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Effect of Local Anesthesia on Postoperative Pain with General Anesthesia

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EFFECT OF LOCAL ANESTHESIA ON POSTOPERATIVE PAIN WITH GENERAL ANESTHESIA

A thesis submitted in partial fulfillment of the requirements for the degree of Masters of Science in Dentistry at Virginia Commonwealth University.

by

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Abstract

EFFECT OF LOCAL ANESTHESIA ON POSTOPERATIVE PAIN WITH GENERAL ANESTHESIA

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Dentistry at Virginia Commonwealth University.

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Purpose: The aim of this study was to determine if the use of local anesthesia with general anesthesia results in less postoperative pain. The alternative hypothesis is that children will experience less postoperative discomfort when utilizing intraligamental local anesthetic during the intra-operative time period.

Methods: Patients were recruited for this single blind, randomized, prospective cohort study with the following inclusion criteria: English speaking children age 3-6 years, ASA I/II requiring general anesthesia for dental treatment. Randomization was done to place patients in groups of no local anesthetic vs. local anesthetic administration. A Wong-Baker Faces Pain Scale was utilized to evaluate pre-operative and postoperative pain. Data were compared using a two way mixed model ANCOVA controlling for sex, ethnicity, pre-op pain, and intra-op meds given.

Results: Data was collected and evaluated on 90 patients. There was a statistically significant difference in postoperative pain for patients who received extractions without local anesthesia vs. those with local anesthetic. There was no statistically significant difference in pain outcomes based solely on whether local anesthetic was administered regardless of treatment type.

Conclusions: The outcome of this study shows evidence for provision of local anesthetic during general anesthesia in patients receiving extractions to reduce postoperative pain.

Introduction

The International Association for the Study of Pain's widely used definition states, "Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage". Pain is described as a very subjective feeling related to experience in early life and is influenced by such factors as age, fear, personality, circumstances and culture.[1] A well documented phenomenon in medicine is the under-treatment of pain in children.[2] The American Academy of Pediatrics and the American Pain Society issued joint recommendations in 2001 regarding the role of the pediatrician to ensure effective treatment of pain in infants, children, and adolescents but does not comment on pediatric dentists and their role in alleviating discomfort for their patients.[3]

The Centers for Disease Control and Prevention reports that caries is the most prevalent infectious disease in our nation's children. More than 40% of children have caries by the time they reach kindergarten. In contrast to declining prevalence of dental caries in older age groups, the prevalence of caries in poor US children under the age of 5 is increasing.[4] This increase in caries has led to full-mouth dental rehabilitation under general anesthesia (GA) becoming an increasingly necessary and accepted modality of treatment for comprehensive pediatric dental treatment.[5] GA may be indicated for children with the following: extreme anxiety, extensive needs, very young age, and/or physical/mental disabilities.[6] The chief advantage of GA is that it facilitates completion of all necessary dental care in a single visit with minimal duress to the patient. Dental treatment under GA is usually the last resort due to expense, risk-benefit considerations, and acceptability to parent. Minimizing morbidity is a necessity to ensure acceptability of this treatment modality.

Morbidity related to GA is less of a problem for patients than morbidity related to dentistry.[7] Postoperative dental pain is a common occurrence in patients undergoing general anesthesia for dental procedures.[1,7-9] Studies have shown reports of postoperative pain ranging from 57.5-95% of patients.[1,9] Some pain is common within the first few hours after surgery and thought to be secondary to the trauma to hard and soft tissues. Uncontrolled pain can delay discharge from the hospital. Studies investigating the use of oral preoperative analgesics, i.e. ibuprofen and paracetamol, suggest that these medications provide no greater benefit to postoperative pain than placebo.[10] Improvements in pain control have the potential to significantly reduce reported morbidity following dental treatment under GA.

The concomitant use of local anesthetics is one aspect of outpatient dental treatment under GA that has not received specific recommendations in terms of efficacy, purpose and safety and is still not always part of routine clinical practice.[5] Currently, the American Society of Anesthesiologists and American Dental Association have no recommendations regarding the use of local anesthetics during dental rehabilitation under GA.[11,12] The American Academy of Pediatric Dentistry guidelines state that local anesthesia "may be used" to reduce pain in the postoperative recovery period after GA; and reduce the dosage of inhalation anesthetics required during GA. No directive statements exist in the AAPD guidelines regarding the use of local anesthesia (LA).[13] As evidence-based dentistry has become the standard of care, examination of the impact of local and general anesthetics on pediatric pain is not only clinically relevant but also necessary in order for acceptable treatment to be rendered.

