental restorative procedures. This technique is also helpful in gaining gingival hemostasis for surgical flap procedures. A study performed by Bonar et al. [14] revealed an approximately 30% success rate in anesthetizing pulpal tissues of first permanent mandibular molars by administering crestal anesthesia. A review article reported an excellent success rate for the primary use of CA. Better results were achieved when this technique was used in pediatric dentistry, probably due to the thinner intercrestal bone in children. However, more research is necessary to support its use in the clinic as a primary anesthetic technique [15].

Overall, crestal anesthesia is an efficient and safe anesthetic technique in dentistry. This technique provides the advantage of limiting the anesthetized tissue around the tooth, which is a particularly important factor in children. Also, to our knowledge, limited studies have assessed the efficacy of this technique in anesthetizing primary teeth. Therefore, the main aim of this study was to evaluate the efficacy of crestal anesthesia compared to IANB in 6–9-year-old children undergoing dental extraction procedures.

## Material and Methods

### Study Design and Sample

The present case-control study was carried out on 70 children referred to the Dental Clinic of Kerman Dental School, aged 6–9 years, who needed bilateral mandibular primary molar extraction according to clinical and radiographic signs. Exclusion criteria for the present study were patients with a history of systemic disease, severe fear and anxiety, an acute dental infection, root resorption extending to more than two-thirds of the root, and those having taken oral analgesics to relieve dental pain. Samples were selected on a random basis.

### Ethical Clearance and Data Collection

The study was approved by review panels and ethics committees (IR.KMU.REC.1397.119) at the Kerman University of Medical Sciences. After obtaining informed consent from parents, two extraction procedures were carried out in two separate dental appointments with an interval of at least seven days. The anesthetic technique performed in each appointment (IANB accompanied by a long buccal infiltration/CA) was selected randomly based on a crossover plan. For both techniques, a small amount of topical anesthetic agent (benzocaine gel) was applied at the intended needle insertion site for approximately 30 seconds. The anesthetic solution, 2% lidocaine with 1:00,000 epinephrine, and a 30-gauge short needle were used to perform both techniques in this study.

To perform CA, the needle was inserted at the target region located approximately 2–3 mm below the apex of the mesial and distal papillary triangle. After the bone was contacted, further pressure was applied to advance the needle 1–2 mm into the interdental septum. The needle was inserted at a 40–45-degree angle to the long axis of the tooth, and the bevel was oriented towards the apex of the tooth. The dose of the anesthetic solution injected in each papilla (mesial and distal) was 0.9 mL (half a cartridge in each papilla).

Several parameters were evaluated in this study: efficacy of the anesthetic technique, onset time of anesthesia, duration of anesthesia, and changes in blood pressure.

1) The efficacy of the anesthetic technique was determined by the pressure of an explorer on the gingival tissue along the long axis of the tooth and by asking the subjects to rate the degree of discomfort on the Faces Pain Scale. In this pain measurement tool, six line drawings of faces are scored from 0 to 5: no pain=0, mild pain=1, moderate pain=2, moderate to severe pain=3, severe pain=4, maximum possible pain=5.

2) The onset time of anesthesia in the CA group was evaluated based on the pain evoked by pressing an explorer on the dental gingiva immediately after anesthetizing the second papilla. However, for the IANB group, onset was defined as the time needed to obtain profound lip numbness.

3) To determine the duration of anesthesia, the participants were instructed to express pain, if evident, at any stage during dental extraction.

4) Blood pressure was recorded to determine the degree of pain evoked in patients during the injection. An experienced dental assistant monitored and recorded blood pressure at three specific times using an automatic digital blood pressure monitor. Baseline blood pressure was recorded 5 seconds before needle insertion; the

second blood pressure reading was done immediately after initiating the anesthetic procedure, and the final reading followed the completion of the dental injection [2].

Data Analysis

The data were analyzed using SPSS 25 (IBM Corp., Armonk, NY, USA) using the t-test, chi-squared test, and one-way ANOVA. The level of significance was set to p<0.05.

## Results

Four of the 70 participants were eliminated since they missed the second dental appointment. Of the remaining 66 participants, 59.1% were male, and 40.9% were female; 59.1% of the extracted teeth were second primary molars, and 40.9% were first primary molars. The results revealed no significant difference between the efficacy of the IANB and crestal anesthesia regarding age and sex. The efficacy of IANB (accompanied by the long buccal infiltration) was significantly more than crestal anesthesia (p<0.05) (Table 1).

**Table 1. Comparison between efficacy of crestal anesthesia and inferior alveolar nerve block.**

| Type of Anesthesia | N | Mean Faces Pain Scale | Standard Deviation | p-value |
|---|---|---|---|---|
| Crestal anesthesia | 66 | 2.5758 | 0.18456 | 0.045 |
| Inferior alveolar nerve block | 66 | 1.9697 | 0.16008 | |

Regarding sex, the efficacy of the IANB was significantly higher than CA in girls (p<0.05). However, there was no significant difference in the efficacy of the IANB and CA in boys. When the efficacy of anesthetic techniques was compared regarding age, the IANB was significantly more effective in the 9-year-old age group (p<0.05). The results indicated an onset time of 3–6 minutes for the IANB technique in most subjects. In the case of crestal anesthesia, this time was <3 minutes (Table 2). The duration of IANB anesthesia was significantly more than crestal anesthesia (p<0.05). Regarding blood pressure, as a determinant of the degree of pain experienced by children during the injection, there was no significant difference between the two anesthetic techniques (p>0.05).

