International Journal of Dentistry and Oral Science (IJDOS)
ISSN: 2377-8075

Anaesthetic Efficacy Of Alternative Local Anaesthesia Techniques In Patients With Irreversible Pulpitis - A Systematic Review

Review Article

KrishnaKanth Jaju[1], Iffat Nasim[2*]

[1] Professor and HOD, Department of Conservative and Endodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India.
[2] Professor and HOD, Department of Conservative and Endodontics, Saveetha Dental College and Hospital, Saveetha Institute of Medical And Technical Sciences, Saveetha University 162, Poonamallee High Road, Chennai- 600077, Tamil Nadu, India.

Abstract

Introduction: Pain management during endodontic therapy has been a major concern among the dentists since many years. Patients often associate endodontic treatment with pain. Achieving profound local anesthesia is an important step in performing root canal treatment. In fact, dental practitioners usually face challenges to achieve this goal in their daily practice. Pain is common during root canal treatment and it is mainly due to the inflammation of periodontal ligament. Patient's anxiety level raises due to pain during treatment. Till now, various agents have tried to manage pain during endodontic treatment. Conventional techniques used to anesthetize teeth are Inferior alveolar nerve block (IANB) Posterior superior alveolar (PSA), Infraorbital nerve block (IONB), Greater palatine (GP), Nasopalatine nerve block (NP), Middle superior alveolar nerve block (MSA), Anterior superior alveolar nerve block(ASA), Lingual nerve block(LN), Mental incisive (MI) nerve blocks (NBs). Apart from analgesics, corticosteroids, alternative local anesthesia techniques have also been reported to be effective in the management of inter appointment pain. This systematic review analyzes the anaesthetic efficacy of alternative local anaesthesia techniques in patients with irreversible pulpitis in pain management during endodontic treatment.
Aim: To assess the anesthetic efficacy of alternative local anesthesia techniques in patients with irreversible pulpitis.
Search Strategy: A search was performed in electronic database (i.e. PUBMED CENTRAL, Google and Hand Search) using following search terms alone and in combination by means of PUBMED search builder till October 2020.
Selection Criteria: All in vivo studies that used alternative local anaesthesia techniques in patients with irreversible pulpitis during root canal treatment were selected.
Data Collection and Analysis: All the studies were based on the data extraction and analysis of the studies for quality. The outcome measure was to evaluate the reduction of pain during root canal treatment after use of alternative local anesthesia techniques.
Results: Two studies included for this review had high risk of bias. The included studies used alternative local anesthesia techniques. Of the 2 studies included for this review, only 1 study indicated the use of alternative local anesthesia techniques for effective pain management during endodontic treatment and other study indicated alternative local anesthesia techniques provided adequate pulpal anesthesia but the results were not statistically significant.
Conclusion: This review concludes that the studies reviewed here have a high risk of quality bias. However, alternative local anesthesia techniques yielded better results compared to conventional local anesthesia techniques. The included studies were not designed properly with respect to randomization, sample size calculation, blinding. Hence further clinical trials need to be conducted with proper sample size calculation, blinding and randomization to obtain acurate results.

Introduction

Pain during endodontic treatment is of main concern to both the patient and the dentist. Many patients associate endodontic treatment with pain [1]. Therefore effective local anesthesia is an important aspect during management of painful endodontic treatment. Local anesthesia is not always effective in all the cases, irrespective of the involved tooth or technique of local anesthesia used. Various mechanisms have been hypothesized to explain the failure of local anesthetics, including anatomic variations, such as

***Corresponding Author**:
Iffat Nasim,
Professor and HOD, Department of Conservative and Endodontics, Saveetha Dental College and Hospital, Saveetha Institute of Medical And Technical Sciences, Saveetha University 162, Poonamallee High Road, Chennai- 600077, Tamil Nadu, India.
E-mail: iffatnasim@saveetha.com

Received: May 05, 2021
Accepted: June 20, 2021
Published: June 26, 2021

Citation: Krishna Kanth Jaju, Iffat Nasim. Anaesthetic Efficacy Of Alternative Local Anaesthesia Techniques In Patients With Irreversible Pulpitis - A Systematic Review. *Int J Dentistry Oral Sci.* 2021;8(6):2833-2840. doi: http://dx.doi.org/10.19070/2377-8075-21000573