Local anesthesia has been used in conjunction with general anesthesia to reduce postoperative pain in a variety of other surgical procedures, i.e. joint replacements. Some operators use local anesthetic as an adjunct to GA for its associated vasoconstriction. While this could reduce bleeding, it could also increase post-op distress due to associated facial numbness. Prior research on effectiveness of LA in young children has been inconclusive. Gazal et al. investigated bupivicaine soaked swabs as an alternative topical method of pain control to avoid postoperative facial numbness. The results indicated that they were ineffective at reducing pain.[14] Numerous other studies regarding the use of injected local anesthetic have shown no differences in postoperative pain when a of local anesthetic was used in conjunction with GA.[2,8,15] A study of intraligamental local anesthetic by Sammons et al. showed less pain initially after recovery, but that the difference was not sustained over the first hour after dental extraction.[16] There is evidence for the use of local anesthetic for reduction in intra-operative hemorrhage.[15,17]

The intraoral infiltration of a local anesthetic causes profound alteration of orofacial sensation, particularly affecting the lips and cheeks. Older children can be counseled preoperatively to expect numbness of the lips or gums when they wake up from general anesthesia, but younger children are often incapable of understanding this. In many cases, general anesthesia is indicated in children because of anxiety, behavioral issues, or extent of treatment required. Many of these children do not attend regular dental appointments and therefore may not have previous experience with the altered sensation of the oral cavity associated with a local anesthetic. Many providers note that younger children sometimes appear to be as distressed by the feeling of numbness as by the postoperative pain of the procedure.

The use of local anesthesia may also lead to inadvertent lip biting.[2,18] A prospective study published in 2000 found that 13% of children aged 2 to 18 experienced soft tissue trauma after unilateral or bilateral mandibular nerve block anesthesia.[19] Predictably, the evidence of soft tissue trauma was highest among the youngest age groups- 18% among children less than 4 years, 16% in children aged 4 to 7, 13% in 8 to 11 year old children, and 7% in children 12 year and older.[19] Children may bite their lower lip, either out of curiosity associated with the unfamiliar sensation of being numb or inadvertently because no pain is felt. Inadvertent lip biting can also occur during the immediate postoperative period when eating or sleeping.

One method to overcome this distress and possible trauma is to abandon the use of local anesthesia altogether. Alternatively, LA could be administered using intraligamental injection as there is less associated soft tissue numbness.[17,20] Intraligamental administration does not produce anesthesia of the lip or tongue and, therefore, eliminates the risk of self-damage in children during the immediate postoperative period of anesthesia. Leong et al. showed that intraligamental injection resulted in significantly lower pain scores during the first night postoperative compared to local infiltration of LA. The researchers reasoned that the after-effect of less soft tissue numbness initially could be better tolerated with reduced perceived pain/discomfort and thus, showed more favorable outcomes later.[17]

Numerous formulations of anesthetic are available for dental use. Most of the anesthetic solutions commonly used contain a vasoconstrictor in order to prolong the anesthetic effect. Vasoconstrictors have been shown to interfere with pulpal blood flow.[21] It has been found that infiltration injection of 2%lidocaine with 1:100,000 epinephrine reduces pulpal blood flow to as low as 28% and the recovery of flow may take up to 75minutes.[22] During this time period, the dental pulp may experience decreased oxygenation which may contribute to an irreversible injury. Other studies have shown that at higher doses, local injections of epinephrine causes pulpal blood vessels to collapse, producing total ischemia of the pulp.[21] The individual effect of epinephrine in attaining anesthesia was investigated by Handler and Albers in their study of intraligamental anesthesia. They found no significant differences between 2% lidocaine, 2%lidocaine with epinephrine 1:50,000, 2% lidocaine with epinephrine 1:100,000 with regard to occurrence or duration of pulpal anesthesia.[23] In a clinical trial, Edwards et al. successfully anesthetized and removed 79% of permanent teeth with use of 2% lidocaine administered by intraligamental injection.[24]

Since a primary goal of intraoperative local anesthesia is the reduction of postoperative distress, it is important to determine if local anesthesia actually accomplishes this or whether it would be better to omit this practice in young children. Observational studies in the community dental clinic highlight that local anesthetic injections appear superior to systemic analgesia, and patients who received local anesthetic injections seem more settled in recovery.[25] Ashkenazi et al. evaluated postoperative dental pain and determined that root canal treatment and preformed stainless steel crowns, with or without pulpotomy, induced a significantly higher incidence of postoperative dental pain compared to extraction, restorations, and sealant.[26] Other studies have indicated that extractions are the most invasive procedure and that children undergoing extractions were 7 times more likely to report pain after returning home.[9]

The aim of this study was to determine if the use of local anesthesia utilizing the intraligamental injection results in less postoperative pain in patients undergoing GA. Intraligamental injections concurrently eliminate soft tissue anesthesia and the possible confounding factor of unusual sensation which may lead to distress. The correlation between pain scores provided by patients and the evaluation of their pain by providers and parents to determine if outsiders can accurately evaluate pain in a young child was also evaluated. If the hypothesis is correct, this study will give evidence-based recommendations for use of local anesthesia when providing full mouth dental rehabilitation under GA in terms of reduction of postoperative pain.

