Research Article

Anaesthetic Efficacy of Infiltration and Conventional Nerve Block Techniques in Restorative Dental Treatment – A Systemic Review and Meta-Analysis

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ABSTRACT

Over the years, there has been a pursuit for an ideal local anesthetic technique which provides minimal discomfort during dental procedures. There is no valid consensus on the use of a particular technique or formulation during restorative dental procedures. The aim of the review was to evaluate the difference in anesthetic efficacy between infiltration anesthetic technique and nerve block techniques in patients undergoing restorative dental treatment procedures. An electronic search was launched with PubMed database to screen for articles from 1966 to 1st July 2014 discussing the efficacy of infiltration techniques over nerve block techniques using different modes of deposition during dental restorative procedures using suitable keywords. The selected articles were screened and data extracted. The results were then statistically evaluated by a meta-analysis. The search yielded a total of 92 articles out of which 67 were discarded after reading the abstracts. A total of five articles were obtained based on the inclusion and exclusion criteria. The results of the meta-analysis indicated an odds ratio of 1.042 (Confidence Interval- 0.935- 1.131) with p value >0.05) and hence null hypothesis formulated for the review was accepted. This indicated that there is no significant difference between infiltration anesthetic technique and the nerve block anesthetic technique during restorative dental treatment procedures. There is no difference in anesthetic efficacy between infiltration anesthetic techniques and nerve block techniques and both the techniques are equally effective in restorative dental treatment procedures.

Keywords: local anaesthesia, infiltration technique, nerve block technique, anaesthetic effectiveness

INTRODUCTION

Proper selection of the anesthetic technique according to the need and clinical situation is imperative for least discomfort of the patients undergoing dental treatment. Nerve blocks are amongst the most effective techniques in obtaining anesthesia of the desired region. In nerve blocks, the local anesthetic is deposited close to a main trunk of the nerve thus anesthetizing the hard and soft tissues supplied by it. However, these techniques also have risks and complications associated with them such as paresthesia, trismus etc. While performing non- surgical dental restorative procedures, more than a profound soft tissue anesthesia covering a wide area is achieved, whereas an anesthetic technique which gives an efficacious pulpal anesthesia of a single tooth is required. An alternative to using nerve blocks is the use of the supra periosteal injection technique, also called local infiltration. In this technique, small nerve endings in the area of the dental treatment are flooded with local anesthetic solution. This method is better as, only a localized area gets anesthetized which causes less discomfort to the patient[1].

In recent years, there has been a surge in the study of newer and more efficacious anesthetic agent formulations (Articaine, Articaine with analgesics) and newer techniques (computer controlled techniques, intra-osseous techniques) and their comparison with the conventional techniques[2-7]. Despite these newer methods, the basic injection techniques remain unchanged.

Though numerous studies have been done to find the success rate among the various methods[8-10], it is inconclusive as to whether the nerve blocks are a more effective alternative to infiltration techniques for restorative procedures involving single teeth[11].

Most studies have focused on the efficacy of the techniques and agents in endodontic procedures and extractions of teeth with irreversible pulpitis or grossly decayed teeth[12].

There are very few reports in the literature pertaining to the usage and efficacy of local anesthetics in common dental restorative procedures[13].

Hence, this systematic review was attempted to review literature concerning the use of the infiltration technique and the nerve blocks in dental restorative procedures.

Aim

The aim of the review was to evaluate the difference in anesthetic efficacy between infiltration anesthetic technique and nerve block techniques in patients undergoing restorative dental treatment procedures.

Null Hypothesis

There is no difference in the anesthetic efficacy between infiltration anesthetic technique and nerve block

techniques during restorative dental treatment procedures.

Alternate Hypothesis

There is a difference in the anesthetic efficacy between infiltration anesthetic technique and the nerve block techniques during restorative dental treatment procedures.

PICO Analysis

P - Population – Apprehensive dental patients with less pain threshold undergoing restorative dental treatment procedures.

I - Intervention- Site specific infiltration anesthetic techniques

C- Comparison – Nerve block techniques

O -Outcomes –Primary outcomes:

Anesthetic efficacy during the dental treatment procedures measured as:

1. Absence of pain / discomfort
2. Absence of hypersensitivity

Secondary outcomes

Factors contributing to anesthetic success

1. Duration of anesthesia
2. Anesthetic recovery
3. Pain/ discomfort during infiltration
4. Post operation ulceration in anesthetic site
5. Post-operative trismus

MATERIALS AND METHODS

Sources used

An electronic search was conducted for articles written in English, translated into English listed with Pubmed, Cochrane, Science Direct databases till July 1st 2014 using suitable keywords and additional hand searching.