cross-innervations and accessory innervations (with lingual nerve, buccal nerve, mylohyoid nerve, or cervical plexus); decreased local pH; tachyphylaxis of anesthetic solutions; activation of nociceptors, including tetrodotoxin and capsaicin sensitive transient receptor–potential vanilloid type 1 (TRPV1) [2]. Conventional techniques used to anesthetize teeth are Inferior alveolar nerve block (IANB) Posterior superior alveolar (PSA), Infraorbital nerve block (IONB), Greater palatine (GP), Nasopalatine nerve block (NP), Middle superior alveolar nerve block (MSA), Anterior superior alveolar nerve block(ASA), Lingual nerve block(LN), Mental incisive (MI) nerve blocks (NBs). Conventional local anesthesia techniques are most commonly used technique for achieving pulpal anesthesia for endodontic procedures [3]. It involves deposition of local anesthesia solution in the respective space, bathing the inferior alveolar nerve just before it enters the mandibular foramen. This technique does not anesthetize other branches of the mandibular nerve, including lingual, buccal, and nerve to mylohyoid. IANB has a high failure rate ranging from 7% to 77% [4]. The success rates get even worse in patients with inflamed pulpal tissues. The inferior alveolar nerve block does not always provide profound pulpal anesthesia. Lower pH of inflamed tissue reduces the amount of the base form of anesthetic to penetrate the nerve membrane. Consequently, there is less of the ionized form within the nerve to achieve anesthesia. Therefore, it is difficult to correlate local pH changes with failure of the inferior alveolar nerve block [4, 5]. Nerves arising from inflamed tissue have altered resting potentials and decreased excitability thresholds. Therefore, local anesthetic agents do not prevent impulse transmission due to these lowered excitability thresholds [6]. Tetrodotoxin-resistant (TTXr) class of sodium channels that have been shown to be resistant to the action of local anesthetics. A related factor is the increased expression of sodium channels in pulps diagnosed with irreversible pulpitis [7]. Patients in pain are often apprehensive, which lowers their pain threshold.

Mental Nerve Block is another technique used to anesthetize mandibular premolars. The anesthetic agent is deposited near the mental foramen to anesthetize the distribution of the mental nerve. Clinical trials showed that both Mental Nerve Block and Inferior Alveolar Nerve Block had a similar anesthetic success rate in mandibular premolars [8].

Gow-Gate, Vazirani-Akinosi technique, Intraligamentary Anesthesia, Intraosseous injection, Transcutaneous electrical nerve stimulation (TENS), Intraoral lidocaine patch and Computerized local anesthesia(the Wand) are newly developed methods to alleviate the pain and anxiety of dental patients, as alternatives to conventional local anesthesia [8, 9].

The purpose of the current review is to assess the anesthetic efficacy of alternative local anesthesia technique with conventional local anesthesia technique in teeth with irreversible pulpitis using a systematic approach to the present evidence.

Previously our team has a rich experience in working on various research projects across multiple disciplines [10-24]. Now the growing trend in this area motivated us to pursue this project.

Aim

The aim of this systematic review is to assess the anaesthetic efficacy of alternative local anaesthesia techniques in patients with irreversible pulpitis.

Structured Question

Is anesthetic efficacy of alternative local anesthesia technique as effective as conventional local anesthesia technique in patients with irreversible pulpitis?

Pico Analysis

Population - Patients with symptomatic irreversible pulpitis undergoing root canal treatment.

Intervention - Alternative anesthesia techniques.
Comparison - Conventional anesthesia techniques
Outcome - Anesthetic Efficacy
Studies - In vitro

Null Hypothesis

Alternative local anesthesia techniques are as effective as conventional local anesthesia techniques in patients with irreversible pulpitis

Alternate Hypothesis

Alternative local anesthesia techniques are not as effective as conventional local anesthesia techniques in patients with irreversible pulpitis.

Materials And Methods

Sources used

For identification of studies included or considered for this review, detailed search strategies were carried out on the following databases.

- PUBMED Advanced Search (until october 2020)
- Google Search
- Hand Search

No limits and language restrictions were applied during the electronic search to include the search phase of the systematic review. No time restriction was applied. Reference list of reviews and of the identified *in vitro* studies were also checked for possible additional studies.

Hand Search

- International Endodontic Journal
- Journal of Endodontics
- Oral Surgery Oral Medicine Oral Pathology
- Oral Surgery

Inclusion Criteria

Criteria for considering studies for this review:

- In vivo studies/clinical trials on patients having irreversible pulpitis.

- Patients undergoing endodontic treatment.
- Studies where alternative local anesthesia techniques are/is used.
- Studies where alternative local anesthesia techniques are compared with conventional local anesthesia techniques.

Exclusion Criteria

The following studies were excluded:

- Studies that assessed the anesthetic techniques supplemented by infiltration anesthesia.
- Studies that assessed the effectiveness of medication/placebo on the anesthetic techniques.
- Studies on pediatric patients.
- Studies where the comparison to conventional anesthetic techniques was not done.

Results And Discussion

Description of studies

The search identified 713 publications out of which 702 were excluded after reviewing the title and the abstract and 9 were excluded after reading the full article. A total of 2 publications fulfilled all criteria and were included in this review.