Methods

All patients included in this single blind, randomized, prospective cohort pilot study were seen on an outpatient basis at Virginia Commonwealth University Ambulatory Care Center. The VCU Institutional Review Board (IRB) for Humans Subjects Protection approved this study. Informed consent was obtained from the parent on the day of surgery during the pre-surgical consultation at the Ambulatory Care Center. Patients seen at the Ambulatory Care Center were scheduled for care under general anesthesia based on the pre-cooperative/uncooperative behavior and/or amount of treatment needed. The inclusion criteria for this study were as follows: English speaking ASA 1 and 2 children with restorative needs in primary dentition only, 3-6 years of age, predetermined to require general anesthesia care for dental treatment and/or extractions. A prior pilot study determined that 84 patients would be required to have 80% power to determine a difference between groups. A total of 90 patients were recruited and data collected.

Prior to the commencement of this study, Post Anesthesia Care Unit (PACU) nurses and pediatric dental residents were formally calibrated prior to their participation in this study. All instructions, informed consent, and IRB paperwork were reviewed prior to this study allowing practitioners and nurses to participate. There were two groups with a total of n=90 patients. N=46 patients were randomized to receive local anesthesia and n=44 were in the no local anesthetic control group. Each of these groups were then treated either with or without local anesthesia using intraligamental lidocaine, as previously randomized using the Statistical Analysis System (SAS) randomization technique prior to starting the study. During data analysis the groups where further divided into a first group of children receiving dental restorations only for primary teeth, and a second group of children receiving the combination of dental restorations and dental extractions of primary teeth. Each number from 1-90 was assigned a random value of local anesthesia or no local anesthesia. Each child participating received one of the pre-numbered and randomized packets. The children not receiving local anesthetic served as the control group for this study.

After receiving informed consent, the child, parent and the resident in the preoperative assessment area evaluated and rated the patient's preoperative pain utilizing the Wong-Baker Faces Pain Scale (Figure 1), prior to the start of anesthesia care. The Wong-Baker Faces pain scale consists of six cartoon faces with varying expressions ranging from very happy to very sad.[27] The six different faces with associated numbers are on an ordinal continuous value scale ranging from 0 (no hurt) to 10 (hurts worst). Three preoperative baseline pain scores were recorded at the pre-operative assessment time.

Figure 1:Wong Baker Faces Pain Scale: Visual Scale for numerical pain intensity evaluation.

The study used a standardized anesthetic regimen, as deemed appropriate by the consulting pediatric anesthesiologist. The anesthesia protocol included, pre-operative oral midazolam at 0.5

milligrams (mg) per kilogram (kg) up to 20 mg total, mask induction with sevoflurane/oxygen/nitrous oxide, induction medications such as fentanyl (narcotic) 0.5-1.0 micrograms per kilogram and propofol at 2 mg/kg. It was requested that no additional pain medications (narcotics) be administered throughout the intra-operative time period unless found to be medically necessary by the anesthesia team (interventions were recorded).

Subjects were randomly assigned to either receive LA or no LA. The pediatric dental resident opened the pre-randomized sealed envelope with the corresponding number and value of LA or no LA after consent had been obtained. Subjects assigned to the LA group received a standardized LA protocol as follows: 2% plain lidocaine administered in the first quadrant to be treated, after placement of a gauze throat pack, and prior to the start of the procedure. Operators used intraligamental injections of the 2% lidocaine plain with a 3mL syringe and a 30 gauge extra-short needle. Previous literature shows evidence of pulpal ischemia with use of epinephrine containing anesthetics.[21,22] To eliminate any possible confounding pain due to ischemia by use of a vasoconstrictor, a plain formulation of lidocaine was selected. The local anesthetic was administered in two locations for each single rooted tooth (buccal and lingual), and four locations for each multi-rooted tooth treated (mesial buccal, distal buccal, mesial lingual and distal lingual). The operators did not exceed doses of 4.4mg/kg total of 2 % plain lidocaine. The total amount and time of administration of the local anesthesia was recorded in the anesthesia record. Treatment in each quadrant was completed in the following order: sealants, anesthesia administration, extractions, composite resins, pulpotomies, and stainless steel crowns. Treatment was completed by quadrants with administration of local anesthetic occurring just prior to beginning treatment in the subsequent quadrants.