**Table 2. Comparison between crestal anesthesia and the inferior alveolar nerve block regarding the onset time of anesthesia, duration of anesthesia, and changes in blood pressure.**

| Parameter | Time | Crestal Anesthesia N (%) | Inferior Alveolar Nerve Block N (%) | p-value |
|---|---|---|---|---|
| Onset Time | <3 min | 64 (97.0) | 9 (13.6) | <0.05 |
| | 3–6 min | 2 (3.0) | 52 (78.8) | |
| | >6 min | 0 (0.0) | 5 (7.6) | |
| Duration | | 66 | 66 | <0.001 |
| Mean ± SD | | 0.5682±0.10641 | 4.7121±0.18418 | |
| Changes in Blood Pressure | | 66 | 66 | 0.789 |
| Mean ± SD | | 108.3737±0.32784 | 108.5354±0.36866 | |

## Discussion

One of the most important aspects of pediatric dentistry is pain control, most commonly obtained by a dental injection. The best injection technique provides optimal anesthesia that uses the least amount of anesthetic solution and reduces side effects [1,2]. Crestal anesthesia and other similar anesthetic techniques rely on the nutrient canals of alveolar bone as a route for drug distribution. Traditionally these techniques were only considered supplemental techniques, but today they are successfully used as primary anesthetic techniques.

Several studies reported CA as a reliable and safe anesthetic technique with a high success rate and satisfaction for both the dentist and the patient [2].

This study revealed that IANB is a significantly more efficient anesthetic technique for extracting primary molars than CA. Following an IANB injection, the mental, incisive, and lingual branches of the IAN are anesthetized. However, the long buccal nerve branch is not anesthetized. Studies show that the long buccal nerve may play a role in the innervation of mandibular buccal mucosa and gingiva adjacent to primary molars. Thus, long buccal infiltration must be considered a supplemental injection after IANB for dental procedures in which the buccal mucosa is manipulated [16].

Only terminal nerve endings are anesthetized when CA is performed as a result of administrating the anesthetic solution directly into the cancellous bone adjacent to the tooth. Therefore, a higher success rate for IANB is expected due to multiple nerve branches being anesthetized in this technique. Another possible explanation for lower success rates of crestal anesthesia may be related to the failure of the anesthetic solution to reach the cancellous bone due to inadequate penetration depth of the needle. Failure rates may also increase when large amounts of anesthetic solution leak into the oral cavity, expressed by participants as an unpleasant taste in their mouth [7].

The current study reported an onset time of 3 minutes and 3–6 minutes for CA and IANB, respectively. Wong reported anesthesia onset within the first minute following CA [17]. Many studies have confirmed this rapid onset time [13,14]. CA is a variation of the intraosseous technique, and regarding the latter, an onset time of 2.5 minutes and a success rate of 78% has been reported. This success rate is moderately high compared to IANB, for which 89% has been reported [18].

When assessing the duration of anesthesia, the present study indicated a significantly higher duration time for IANB than CA, which was also confirmed by the studies by Dower and Barniv [19] and Taheri Talesh et al. [2]. This is due to the different target points where the anesthetic solution is delivered. CA relies on the distribution of anesthetic solution through the surrounding cancellous bone, but in an IANB, the nerve trunk is anesthetized [2,19].

The present study reported no significant differences between the two anesthetic techniques regarding changes in blood pressure, which was similar to the results achieved by Taheri Talesh. Wood et al. [20] assessed changes in heart rate using a pulse oximeter during and two minutes after intraosseous and infiltration injections, reporting a significant increase in heart rate during and two minutes after intraosseous injection compared with infiltration injection.

This study revealed a higher efficacy for crestal anesthesia in 6–9-year-old boys compared to girls, which might be attributed to the higher bone mineral density observed in girls at this age due to an earlier pubertal onset.

In addition, the current study showed that older participants in this age group reported more pain as CA was performed, which might have resulted from increased cognitive development and awareness of the anticipated dental treatment. This is particularly expected when the syringe is in the child's direct view. Moreover, the increased bone mineral density in older children may be involved in this higher pain perception. Overall, studies have reported no pain perception or only a mild perception of perforation and solution deposition [21,22].

According to a literature review presented by Tom and Aps [15], the intraosseous technique is efficient as a primary anesthetic technique for tooth extractions and restorative and endodontic procedures. This technique is favored by 61% of patients due to limited numbness of soft tissues, rapid onset time, and adequate duration [15]. Gazal et al. [6] suggested CA as a first-choice anesthetic technique for dental procedures demanding significant pulpal, bone, and soft tissue anesthesia.

Studies evaluating the efficacy of the intraosseous technique in children reveal a success rate of 91.9% for extractions and endodontic and restorative procedures. It was also reported that this technique could be used as an alternative to conventional anesthetic techniques due to its rapid onset time, adequate duration, reduced risk of self-trauma and postoperative pain, and reduced amount of anesthetic solution consumed [23].

The limitations of the study were insufficient sample size, the limited time between the two injections, and inherent limitations of the VAS scale for children that decrease its accuracy.

## Conclusion

The present study's findings indicate that IANB is a more efficient anesthetic technique than crestal anesthesia. Also, the duration of the IANB is significantly higher. CA provides the advantage of reducing the onset time of anesthesia. Regarding changes in blood pressure, no significant differences were observed between the two anesthetic techniques. Considering the results of the present study, it is suggested that further research be undertaken to evaluate different anesthetic solutions (e.g., articaine, mepivacaine, etc.) and different dental procedures for which the tooth is anesthetized (pulp therapy, restorative treatment, etc.).

## Authors' Contributions


| | | |
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All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.


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## Conflict of Interest

The authors declare no conflicts of interest.

## Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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