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Pain Assessment During Extraction of Lower Primary Molars in Children: A Comparative Study of Physics Forceps and Conventional Forceps (Clinical Study)

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Abstract:

Background: Extraction of primary molars represents one of the most frequently performed interventions in pediatric dentistry and is commonly associated with postoperative discomfort and pain of varying severity. Pain intensity is modulated by several factors, foremost among which are the extraction technique employed and the specific type of forceps utilized. These considerations highlight the importance of comparative studies evaluating the effects of conventional forceps and Physics Forceps on patient comfort and overall treatment experience. **Objective**: This study aimed to compare the severity of pain following the extraction of lower primary molars using Physics Forceps in comparison to conventional forceps. Pain evaluation was conducted in pediatric patients employing the modified Wong-Baker Faces Pain Rating Scale.

Materials and Methods: A prospective randomized clinical trial was performed involving 80 healthy children aged 6 to 9 years from the Pediatric Dentistry Department, Faculty of Dental Medicine, Damascus University, all requiring extraction of lower primary first and second molars. Participants were randomly assigned to four groups: The Physics Forceps group (n=40 teeth: 20 primary first molars, 20 primary second molars) and the conventional forceps group (n=40 teeth: 20 primary first molars, 20 primary second molars). Postoperative pain was assessed using the modified Wong-Baker Faces Pain Rating Scale at T0 (post-local anesthesia), T1 (immediately post-extraction), and T2 (2 hours post-extraction).

Results: Evaluation of postoperative pain using the modified Wong-Baker Faces Pain Rating Scale revealed statistically significant differences, with the Physics Forceps group showing markedly lower pain levels immediately after extraction and at the two-hour follow-up compared to the conventional forceps group ($p < 0.05$). Despite higher initial pain scores following local anesthesia in the Physics Forceps group, these findings demonstrate the technique's overall effectiveness in reducing pain during and after the procedure.

Conclusion: Physics Forceps represent a valuable atraumatic tool for pediatric tooth extraction , it offers a clear clinical advantages in pediatric extractions by reducing postoperative pain, improving child comfort, and enhancing the overall dental experience compared to conventional methods.

Key Words: Physics forceps, Tooth Extraction, Primary molars, Atraumatic Extraction, Dental Pain.

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تقييم الألم أثناء قلع الأرحاء المؤقتة السفلية لدى الأطفال: دراسة مقارنة بين الكلابة الفيزيائية و الكلابة التقليدية (دراسة سريرية)

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الملخص:

الخلفية: يُعد قلع الأرحاء المؤقتة من الإجراءات الشائعة في طب أسنان الأطفال، ويُرافقه غالبًا شعور بعدم الارتياح أو الألم بدرجات متفاوتة. تختلف شدة هذا الألم تبعًا لعدة عوامل، من أبرزها كيفية القلع ونوع الكلابة المستخدمة أثناء الإجراء، مما يستدعي دراسة تأثير كل من الكلابة التقليدية والفيزيائية على تجربة المريض.

الهدف: هدفت هذه الدراسة إلى مقارنة شدة الألم الناتج عن قلع الأرحاء المؤقتة السفلية باستخدام الكلابة الفيزيائية Physics Forcepsمقابل الكلابة التقليدية، وذلك بالاعتماد على مقياسWong-Baker المعدل من قبل المنقل لتقييم الألم لدى الأطفال.

المواد والطرائق: دراسة سريرية أجريت على 80 طفل سليمين أعماهم بين 6–9 من مراجعي قسم طب أسنان الأطفال في قسم طب أسنان الأطفال في جامعة دمشق كلية طب الأسنان، ولديهم أرحاء سفلية أولى وثانية بحاجة قلع، وموزعة عشوائياً على 4 مجموعات، المجموعة المدروسة تستخدم فيها الكلابات الفيزيائية للقلع (20 رحى مؤقتة أولى، 20 رحى مؤقتة ثانية)، ومجموعة شاهدة تستخدم فيها الطريقة التقليدية بوساطة الكلابات التقليدية (20 رحى مؤقتة أولى، 20 رحى مؤقتة ثانية) وتم تسجيل درجة الألم بمقياس وونغ بيكر المعدل عند 3 مراحل وهي (T0 بعد التخدير، T1 بعد القلع، T2 بعد ساعتين من القلع).