Following completion of the dental treatment and general anesthesia care, the patients were escorted to the PACU. The PACU nurses, patients, and their parents were blinded as to whether or not the child had received a local anesthetic. Three pain scores were obtained as follows: patients, PACU nurse and the parent subjectively graded the child's pain intensity in the immediate postoperative time period, using the visual Wong-Baker pain scale.. Additional pain medications administered in the PACU were recorded if needed in the immediate postoperative time period prior to discharge. The patients were contacted 6-8 hours following their procedure. The parents evaluated their pain at this time, utilizing the Wong-Baker Faces Pain Scale which was sent home along with routine postoperative instructions. The research assistant, who was blinded as to whether or not the patient received LA, recorded the pain measurement for future review. If parents reported that pain medications were administered at home, then that amount was recorded.

A total of eight pain scores were recorded for each patient: three preoperative (patient, parent, and pediatric dental resident obtaining consent), three in the immediate postoperative time period (patient, PACU nurse, and parent), and two (patient and parent) 6-8 hours postoperative. Outcome variables were self reported patient postoperative pain scores, and the control variables included pre-operative pain score, treatment type, and the need for intra-operative interventions.

ANCOVA controlling for pre-operative reported pain scores, treatment completed, and the need for intra-operative medications was used for data analysis. Primary independent variable comparison was made between the local anesthetic and no local anesthetic experimental groups.

Agreement between raters was assessed by the calculation of Cohen's Kappa, a change-corrected measure of agreement.

Results

The overview of the results section is as follows: The first portion of results describes the level of agreement between the different individual's rating of pain. The second section addresses the primary aim, whether local anesthesia use has an effect on the patient rating of post-op pain. The final portions address the secondary analyses that consider other factors that may be related to pain, other raters of pain, and the in-home follow-up rating.

Pain ratings: Descriptive

There were N = 674 pain ratings given by the four evaluators (parent, patient, resident, and nurse), across the three occasions (pre-op, post-op, and home). Residents only gave pain assessments at pre-op and nurses only gave assessments at post-op. About two-thirds of the time, pain was rated at 0= "no hurt" (Table 1) and pain at the 10= "hurts worst" did occur.

Table 1: Pain assessment across evaluators

	Frequency				
Pain	Parent	Patient	Resident	Nurse	%
0	153	151	80	61	66.0
1	5	3	2		1.5
2	33	37	6	7	12.3
3	6	2		2	1.5
4	22	18	2	5	7.0
5	5	4			1.3
6	5	9		5	2.8
7	2	1		1	0.6
8	6	9		4	2.8
9	2				0.3
10	8	13		5	3.9
n	247	247	90	90	100
Mean	1.59	1.77	0.24	1.77	
SD	2.61	2.87	0.77	3.05	

Abbreviation: n = frequency, SD = standard deviation

Since multiple raters assessed pain intensity at the same time, the level of agreement between raters may be described. Overall there is good agreement between the parent and patient ratings (r = 0.67, Table 2).

Table 2: Correlation of raters

	Rater		
Rater	Patient*	Resident	Nurse
Parent	0.67	0.45	0.55
Patient		0.49	0.34

Correlations constrained to have a zero intercept. * n = 247 paired ratings. All other paired ratings are n = 90.

Agreement between Parents and Patients

There were n = 247 occasions where both parents and patients rated the level of pain and on 128 of those occasions, both raters gave a rating of 0 (Table 3). There was no mean difference between the mean levels of pain (paired t-test P = 0.1705). In 66% of all cases, both raters agreed (shown in bold in the table; chance corrected Kappa = 0.42). In 89% of all cases the ratings differed by 3 or less. This level of agreement may also be seen in Figure 2, where the sizes of the circles are proportional to the frequency of occurrence. There were few cases (n = 15) where raters disagreed by 5 or more and the maximum disagreement was 8.

Table 3: Agreement between parents and patients

	Parent											
Patient	0	1	2	3	4	5	6	7	8	9	10	
0	**128**	2	12	1	5			1	2			151
1		**2**	1									3
2	17	1	**11**	4	1		2			1		37
3			1	**1**								2
4	3		3		**11**	1						18
5	1				1	**1**			1			4
6	3				2	2	**1**			1		9
7								**1**				1
8	1		2		1	1	1		**1**		2	9
9												0
10			3		1		1		2		**6**	13
	153	5	33	6	22	5	5	2	6	2	8	247