Search Algorithm

The search algorithm applied in PUBMED was as follows:

((local anesthetic) OR targeted anesthesia) OR local anesthetic efficacy) OR local anesthetic effectiveness) OR numbness) OR pre operative discomfort) AND post operative discomfort) OR procedural discomfort) OR treatment discomfort) OR anesthetic potency) OR anesthetic recovery) OR anesthetic duration) OR ester linked anesthetics) OR amide linked anesthetics) OR injectable anesthetics)) AND ((buccal infiltration) OR subperiosteal infiltrations) OR supra periosteal infiltration) OR periodontal injection) OR intraligamental injection) OR intraligamental infiltration) OR intraosseous injection) OR infraorbital nerve block) OR incisal nerve block) OR nasopalatine nerve block) OR palatine nerve block) OR anterior superior alveolar nerve block) OR posterior superior alveolar nerve block) OR middle superior alveolar nerve block) OR inferior alveolar nerve block) OR mental nerve block) OR akinosi nerve block) OR gow gates nerve block) OR conventional infiltration) OR computer controlled infiltration) OR conventional injection) OR computer controlled injection)) AND ((dental extraction) AND exodontia) OR transalveolar extraction) OR surgical extraction) OR cavity preparation) OR excavation of caries) OR pulpotomy) OR pulpectomy) OR vitality assessment) OR enameloplasty) OR coronoplasty) OR tooth preparation) OR complete veneer crowns) OR partial veneer crowns) OR metal crowns) OR metal ceramic crowns) OR all ceramic crowns) OR acrylic crowns) OR dental restorations) OR inlays) OR onlays) OR laminate veneers) OR composite laminate veneers) OR porcelain laminate veneers) OR (crown and bridge preparation))

Selection of Studies

The review process consisted of two phases. In the first phase, titles and abstract of the search were initially screened for relevance and the full text of relevant abstract were obtained and accessed. The hand searches of selected journals as well as search of references in the selected studies were also done. The articles that were obtained after first step of review process using the following inclusion and exclusion criteria were screened in second phase and relevant and suitable articles were isolated for further processing and data extraction.

Inclusion Criteria

The articles discussing the following parameters were included for the systematic review:

1. Randomized controlled *in vivo* trials reporting the anesthetic efficacy of infiltration anesthetic techniques in restorative dental treatment procedures.
2. Randomized controlled *in vivo* trials reporting the anesthetic efficacy of nerve block anesthetic techniques in restorative dental treatment procedures.

Exclusion Criteria

Articles and manuscripts discussing the following parameters were excluded:

1. Case reports.
2. Randomized controlled trials for anesthetic technique in teeth with irreversible pulpitis, supplementary injection techniques, pre-anaesthetic medication, and combination of anesthetic techniques.
3. Animal studies
4. Randomized controlled trials involving extraction and periodontal surgeries

Results of the Electronic Search

The database search yielded 81 articles out of which 56 articles were discarded after reading the abstract. Full texts were obtained for the remaining 25 articles. 14 articles were selected based on the inclusion criteria and 9 articles were excluded[19-27]. The finally selected 5 articles were subjected to data extraction. The search flowchart is as shown in Fig. 1.

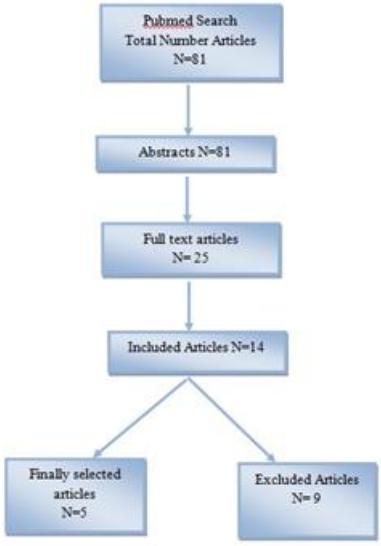

Figure 1: The search flowchart

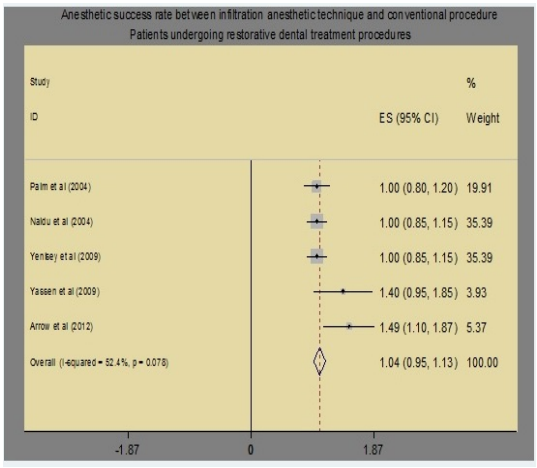

Figure 2: Graph for Forrest plot

RESULTS

Table 1 tabulates the critical appraisal of the selected articles.