Risk of Bias of Included Studies

The assessment for the four main methodological quality items is shown in the table. The study was assessed to have a 'high risk' of bias if it did not record a 'Yes' in three or more of the main four categories, 'Moderate' if two out of four categories did not record a 'Yes' and 'Low' if randomization assessor blinding and completeness to follow up were considered adequate.

Quality Assessment

(Higgins and Green. Cochrane reviewer's Handbook 2009)

The quality assessment of included trials was undertaken independently as a part of data extraction process. Four main criteria were examined.

1. Method of Randomization, recorded as

- Yes- Adequate as describes in the text
- No- Inadequate as recorded in the text
- Unclear in the text

2. Allocation Concealment, recorded as

- Yes- Adequate as described in the text
- No- Inadequate as recorded in the text
- Unclear in the text

3. Outcomes assessors blinded to intervention, recorded as

- Yes- Adequate as described in the text

Table 1. Search methodology.

Search	Add to builder	Query	Items found	Time
#50	Add	Search ((((((((((((((((((((Periapical Inflamation) OR Root canal therapy) OR Root canal treatment) OR Pulp hyperemia) OR Periapical disease) OR Pulp therapy) OR Endodontic therapy) OR Endodontic treatment) OR Endodontic disease) OR Endodontic inflammation) OR Vital teeth) OR Vital pulp) OR Inflamed teeth) OR Inflamed tooth) OR Inflamed pulp) OR Pulpal inflammation) OR Irreversible pulpitis) OR Dental pulp diseases) OR Pulpitis)) AND ((((((Intraosseous Local Anesthesia) OR Intraligamentary delivery) OR Computer-controlled local anesthestic delivery system) OR Intraoral anesthetic patches) OR Gow Gates technique) OR Vazirani-akinosi technique) OR Alternative anesthesia techniques)) AND ((((((((((Inferior alveolar nerve block) OR Posterior superior alveolar nerve block) OR Infraorbital nerve block) OR Greater palatine) OR Nasopalatine nerve block) OR Middle superior alveolar nerve block) OR Anterior superior alveolar nerve block) OR Lingual nerve block) OR Mental nerve block) OR Local Anesthesia) OR Dental Anesthesia) OR Conventional anesthesia techniques)) AND ((Anaesthetic success) OR Anesthetic Efficacy)) AND ((((Randomised controlled clinical trial) OR In vivo Study) OR Clinical study) OR Randomized Human Trial)	702	08:35:00
#49	Add	Search (((Randomised controlled clinical trial) OR In vivo Study) OR Clinical study) OR Randomized Human Trial	2027622	08:34:41
#48	Add	Search (Anaesthetic success) OR Anesthetic Efficacy	50055	08:34:08
#47	Add	Search ((((((((((Inferior alveolar nerve block) OR Posterior superior alveolar nerve block) OR Infraorbital nerve block) OR Greater palatine) OR Nasopalatine nerve block) OR Middle superior alveolar nerve block) OR Anterior superior alveolar nerve block) OR Lingual nerve block) OR Mental nerve block) OR Local Anesthesia) OR Dental Anesthesia) OR Conventional anesthesia techniques	226307	08:33:14
#46	Add	Search ((((((Intraosseous Local Anesthesia) OR Intraligamentary delivery) OR Computer-controlled local anesthestic delivery system) OR Intraoral anesthetic patches) OR Gow Gates technique) OR Vazirani-akinosi technique) OR Alternative anesthesia techniques	94762	08:32:18
#45	Add	Search ((((((((((((((((((Periapical Inflamation) OR Root canal therapy) OR Root canal treatment) OR Pulp hyperemia) OR Periapical disease) OR Pulp therapy) OR Endodontic therapy) OR Endodontic treatment) OR Endodontic disease) OR Endodontic inflammation) OR Vital teeth) OR Vital pulp) OR Inflamed teeth) OR Inflamed tooth) OR Inflamed pulp) OR Pulpal inflammation) OR Irreversible pulpitis) OR Dental pulp diseases) OR Pulpitis	78217	08:31:27
#44	Add	Search Randomized Human Trial	641587	08:29:56
#43	Add	Search Clinical study	183033	08:29:48
#42	Add	Search In vivo Study	1479687	08:29:38
#41	Add	Search Randomised controlled clinical trial	34652	08:29:30
#38	Add	Search Conventional anesthesia techniques	70244	08:29:02
#37	Add	Search Dental Anesthesia	31499	08:28:53
#36	Add	Search Local Anesthesia	155781	08:28:43
#35	Add	Search Mental nerve block	19629	08:28:36
#34	Add	Search Lingual nerve block	2417	08:28:28
#33	Add	Search Anterior superior alveolar nerve block	2134	08:28:19
#32	Add	Search Middle superior alveolar nerve block	1745	08:28:08
#31	Add	Search Nasopalatine nerve block	96	08:27:58
#30	Add	Search Greater palatine	4385	08:27:48
#29	Add	Search Infraorbital nerve block	911	08:27:38
#28	Add	Search Posterior superior alveolar nerve block	1989	08:27:30
#27	Add	Search Inferior alveolar nerve block	4005	08:27:22
#26	Add	Search Alternative anesthesia techniques	93608	08:27:12
#25	Add	Search Vazirani-akinosi technique	41	08:27:05
#24	Add	Search Gow Gates technique	3	08:26:56
#23	Add	Search Intraoral anesthetic patches	87	08:26:48
#22	Add	Search Computer-controlled local anesthestic delivery system	1	08:26:38
#21	Add	Search Intraligamentary delivery	131	08:26:28
#20	Add	Search Intraosseous Local Anesthesia	1428	08:26:20
#19	Add	Search Periapical Inflamation	11	08:26:04
#18	Add	Search Root canal therapy	12132	08:25:51
#17	Add	Search Root canal treatment	28287	08:25:28
#16	Add	Search Pulp hyperemia	779	08:24:59
#15	Add	Search Periapical disease	6593	08:24:50
#14	Add	Search Pulp therapy	21933	08:24:38
#13	Add	Search Endodontic therapy	7352	08:23:42
#12	Add	Search Endodontic treatment	11130	08:23:30
#11	Add	Search Endodontic disease	13646	08:23:21
#10	Add	Search Endodontic inflammation	5240	08:23:11
#9	Add	Search Vital teeth	22817	08:23:01
#8	Add	Search Vital pulp	8937	08:22:52
#7	Add	Search Inflamed teeth	8972	08:22:44
#6	Add	Search Inflamed tooth	5491	08:22:35
#5	Add	Search Inflamed pulp	3734	08:22:27
#4	Add	Search Pulpal inflammation	2118	08:22:18
#3	Add	Search Irreversible pulpitis	1141	08:22:07
#2	Add	Search Dental pulp diseases	9529	08:21:58
#1	Add	Search Pulpitis	2193	08:21:49