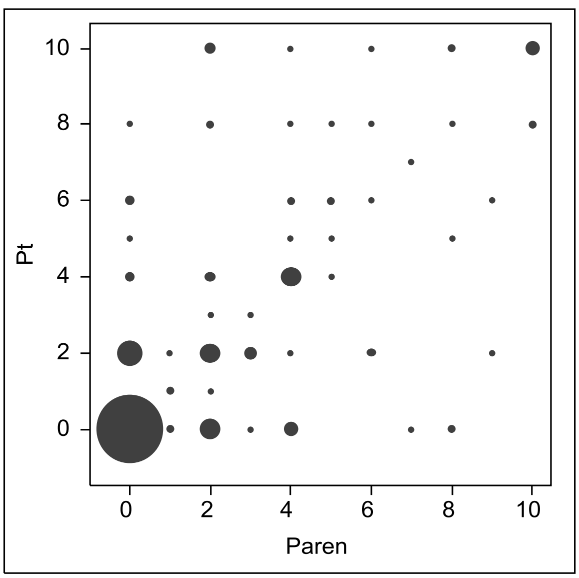

Figure 2: Agreement between parents and patients

Agreement between Residents and Patients

During pre-op there were n = 90 occasions where both residents and patients rated the level of pain. For 58 patients, both raters gave a rating of 0 (Table 4). There was a mean difference between the mean levels of pain (paired t-test P < .0001). The patients recorded significantly more pain than did the residents (mean = 1.23 versus 0.244). In 66% of all cases, both raters agreed (shown in bold in the table; chance corrected Kappa = 0.11; which was not beyond a chance level of agreement, P = 0.0757). In 87% of all cases the ratings differed by 2 or less. There were few cases (n = 5) where raters disagreed by 5 or more and the maximum disagreement was 8.

Table 4: Agreement between residents and patients

	Resident											
Patient	0	1	2	3	4	5	6	7	8	9	10	
0	**58**	1	2									61
1												
2	14	1	**0**									15
3												
4	4		1		**1**							6
5	1		0		0							1
6	1		2		0							3
7												
8	2				1							3
9												
10			1									1
	80	2	6		2							90

Agreement between Nurses and Patients

During post-op, there were n = 90 occasions where both the recovery nurse and the patient rated the level of pain.

Baseline comparisons

At pre-op there was no difference in the patient's reported pain depending upon race, resident year, whether an extraction was to be performed, whether a restoration was to be performed, or the age of the patient (Table 5). The average age of the patient at the time of surgery was 4.5 years (SD = 1.02, range = 3.0 to 6.9 years). There also was no pre-op pain difference depending upon the randomly assigned local anesthesia groups or whether an intra-op pain medication was used.

Table 5: Baseline comparisons

Characteristics		Patient Pre-Op Pain n	Mean	SE	p-value
Race/Ethnicity					0.759
	Caucasian	43	1.233	0.352	
	African American	36	1.389	0.384	
	Hispanic	4	0.500	1.153	
Resident year					0.607
	1	33	1.394	0.390	
	2	57	1.140	0.297	
Extraction					0.620
	No	30	1.067	0.410	
	Yes	60	1.317	0.290	
Restoration					0.582
	No	1	0.000	2.243	
	Yes	89	1.247	0.238	
Age (years)					0.515
		90	1.233	r = 0.07	
Local anesthesia					0.335
	Yes	46	1.457	0.329	
	No	44	1.000	0.337	
Intra-op pain medication					0.316
	No	33	1.545	0.389	
	Yes	57	1.053	0.296	

Outcome analysis

Patients were randomly allocated to local anesthesia groups (Yes = 46, No = 44) and then during the surgical process it was determined whether an extraction would be done. It was also documented whether intra-op pain medication was administered. In the local anesthesia groups, there were an approximately equal number of patients with extractions (34/46 in the local anesthesia group, and 26/44 in the no local anesthesia group). There was also an approximately equal number of patients receiving intra-op pain medication (27/46 in the local anesthesia group, and 30/44 in the no local anesthesia group). The results of the primary outcome analysis are shown in Table 6. There was weak evidence for a relationship between the use of intra-op pain medications and patient post-op pain (P < 0.07) and weak evidence for a correlation between pre-op pain and post-op pain (P < 0.08). The interaction test indicated that the effect of local anesthesia was not consistent across the two extraction groups (P = 0.019). So, an interpretation of the main-effects of local anesthesia and of extraction is not appropriate.