النتائج: أظهرت نتائج تقييم الألم بمقياس Wong-Baker المعدل فروقًا إحصائية مهمة، حيث سجلت مجموعة Forceps Physics انخفاضًا ملحوظًا في الألم عند القلع، وبعد ساعتين من القلع مقارنة بالكلابة التقليدية ($p<0.05$)، رغم ارتفاع الألم الأولي بعد التخدير، مما يدل على فعالية التقنية في تقليل الألم الإجمالي أثناء وبعد إجراء القلع.

الاستنتاج: تمثل الكلابة الفيزياء أداة فعالة وغير رضية لقلع الأسنان في طب أسنان الأطفال، إذ توفر تفوقًا سريريًا ملحوظا من خلال خفض مستوى الألم ما بعد الإجراء، تعزيز راحة الطفل، وتحسين التجربة السنية بشكل عام وذلك بالمقارنة مع الطرق التقليدية.

الكلمات المفتاحية: الكلابة الفيزيائية، قلع الأسنان، الأرحاء المؤقتة، القلع غير الرضي، الألم السني.

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Introduction:

Tooth extraction, according to Geoffrey L. Howe, is the non-traumatic removal of a whole dental or tooth root with little stress to the investing tissues, ensuring a smooth recovery with no post-operative complications (Sangra et al. 2023).

In pediatric dentistry, the extraction of primary (deciduous) teeth is a common procedure performed for various reasons, such as severe caries, infections, or to facilitate the eruption of permanent teeth. However, this procedure is often associated with pain and anxiety in children, which can negatively impact the overall treatment experience. Lower primary molars, in particular, pose a challenge due to their anatomical position and structure, where the use of conventional forceps may cause greater trauma to surrounding tissues, including the gingiva and alveolar bone, leading to increased postoperative pain (Elicherla et al. 2021).

Traditional forceps consist of two first-class levers attached by a hinge. The lever's long side is the handles of the forceps, the short side is the beaks, and the hinge serves as a fulcrum or pivot point. The handles of the forceps receive the forces applied by the operator's hand and magnify them, allowing the forceps to grasp the tooth with considerable force. However, none of these forces is utilized to remove the tooth. Instead, increased forces may result in crown destruction (Jason et al. 2025).

The Physics Forceps was introduced by "Goldent" in 2004 for atraumatic extraction purpose. It is based on Class-I lever principle. It has a beak and bumper system. The beak is placed in the lingual/palatal surface of tooth below Cemento Enamel Junction (CEJ) through gingival sulcus beneath the gingiva. The bumper is placed over the buccal soft tissue apical to the tooth (Patel et al. 2025).

The biomechanical principle of Physics Forceps is based on a first-class lever system. The beak is engaged on the lingual or palatal surface apical to the cementoenamel junction, while the bumper is placed on the buccal alveolar bone, acting as the fulcrum. This design allows the operator to apply a slow, controlled rotational force through wrist movement rather than compressive or pulling forces. The rotational torque expands the periodontal ligament space and elevates the tooth along its long axis with minimal lateral pressure on the buccal cortical plate, thereby significantly reducing the risk of root fracture, crown fracture, alveolar bone loss, and soft-tissue trauma compared to traditional forceps (Perkins et al. 2010).

Physics Forceps have emerged as an innovative alternative, utilizing principles of physics to apply a continuous rotational force rather than direct pulling, thereby minimizing pressure and trauma during extraction. This tool aims to simplify the procedure while reducing complications such as tooth or root fracture, ultimately leading to less postoperative pain (Laskar et al. 2022).

Unlike conventional forceps, there is only a single contact point on the tooth through the beak of the extractor. Furthermore, there is no squeezing force exerted on the handle or the intended tooth, but once in place, the handles are rotated by the operator's wrist as one unit for a few degrees buccally (Mutashar 2023).

To objectively assess pain, especially in children who may struggle to verbalize it, the Wong-Baker 0 (no pain) to 10 (worst pain), enabling accurate pain measurement postoperatively and facilitating effective comparisons between extraction methods (Naik et al. 2024).

A modification to the Wong-Baker Faces Pain Rating Scale was made by Al-Mungal and Al-Hajji Baker 2015 , reducing the faces to only four to make it easier for children to select the face that expresses the pain they feel and to improve the reliability of the obtained results (Al-Mungal and Al-Hajji Baker 2015).