Table 2 shows data for primary and secondary outcome measures.

Table 3 tabulates the final data extraction and the summation of the selected articles which was further subjected to statistical analysis.

Table 4 shows the results of the meta analysis of the review which compares infiltration anesthetic technique and the nerve block technique.

Graph 1 shows the forrest plot for anesthetic success rate between infiltration anesthetic technique and conventional nerve block procedures in patients undergoing restorative dental treatment procedures.

The results of the meta analysis indicated an estimated odds ratio effect size of 1.045 (95%CI 0.953-1.131) which indicated that both the techniques are effective to the same magnitude as far as restorative dental procedures not involving the pulp are concerned.

DISCUSSION

Alleviating the pain is of paramount importance for the clinician while treating apprehensive dental patients. Various factors contribute to increased pain perception such as psychological factors, genetic factors, previous history of traumatic dental experience, psychosomatic factors, neurological factors and anxiety. Furthermore, the type of the needle being used, the topography of the needle bevel, site of the injection, type of solution being used, injection into blood vessels and rate of deposition, play a crucial role in pain perception during injection.

In dental practice, patients can experience pain due to pulpal pathology, periodontal pathosis, infections, malignancies, trauma and caries. The management of all the conditions invariably utilizes definitive forms of anesthesia for treatment, however, the use of anesthetic agents during dental restorative procedures, not involving the pulp is subject to debate and literature evidence is inconclusive.

Even though anesthetic agents may not be required for restorative dental treatment procedures, it has to be used in apprehensive patients with a low pain threshold, or increased hypersensitivity. The exposure of the root surfaces, cervical abrasions, attritions, abrasion, and usage of burs during tooth preparation and cavity preparation can cause severe hypersensitivity as the free nerve endings in the dentino-enamel junction are stimulated. Similarly cementum exposure leave the dentin vulnerable to attack from the high speed water and compressed air emanated from the dental hand pieces which could stimulate the pulpal nerve endings and induce pain. The usage of local anesthesia becomes mandatory in the successful treatment of such conditions to improve patient compliance and establish confidence in the clinician.

The various anesthetics available in dentistry are nerve block anesthesia, infiltration anesthesia, intra-osseous anesthesia, sub-periosteal infiltration, intra-ligamental, intra-pulpal, intranasal, sublingual, conscious sedation, general anesthetic techniques. Amongst these, the commonly used anesthetic techniques include nerve block and site specific infiltration techniques.

Table 1: Critical Appraisal of the Selected Studies

S. No	Study	Type of study	No. of subjects / groups	Anesthetic technique used	Measurement of pain	Statistical tests	Randomization	Blinding	Bias	Power of the study	Inclusion / exclusion criteria	Out liers	Allocation concealment	Controls Used
1	P. Arrow et al, 2012	Analytical, experimental, randomized controlled trial. Parallel group with split mouth design	n=57 2 Groups- 2	Inferior alveolar nerve block Buccal infiltration	Faces pain scale-Revised	Chi square test t-test	Done. Two stage computer generated random permuted block design	Triple blinded Patient , Clinician, Assistant, Parent	Risk of bias present-Operator bias	90%	Mentioned	No out liers	Done	Patient served as their own controls
2	Ghaeth.H. Yassen et al, 2009	Analytical, experimental, randomized controlled trial	N= 98 2 Groups- 2	Mandibular nerve block Infiltration for maxillary canine	No pain scale used	z-test chi- square test	Done	Single blinded Evaluator blinded		90%	Exclusion criteria: not mentioned	No outliers	No	Patients served as their own controls
3	Murat Yenisey et al ,2009	Analytical, experimental, randomized controlled trial split mouth design	N=16, 2 Groups- 2	Anterior middle superior alveolar nerve block using Wand Anterior middle superior alveolar nerve block using conventional syringe	VRS pain scale	Mann Whitney U test	Done	Single blinded Patient blinded		100%	Exclusion criteria: not mentioned	No outliers	no	Control group-Conventional anesthesia
4	A .M .Palm et al 2004	Analytical, experimental, randomized controlled trial split mouth design	N==33, Groups- 2	Inferior alveolar nerve block with wand, Inferior alveolar nerve block with conventional syringe	VAS pain scale	Wilcoxon signed rank test, Mann whitney U test	Done- type and sequence of administration. Done using table of random numbers	Single blinded Patient blinded		Not mentioned	Not mentioned	4 outlier data	No	Patient served as their own controls
5	Sinuba naidu et al 2004	Analytical, experimental, randomized controlled trial.	N= 106, 2 groups – 2	Inferior alveolar nerve block, Infiltration	CAS scale	Student t test Fishers test	Done using computer generated algorithm	Done- Double blinded Dentist, patient blinded		79.7%	Exclusion criteria: not mentioned		No	No control group