Table 6: ANCOVA results-Primary outcome: Patient post-op pain

Source	df	F	p-value
Intra-op pain meds	1	3.413	0.068
Pre-op pain	1	3.334	0.071
Extraction	1	0.682	0.411
Local anesthesia	1	0.349	0.557
Extract*Local	1	5.723	0.019
Error	84		

N = 90, R^2 = 15%

The effect of local anesthesia on patient post-op pain is seen in Table 7. Within the no extraction group, there was no significant difference depending upon the use of local anesthesia (P > 0.2) but in the extraction group, there was a significant difference in pain (P < 0.02) with the local anesthesia group showing less pain (mean = 1.6 vs. 3.9). The 95% CI on the difference indicates that when there is an extraction, the use of local anesthesia reduces pain by between 0.6 and 4.0 units.

Table 7: Mean patient post-op pain, depending upon local anesthesia and extraction

	Post-op Pain				
Local	LS Mean	SE	95% CI		p-value
	No extraction				
Yes	2.819	0.970	0.889	4.748	
No	1.432	0.789	-0.136	3.000	
difference	1.387	1.249	-1.062	3.836	0.270
	Extraction				
Yes	1.609	0.574	0.468	2.750	
No	3.895	0.683	2.537	5.252	
difference	-2.286	0.882	-4.014	-0.558	0.011

Least-squares mean estimates and p-values calculated from an ANCOVA with the following effects: Intra-op pain meds (yes/no), pre-op pain, extraction (yes/no), local anesthesia (yes/no), extraction*local interaction.

The follow-up analysis of this primary outcome also explored the effect of age (in months), number of interventions, restoration, patient race, and resident year. Since race was not reported by 7 patients and since the preliminary analysis indicated no evidence for an effect of race (P = 0.529), race was not included in subsequent analyses. The result of this follow-up analysis is shown in Table 8. As may be seen, none of the additional factors were related to patient post-op pain and the significance of the factors in the primary analysis did not change materially.

Table 8: ANCOVA follow-up results-Primary outcome: Patient post-op pain

Source	df	F	p-value
Intra-op pain meds	1	2.032	0.158
Pre-op pain	1	3.472	0.066
Extraction	1	0.552	0.460
Local anesthesia	1	0.328	0.569
Extract*Local	1	6.128	0.015
Patient age	1	0.062	0.804
#interventions	1	0.248	0.620
Restoration	1	0.066	0.797
Resident Year	1	2.443	0.122
Error	80		

N = 90, R^2 = 17.6%

Parent's pain rating post-op,

In these follow-up analyses, since none of the exploratory factors was significant, the analysis model will be the same as that used for the primary outcome. The results of the analysis of the parent's pain rating immediately post-op is shown in Table 9. The pattern of results is similar to that found when analyzing the patient pain score in that there was a non-significant interaction effect (P < 0.06).

Table 9: ANCOVA results-Secondary outcome: Parent post-op pain

Source	df	F	p-value
Intra-op pain meds	1	5.65	0.020
Pre-op pain	1	0.23	0.631
Extraction	1	0.36	0.550
Local anesthesia	1	0.05	0.821
Extract*Local	1	3.69	0.058
Error	84		

N = 90, R^2 = 10%

The average parent post-op pain score, after controlling the effects of intra-op pain med, and pre-op pain is shown in Table 10. Within the no extraction group, there was no significant difference depending upon the use of local anesthesia (P > 0.3) and in the extraction group, there was a non-significant difference in pain (P > 0.06) with the local anesthesia group showing nominally less pain (mean = 2.3 vs. 4.0). The 95% CI on the difference indicates that when there is an extraction, the use of local anesthesia reduces pain by between –0.06 and +3.5 units.

Table 10: Mean parent post-op pain, depending upon local anesthesia and extraction

	Post-op Pain				
Local	LS Mean	SE	95% CI		p-value
	No extraction				
Yes	3.327	1.019	1.301	5.353	
No	1.973	0.804	0.375	3.571	
difference	1.354	1.299	-1.192	3.900	0.300
	Extraction				
Yes	2.266	0.586	1.101	3.432	
No	3.976	0.698	2.588	5.364	
difference	-1.710	0.901	-3.476	0.057	0.061

Estimates and p-values calculated from an ANCOVA with the following effects: Intra-op pain meds (yes/no), parent rating of pre-op pain, extraction (yes/no), local anesthesia (yes/no), extraction*local interaction.

Nurse's pain rating post-op,

The analysis of the nurse's pain rating used the same model as for the primary analysis, including the patient's pre-op pain rating (since the nurse did not rate pain pre-op). The results are shown in Table 11. Again, there was a marginally non-significant interaction (P = 0 .053) indicating that the effect of a local anesthesia may depend upon whether an extraction is performed.

Table 11: ANCOVA results-Secondary outcome: Nurse post-op pain

Source	df	F	p-value
Intra-op pain meds	1	0.00	0.959
Pre-op pain	1	3.67	0.059
Extraction	1	3.02	0.086
Local anesthesia	1	1.02	0.315
Extract*Local	1	3.84	0.053
Error	84		

N = 90, R^2 = 14%

The table of the mean nurse rating of post-op pain (Table 12) shows a similar pattern except that in this instance, in the extraction group the effect of a local anesthetic is significant (P < .02).