In this article, we will explore the theoretical background of Physics Forceps, review comparative studies focusing on the extraction of lower primary molars, with emphasis on pain outcomes using the Wong-Baker Scale, supported by reliable scientific references. The goal is to provide a comprehensive overview of how this modern technique can improve treatment outcomes for children by reducing trauma and pain, thereby enhancing cooperation and psychological well-being.

Materials and Methods:

This study was designed as a clinical trial and conducted at the Department of Pediatric Dentistry, Faculty of Dentistry, Damascus University, between May and December 2025.

The research adhered to the CONSORT checklist guidelines (Cuschieri 2019) and was carried out in accordance with the ethical principles of the Declaration of Helsinki for studies involving human participants (Shrestha and Dunn 2019). Ethical approval was granted by the Ethics Committee of Damascus University (Approval No. 2324/2025).

Participants were not excluded based on socioeconomic background, or ethnicity. Prior to enrollment, all procedures were thoroughly explained to the children's parents or legal guardians, and written informed consent was obtained.

Sample Size:

The sample size was determined using G*Power software version 3.1.9.4 (Heinrich Heine University, Düsseldorf, Germany), based on a previous studies (Elicherla et al. 2021) (Patole and Chidambar 2021), at a confidence level of 80%, a significance level of 5%, and an effect size of 0.40, the sample size was determined to be 80 molars, with 20 in each group (4 groups).

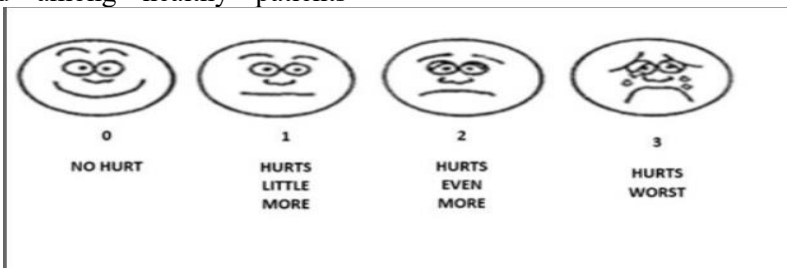
The sample consisted of 80 primary mandibular molars, distributed among healthy patients attending the Department of Pediatric Dentistry at the Faculty of Dentistry, Damascus University. These patients had primary first or second mandibular molars indicated for extraction. The teeth were randomly allocated into four groups: The study group, in which Physics Forceps were used for extraction (20 primary first molars and 20 primary second molars), and the control group, in which the conventional method using traditional forceps was applied (20 primary first molars and 20 primary second molars).

Inclusion criteria:

1. Children aged 6–9 years.
2. Healthy children with no neurological disorders or systemic diseases.
3. Mandibular primary molars deemed non-restorable and indicated for extraction, with at least half of root length remaining.
4. Cooperative children classified as Frankl Behavior Rating Scale 3–4.
5. Absence of acute inflammatory condition or active abscess around the tooth on the day of extraction.

Primary Outcome Measure:

The primary outcome of the study was The severity of pain, assessed using the modified Wong-Baker FACES Pain Rating Scale by Al Manqal.



Patients were instructed to select the face that best expressed their pain at the following time points:

T0: After the local anesthesia injection.

T1: After the extraction procedure.

T2: Two hours later.

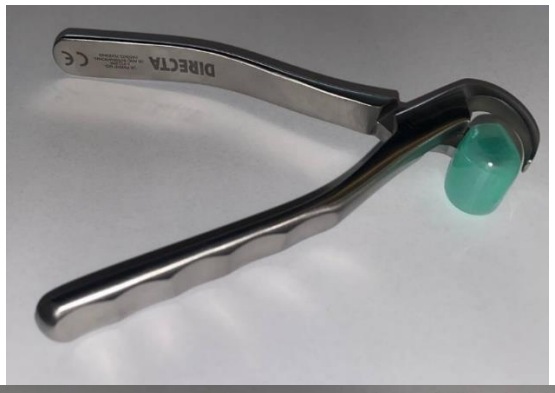
Procedure:

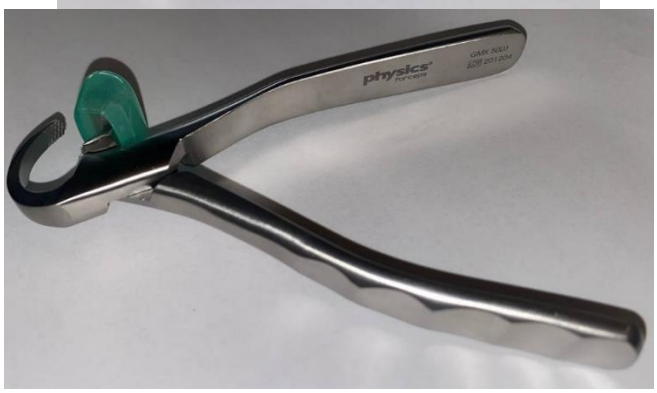
Initially, a periapical radiograph was performed to confirm the indication for tooth extraction and to assess the length of the roots, informed consent was obtained from one of the parents or the child's legal guardian after explaining the study objectives and providing a clear overview of the procedure. Each child was then interviewed, and their behavior was assessed according to Frankl's Behavior Rating Scale to ensure compliance with the inclusion criteria.

To avoid bias, a simple random sampling method will be employed through a lottery procedure. Two separate boxes will be used: One box for the first molars patients and another for the second molars patients. Each box will contain 40 paper slips (20 slips marked “Physics Forceps” and 20 slips marked “Conventional Forceps”).

The slip drawn by the child for each extraction will not be returned to the respective box. This method ensures that the choice of the forceps type for each tooth extraction is completely randomized while maintaining an equal probability of selecting either instrument type at the beginning of each extraction.

Subsequently, the procedure was explained to the child in a simple and age-appropriate manner (TSD). Following this, topical anesthesia was applied using 20% Benzocaine® gel (Darby, DDS, LLC) on dried oral mucosa for one minute. Infiltration local anesthesia using Articaine 4% with Epinephrine 1:100.000 (Artheek®)was applied supraperiosteally in the vestibular aspect and submucosally in the lingual aspect using a 27-gauge, 16-mm needle. Then the faces of the modified Wong-Baker FACES Pain Rating Scale were presented to the child, who was asked to indicate the degree of pain, if any. After confirming the success of anesthesia, the periodontal ligament was severed, followed by the application of forceps—either Physics Forceps (Directa) or conventional forceps to the tooth, and extraction was commenced, after removal of the tooth from its socket, the child was again requested to select a face from the modified Wong-Baker Scale to assess the intensity of pain during extraction, if present.





A sterile gauze pack was then placed over the socket, and the patient was instructed to bite firmly on the gauze for one and a half to two hours. Comprehensive post-extraction instructions were provided to the parents and patient which involve , not to change the gauze pack even if it became soaked with blood; instead, the child was encouraged to swallow saliva continuously. On the first day, hot and cold foods and beverages were to be avoided, with only lukewarm food consumed on the opposite side of the mouth. Rinsing, spitting, or using a straw was strictly prohibited. For the first three days, brushing near the

extraction site was to be avoided. Gentle rinsing with warm salt water was recommended starting from the day following the extraction.
At the end , an image of the modified Wong-Baker FACES Pain Rating Scale was sent to the parents via WhatsApp, followed by a telephone call two hours post-procedure, during which the child was asked to select the face best representing any pain experienced.

Statistical analysis:

SPSS version 25.0 (IBM Corp., Armonk, NY, USA) was used for preforming all statistical analyses. Frequencies, percentages, means, standard deviations, and medians were employed for description statistics. A *P-value* of less than 0.05 was considered statistically significant for all tests.

To assess the normality of distribution the Kolmogorov–Smirnov test was used (Modified Wong – Baker). According to the test (*P-value* < 0.001), non-parametric test was employed for comparison analysis (Mann-Whitney U).

Results:

The sample in this randomized controlled clinical study consisted of eighty children attending the Department of Pediatric Dentistry, Faculty of Dentistry, Damascus University, who were scheduled for the extraction of a mandibular primary molar.
The study sample included 38 males (47.5%) and 42 females (52.5%), with ages ranging from 6 to 9 years, a mean age of 8.01 years, and a standard deviation of 0.961.

Gender	N	%
Male	38	**47.5**
Female	42	**52.5**
Total	80	**100.0**

	Minimum	Maximum	Median	Mean	Std. Devition
Age	6.00	9.00	8.00	8.01	**0.961**

Postoperative pain, evaluated using the modified Wong-Baker Faces Pain Rating Scale, showed significant differences between the Physics Forceps and conventional forceps groups at all assessed time points.
Following local anesthesia (T0), the conventional group experienced lower pain levels (mean 1.08 ± 0.350) compared to the Physics Forceps group (mean 1.58 ± 0.501; p = 0.001).
Immediately after extraction (T1), pain was significantly reduced in the Physics Forceps group (mean 0.95 ± 0.597) relative to the conventional group (mean 1.30 ± 0.564; p = 0.010).
At the two-hour post-extraction follow-up (T2), the Physics Forceps group continued to report lower pain (mean 0.15 ± 0.362) than the conventional group (mean 0.38 ± 0.490; p = 0.023). These findings indicate that the Physics Forceps technique is associated with decreased pain during and after the extraction procedure despite higher initial post-anesthesia scores.