Table 2: Primary and Secondary outcome measures for Infiltration and Nerve Block Techniques

S No.	Study	Pain during procedure		Hypersensitivity during procedure		Duration of anesthesia		Anesthetic Recovery	Pain/ discomfort on injection		Post- operative ulceration	Post operative trismus
				Infiltration	Nerve block	Infiltration	Nerve block					
1	Arrow	Faces Pain Scale –No /Mild pain- 32 Moderate/Severe pain- 22	Faces Pain Scale –No/mild pain- 45 Moderate/severe pain- 11	Not measured	Not measured	Mean time to appearance of lip symptoms-Infiltration-Art- 115 seconds (SE- 16) Ligno- 170 seconds (SE- 42)	Mean time to appearance of lip symptoms-IANB-Art- 129 sec (SE 31) IANB Ligno- 119 sec (SE 16)	Not measured	1 pain at injection site		No post operative ulceration	4- aching jaw
2	Yassen	Presence or absence of pain assessed as-Pain during injection, labial, lingual probing, placing rubber dam, Use of handpiece-1/23 (p value -1)	Presence or absence of pain assessed as-Pain during injection, labial ,lingual probing, placing rubber dam, Use of handpiece-1 /23	Not measured	Not measured	Not measured	Not measured	Not measured	Discomfort during procedures- 13		No post operative ulceration	No post operative trismus
3	Yenisey	VRS Scale- Tooth preparation-Conventional- 16 Wand- 17.30	VRS Scale- Tooth preparation- Conventional- 16 Wand- 17.30	Not measured	Not measured	Not measured	Not measured	Not measured	No 26/33- Traditional more painful. 5/33- Wand more painful than traditional		No post operative ulceration	No post operative trismus
4	Palm	VAS scale-Wand- 2.7± 1.73 Conventional- 4.3 ± 1.84	VRS Scale-Tooth preparation-Conventional- 16 Wand- 17.30	Not measured	Not measured	Time of onset- 82 to 832 s- Wand 86 to 680 s- traditional		Not measured	Not mentioned		No post operative ulceration	No post operative trismus
5	Naidu	CAS Scale- SD- 2.86 Infiltration-Mean- 1.84	CAS Scale-Block-	Not measured	Not measured	Not measured	Not measured	Not measured	Not mentioned		No post operative ulceration	No post operative trismus

Table 3: Data Extraction and Summation

S.No.	Study	Year	Injection Technique used	Sample size	Anesthetic success rate	Odds ratio	Confidence interval
1	Arrow	2012	1. Inferior alveolar nerve block 2. Buccal infiltration	n= 57	IANB= 100%, BI= 67%, BI with articaine = 71%, BI with lidocaine = 64%	1.49± 0.38	1.1 - 1.87
2	Yassen	2009	1. Mandibular block 2. Mandibular infiltration for canine	n= 89	Mandibular block= 95%,Mandibular infiltration= 85%	1.40 ± 0.45	0.95 - 1.85
3	Yenisey	2009	Anterior middle superior alveolar nerve block 1.Computer controlled 2. Conventional syringe	n= 16	No difference in success rate	1 ± 0.15	0.85 - 1.15
4	Palm	2004	1.Computer controlled 2. Conventional syringe	n=33	No difference in success rate	1 ±0.20	0.8 - 1.2
5	Naidu	2004	1. Infiltration 2. Inferior alveolar nerve block	n=101	No difference in success rate	1 ± 0.15	0.85 - 1.15

Table 4: Results of Meta Analysis – Infiltration Anesthetic Technique versus Nerve Block Anesthetic

Study	Estimated effect size	95% Lower Limit	95% Upper Limit	% weight
Palm	1	0.8	1.2	19.91
Naidu	1	0.85	1.15	35.39
Yenisey	1	0.85	1.15	35.39
Yassen	1.4	0.95	1.85	3.93
Arrow	1.49	1.1	1.87	5.37
Pooled Estimate	1.042	0.953	1.131	100

The overall estimate is OR = 1.042 (95% CI 0.953 - 1.131); The meta estimate of the available studies indicates that there is no significant difference between the two anesthetic procedures in terms of odds ratios.