Table 12: Mean nurse post-op pain, depending upon local anesthesia and extraction

	Post-op Pain				
Local	LS Mean	SE	95% CI		p-value
	No extraction				
Yes	1.434	0.850	-0.255	3.124	
No	0.791	0.690	-0.582	2.164	
difference	0.643	1.094	-1.501	2.787	0.558
	Extraction				
Yes	1.270	0.502	0.271	2.269	
No	3.261	0.598	2.073	4.450	
difference	-1.992	0.772	-3.504	-0.479	0.012

Estimates and p-values calculated from an ANCOVA with the following effects: Intra-op pain meds (yes/no), patient rating of pre-op pain, extraction (yes/no), local anesthesia (yes/no), extraction*local interaction.

Patient's pain rating 6-8 hours post-op

Not all of the subjects provided in-home 6-8 hour post-op pain ratings. N = 67 subjects did, n = 33 in the local=yes group and n = 34 in the local=no group. An additional factor to consider in the analysis of these data is the use of post-discharge pain medications. These medications were used in 54% of the cases (n = 36). Additionally, the analysis also added the immediate post-op pain rating as a covariate instead of the pre-op pain rating. The results of the analysis are shown in Table 13. The only significant difference was for post-op pain meds (P < .03).

Table 13: ANCOVA results-Secondary outcome: Patient in-home pain

Source	df	F	p-value
Intra-op pain meds	1	0.04	0.838
Post-op pain	1	0.39	0.536
Extraction	1	1.65	0.204
Local anesthesia	1	1.18	0.282
Extract*Local	1	0.08	0.773
post-op pain meds	1	5.02	0.029
Error	84		

N = 67, R^2 = 15%

The differences associated with the use of post-discharge pain meds is shown in the upper portion of Table 14. Those using pain meds reported more pain (P < .02). Additionally, the table also shows the non significant difference depending upon the use of local anesthesia.

Table 14: Mean patient post-discharge pain, depending upon local anesthesia and medications

	Post-discharge Pain				
groups	LS Mean	SE	95% CI		p-value
	Post-discharge pain meds				
Yes	2.022	0.333	1.356	2.687	
No	0.928	0.342	0.243	1.613	
difference	1.094	0.448	0.198	1.989	0.018
	Local anesthesia				
Yes	1.290	0.541	0.207	2.372	
No	2.045	0.452	1.141	2.949	
difference	-0.756	0.697	-2.121	0.610	0.282

Estimates and p-values calculated from an ANCOVA with the following effects: Intra-op pain meds (yes/no), patient rating of post-op pain, extraction (yes/no), local anesthesia (yes/no), extraction*local interaction, and the use of post-op pain meds (yes/no).

Parent's pain rating 6-8 hours post-op

Using the same model as the patient's in-home pain rating, the results are shown in Table 15. The only significant effect was for post-discharge pain meds (P < .02).

Table 15: ANCOVA results-Secondary outcome: Parent in-home pain

Source	df	F	p-value
Intra-op pain meds	1	0.00	0.977
Post-op pain	1	0.05	0.816
Extraction	1	1.01	0.319
Local anesthesia	1	1.03	0.315
Extract*Local	1	0.95	0.335
post-op pain meds	1	5.97	0.018
Error	84		

N = 67, R^2 = 17%

Table 16 shows the mean post-discharge (in-home) pain rating as given by the parent depending upon the use of post-discharge pain meds. Those who did use pain meds had significantly more pain (P < .02). Additionally, the results of the primary research question—the effect of local anesthesia—is shown in the bottom portion of the table. There was no significant difference (P > 0.3).

Table 16: Mean parent post-discharge pain, depending upon local anesthesia and medications

	Post-discharge Pain				
groups	LS Mean	SE	95% CI		p-value
	Post-discharge pain meds				
Yes	2.022	0.333	1.356	2.687	
No	0.928	0.342	0.243	1.613	
difference	1.094	0.448	0.198	1.989	0.018
	Local anesthesia				
Yes	1.225	0.383	0.458	1.992	
No	1.725	0.320	1.084	2.366	
difference	-0.500	0.494	-1.467	0.468	0.315

Estimates and p-values calculated from an ANCOVA with the following effects: Intra-op pain meds (yes/no), parent rating of post-op pain, extraction (yes/no), local anesthesia (yes/no), extraction*local interaction, and the use of post-op pain meds (yes/no).