	Mann-Whitney Test						P-value
	Modified Wong-Baker						
	Conventional		40	Physics		40	
	Mean	Std. Devition	Median	Mean	Std. Devition	Median	
After local anesthesia	1.08	0.350	1.00	1.58	0.501	2.00	.001*
After extraction	1.30	0.564	1.00	0.95	0.597	1.00	.010*
After 2h of extraction	0.38	0.490	0.00	0.15	0.362	0.00	.023*
*there is significant statistical difference							

Discussion:

The age range of 6 to 9 years was selected for this study due to several clinical and developmental considerations pertinent to pediatric dental procedures. This period coincides with the early mixed dentition phase, during which permanent teeth begin to erupt and mandibular primary molars remain highly susceptible to severe caries requiring extraction (Hughes and Alsheneifi 2001) . Updated evidence from recent reviews confirms that primary molars are frequently extracted in this age group due to caries progression. Children in this age range demonstrate improved cooperation during clinical procedures compared to younger preschool children (under 6 years), who often exhibit limited comprehension and higher anxiety. This facilitates more reliable self-reported pain assessment using validated tools such as the Wong-Baker FACES Pain Rating Scale, which has demonstrated high reliability in children aged 6 years and older (Naik et al. 2024) . Excluding older children (over 9 years) was warranted, as most primary molars naturally exfoliate by this stage, diminishing the clinical indication for surgical extraction (Patidar, Sogi, and Patidar 2022).

This study was deliberately limited to primary mandibular molars because they pose greater technical challenges during extraction compared to maxillary primary molars. Mandibular primary molars typically have divergent or convergent roots, denser buccal cortical bone, and limited lingual access, which increases the risk of trauma with conventional forceps. In contrast, maxillary primary molars benefit from thinner buccal bone plates, wider access, and simpler root morphology, often resulting in shorter extraction time and less pronounced differences between techniques (Fayaz et al. 2024). Although Physics Forceps have shown similar atraumatic benefits in maxillary teeth in adult studies(Basheer 2017) (Kapila et al. 2020) the current evidence in pediatric maxillary primary molars remains limited. Future research comparing both arches would provide a more comprehensive understanding of the instrument's efficacy across different anatomical sites.

Pain perception following dental extraction in pediatric patients is a critical outcome, as it directly influences child cooperation, treatment acceptance, and future dental anxiety. In the present study, postoperative pain assessed using the modified Wong-Baker Faces Pain Rating Scale revealed significant differences between Physics Forceps and conventional forceps at all evaluated time points. Although children in the conventional forceps group reported lower pain scores immediately following local anesthesia (T0), those treated with Physics Forceps experienced significantly lower pain immediately after extraction (T1) and at the two-hour postoperative follow-up (T2). These findings highlight the relevance of extraction technique in minimizing procedural and early postoperative discomfort in dentistry, similar to previous research showing reduced pain and anxiety with atraumatic extraction methods (Bhosale et al. 2023).

These findings are also supported by (Abdelwahab, Nørholt, and Taneja 2021) in a systematic review of randomized controlled trials, which concluded that Physics Forceps result in significantly less gingival laceration, bleeding, and pain on the first postoperative day

compared to conventional forceps, with limited but consistent evidence of reduced trauma overall. Similarly, (Janani et al. 2021) in another systematic review of RCTs reported reduced postoperative pain due to the less traumatic nature of Physics Forceps, although evidence quality was noted as insufficient for definitive superiority in all aspects. These results are in line with(Elicherla et al. 2021) , who found significantly lower postoperative pain scores over the first three days in pediatric extractions using Physics Forceps compared to conventional forceps, with reduced trauma to supporting structures and lower anxiety levels in children. Similar benefits were reported also by (Laskar et al. 2022), who highlighted the atraumatic nature leading to less postoperative pain and complications.