The main advantages of the infiltration anesthesia include simplicity of the technique, improved patient and operator characteristics and reasonably profound anesthesia. The limitations of this techniques include, irregular rate of diffusion, varying levels of bone density restricting diffusion, presence of acidic pH in the exudates present which could neutralize the anesthetic solution.

The nerve block anesthesia provides a lot of advantages like profound anesthesia, wider area of anesthesia, increased duration of anesthesia, faster onset of anesthesia.

The disadvantages include, variation in anatomical landmarks, making the technique cumbersome and ineffective, iatrogenic injury to the blood vessels, nerves, injury to muscles, resulting in trismus and the numbness leading to lip and check biting.

However, the effectiveness of various anaesthetic techniques in restorative dental procedures is unclear to the clinicians and hence this systematic review was launched to clarify this situation.

The results of this systematic review accepted the null hypothesis proposed.

A meta-analysis was performed after calculating the odds ratio and the estimated effect size was 1.045 (95%CI 0.953-1.131) with p value>.05 which indicated that both the techniques are effective to the same magnitude as far as restorative dental procedures not involving the pulp are concerned.

P. Arrow performed a randomized control trial to evaluate the efficacy of Articaine 4% with 1:100 000 adrenaline and lignocaine 2% with 1:80 000 adrenaline, delivered either through an inferior alveolar nerve block (IANB) or buccal infiltration (BI) for routine restorative procedures in mandibular posterior teeth among children[14]. There was no statistically significant difference in local analgesia success between articaine and lignocaine when delivered via BI.

Yassen performed a randomized control trial to determine the effectiveness of mandibular infiltration compared with mandibular block in treating primary canines in children and concluded that mandibular infiltration anaesthesia is as effective as mandibular block for restoration, pulpotomy, and extraction in primary canines[15]. The mandibular infiltration anaesthesia was not significantly less painful than the mandibular block.

Yenisey performed a study to compare the pain levels on opposite sides of the maxilla at needle insertion during delivery of local anesthetic solution and tooth preparation for both conventional and anterior middle

superior alveolar (AMSA) technique with the Wand computer-controlled local anesthesia application and observed there was no difference between the Wand and conventional technique for pain level during tooth preparation[16].

Palm performed a study to compare the perception of pain and time of onset in relation to mandibular alveolar nerve block administered by a computerized anesthesia delivery system and a traditional anesthesia system and observed that mandibular alveolar block analgesia to be less painful when using the Wand than when using a traditional syringe[17].

Naidu performed a randomized controlled trial to test the hypothesis that dental pain control using infiltration/intrapapillary injection was less effective than inferior alveolar block/long buccal infiltration anesthesia in children and observed no difference in pain control effectiveness between infiltration/intrapapillary injection and inferior alveolar block/long buccal infiltration using 2% lidocaine with 1: 100,000 epinephrine when mandibular primary molars received pulpotomy treatment and stainless steel crowns.[18]

The articles included for this systematic review were randomized control trials with appropriate methodology and hence considered to provide good levels of evidence. The limitations include lesser samples in few studies and subjective assessment methods, however the results inferred were regarded appropriate by the authors to process the systematic review. The secondary outcomes of interest, of the review, namely, duration of anesthesia, anesthetic recovery, pain/ discomfort during infiltration post operation ulceration in anesthetic site and post-operative trismus also exhibited no perceptible defects, and hence, as far as restorative dental treatment procedures not involving the pulp are concerned, the clinician can choose between infiltration anesthesia and nerve block techniques depending on the clinical situation.

The limitations of the systematic review included selection and screening of the articles listed only in English language. Research could have been done on this topic in non-English speaking countries. Dissertations and unpublished literature might also contain some findings in this pocket of research.

CONCLUSION

There is no difference in anesthetic efficacy between infiltration anesthetic techniques and nerve block techniques in restorative dental treatment procedures and hence the clinicians could prefer both techniques depending on their expertise and clinical judgement.

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