Discussion

Our ability to manage postoperative pain is a vital component of successful dental care for pediatric patients. Managing pain first requires accurately assessing the degree of pain experienced. Based on data collected during this study it can be concluded that parental account of pain intensity for their child can be fairly reliable. There was overall good agreement between pain scores reported by patients and those of their parents ($r=0.67$). On the contrary, residents and nurses rated patient pain to be lower than that described by the patients themselves. Residents recorded significantly lower pain than patients ($p<0.0001$).This may be due to providers extensive exposure to patients and therefore loss of sensitivity to signals that express pain. It would be appropriate to assume a parent would be in touch with signs and signals that their child is experiencing discomfort that outsiders may not be tuned into.

The primary aim of this study was to determine if administration of LA utilizing the intraligamental technique resulted in lower postoperative pain. Analysis of the data reveals that LA administration does not result in lower postoperative pain. However, when evaluation of treatment type occurred there effect of local anesthesia was not consistent across extraction groups. Patient who received LA for extractions had significantly less pain than patients who did not receive LA for extractions ($p<0.02$). In other words, administration of LA for treatment that did not include extractions resulted in non-significant postoperative pain differences ($p>0.5$). Concurrently, if a patient received any extractions as part of their treatment plan, the administration of LA decreased postoperative pain by between 0.6 and 4.0 units.

Secondary analyses were completed to look at the effect of pre-operative pain levels and use of intra-operative pain medications on postoperative pain. There is weak evidence that patients with higher pre-operative pain levels subsequently have higher postoperative pain levels ($p<0.08$). The anesthesia providers were asked to not administer additional narcotics during the intra-operative period unless deemed necessary. Narcotic administration past the point of induction was termed an intervention. There appears to be a possible relationship between necessity for additional intra-operative narcotic administration and postoperative pain ($p<0.07$). Patients who received medication had higher levels of postoperative pain.

Patients were contacted at home the evening of their surgery to determine pain levels and whether the parent at had administered pain medication at home. Patients who had been given pain medications at home had reported significantly higher pain levels ($p<.03$). There was no difference in at home pain levels between the group that received LA and the no LA group. The local anesthetic administered intra-operatively would no longer be present 6-8 hours postoperative when the patients where contacted at home and therefore should not have an effect on levels of pain.

There have been numerous studies on effects of local anesthetic on pain outcomes. It is important to be able to evaluate critically the evidence that is presented to determine clinical relevance to practitioners. A weakness to the current study was the use of plain lidocaine. The majority of pediatric dentists use 2% lidocaine with 1:100,000epinephrine or 4% septocaine with

1:100,000einephrine. The addition of a vasoconstrictor prolongs the period of pulpal anesthesia and therefore may increase effectiveness. Even without the presence of a vasoconstrictor there was significant pain reduction in patients undergoing extractions in this study. The anesthetic solution was administered using standard anesthetic syringes instead of a specially designed intraligamental injection syringe. The standard syringe is readily available for all providers but does not allow for pressurized injection into the ligamental space and therefore does not deliver a standardized dose of anesthetic.

There are many strengths to the current research including the delivery of anesthetic to 4 locations in posterior teeth to ensure thorough anesthesia. Past research administered intraligamental anesthetic into the mesial-buccal root only[17] or did not indicate location of anesthetic administration.[16] There was a uniform order to the procedures completed after administration of local anesthetic. Extractions were completed immediately after administration of local anesthetic. Pulpal anesthesia should have been present for extractions but may have worn off prior to completion of all other restorative treatment leading to the non-significant effect of local anesthesia for restorative work alone.

Future studies in the area of local anesthesia usage during full mouth dental rehabilitation with general anesthesia should evaluate commonly used anesthetic formulations including 2% lidocaine with 1:100,000 epinephrine and/or 4% septocaine with 1:100,000 epinephrine delivered by infiltration and/or nerve blocks to determine is overall postoperative pain can be reduced. The current study was able to show evidence for reducing postoperative pain in patients undergoing extractions but does not give recommendations for local anesthetic usage with treatment that does not include extractions.

Conclusion

1. Use of intraligamental 2% lidocaine can significantly decrease postoperative pain with general anesthesia when extractions are performed.
2. Use of local anesthesia does not significantly reduce pain with treatment not including extractions when utilizing the intraligamental technique.
3. Patients with higher preoperative pain had a tendency for higher postoperative pain.
4. Parents give more accurate accounts of the children's pain than other providers.
5. Patients who receive pain medications at home had higher pain levels.

The use of the intraligamental technique of anesthetic administration provides an effective means of anesthetizing for extractions during general anesthesia care without the unwanted soft tissue numbness that coincides with other techniques.

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Vita

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