The modified Wong-Baker Faces Pain Rating Scale, developed by Al-Munqil and Al-Hajji Bakr (2015) by reducing the faces to only four, was used in this study. The aim was to make it easier for children to choose the face that best expresses their pain and to improve the reliability of the results. This strengthens the clinical relevance of these findings, as the tool is validated and particularly suitable for pediatric pain assessment due to its pictorial and child-friendly format. Pediatric patients are often better able to communicate discomfort using visual scales, which enhances the accuracy and reliability of pain measurement in clinical trials of dental procedures (Alsibai et al. 2023).

The higher pain scores observed at T0 in the Physics Forceps group may be attributed to psychological factors commonly encountered in pediatric patients, such as fear of unfamiliar instruments and heightened anticipatory anxiety. Children are particularly sensitive to novel devices and visual stimuli, which can influence early pain perception even after adequate local anesthesia. Unlike conventional forceps, which are familiar to many children and providers, the design and application method of Physics Forceps may initially increase apprehension, thereby elevating pain reporting immediately following anesthesia (Grisolia et al. 2021) . This pattern of initial higher apprehension with novel instruments aligns with broader observations in atraumatic extraction literature, where Physics Forceps, despite their benefits, may initially elevate patient anxiety in unfamiliar settings before procedural advantages become evident (Chenchev et al. 2024).

In contrast, the significantly lower pain scores observed immediately after extraction (T1) in the Physics Forceps group suggest that the atraumatic nature of this technique plays a substantial role in reducing procedural discomfort. Physics Forceps apply controlled, gradual force that minimizes soft-tissue and hard-tissue injury, consistent with clinical evidence indicating that atraumatic extraction techniques lead to lower postoperative pain and fewer complications. Pediatric studies have similarly demonstrated that less traumatic extraction methods result in better comfort and behavioral outcomes in children undergoing extractions (Elicherla et al. 2021) . The atraumatic mechanism is further corroborated by (Irshad et al. 2023), who demonstrated in a randomized trial that Physics Forceps led to significantly lower postoperative pain scores on days 3 and 7, along with reduced soft tissue tears and higher success rates compared to conventional forceps in mandibular molar extractions .

The persistence of significantly lower pain scores in the Physics Forceps group at the two-hour postoperative interval (T2) further supports the atraumatic nature of this extraction technique. Early postoperative pain is closely related to the degree of tissue injury and inflammatory mediator release at the surgical site. By limiting socket expansion, bone microfractures, and soft tissue tearing, Physics Forceps may reduce the inflammatory response, resulting in diminished pain perception during the early healing phase. Similar outcomes have been reported by several clinical studies demonstrating reduced postoperative discomfort and analgesic consumption following extractions performed with Physics Forceps compared to conventional instruments (Singh et al. 2022) . The sustained lower pain at T2 supports the reduced inflammatory response associated with preserved tissue integrity, consistent with meta-analytic evidence from (Singh et al. 2022) showing lower standardized pain differences and fewer complications (e.g., root fracture, gingival laceration) favoring Physics Forceps across multiple RCTs.

Collectively, these studies reinforce that Physics Forceps offer advantages in minimizing early postoperative discomfort and trauma, particularly relevant for pediatric populations where reduced pain can enhance cooperation and long-term dental attitudes (Janani et al. 2021) (Abdelwahab, Nørholt, and Taneja 2021).
Although the sample size of 80 primary mandibular molars (40 per group) was calculated using G*Power software to achieve 80% power with an effect size of 0.40 and $\alpha = 0.05$ based on previous similar studies, the authors acknowledge that it remains relatively modest for a full-scale clinical trial. This single-center design was chosen due to logistical and ethical considerations in pediatric populations. Future multicenter studies with larger samples are recommended to enhance generalizability and statistical power.

Conclusion:

From a clinical perspective, these results suggest that Physics Forceps represent a valuable tool for pediatric teeth extraction, especially when minimizing postoperative pain and enhancing the overall patient experience are key priorities. Incorporating atraumatic techniques such as the Physics Forceps into routine pediatric practice can improve child comfort, reduce negative dental experiences, and foster positive attitudes toward future dental care. Overall, these findings underscore the clinical advantages of atraumatic extraction methods in promoting better outcomes for young patients (these findings highlight the clinical advantage of atraumatic extraction techniques in improving child comfort and overall dental experience).

Conflict of Interest Statement:

The authors have no competing interests to report.

Data availability:

The data provided for the results presented in this study is available through the corresponding author upon request.

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