Table 2. Variables of interest.

S.NO	VARIABLES OF INTEREST
1	Alternative Local Anesthesia Technique

Table 3. Characteristics of excluded articles.

SR.NO	AUTHOR	YEAR	REASON FOR EXCLUSION
1	Jamileh Ghoddusi	2018	Patients were once again randomly allocated to receive buccal or lingual supplementary infiltration.
2	Pushpendra Kumar Verma	2012	Supplemental injection was given
3	Sholeh Ghabraei	2017	Supplemental injection was given
4	Rut Beneito-Brotons	2011	Endodontic procedure was not performed
5	Abbas Haghighat	2015	Extraction of mandibular molar teeth were performed
6	Atool Chandra Bhuyan	2014	Supplemental injection was given
7	Abhishek Dhindsa	2011	Minor pediatric dental procedures were performed
8	Madhan Chenchugopal	2017	No comparison was done with conventional conventional local anesthetic techniques
9	Vivian Click et al	2014	No comparison was done with conventional local anesthetic techniques

Table 4. General information of variables of interest and interpretation.

S.No	Author and year	Study type	Study design	Outcome variable	Time of assessment	Statistical test	Intervention
1	Vivek Aggarwal et al	Invivo	Sample Size = 97 (Gow gates = 25, Vazirani-Akinosi =24, 26 received only buccal-plus-lingual infiltrations, 22 patients (control) received conventional IANB anesthesia)	Pain during treatment	-Before Treatment - After Treatment	McNemar test	Gowgates = 27, Vazirani Akinosi = 25, conventional IANB anesthesia = 24, 26 received only buccal-plus-lingual infiltrations
2	Hamid Razavian et al	Invivo	Sample size = 40 (X-tip intraosseous injection = 20 IANB = 20)	Success or failure rates, onset of anesthesia	5 - min, 10 - min and 15 - min.	Success/ failure rates - Fisher's exact test, Onset of anesthesia -Mann–Whitney U test.	X-tip intraosseous injection = 20, IANB = 20

Table 5. Summation tables for individual parameters.

AUTHOR AND YEAR	INTERVENTION	EVALUATION PERIOD	OUTCOME
Vivek Aggarwal et al 2010	Gow gates vs Vazirani-Akinosi vs Buccal-plus-lingual infiltrations vs conventional IANB	Before treatment After treatment	Gow - Gates and Vazirani-Akinosi technique has higher success rate compared to Conventional IANB. None of the techniques gave 100% success rate.
Hamid Razavian 2013	X-tip intraosseous injection vs IANB	5 - min, 10 - min and 15 - min.	Intraosseous injection system resulted in successful anesthesia

- No- Inadequate as recorded in the text
- Unclear in the text

4. Completeness of follow up (was there a clear explanation for withdrawals and drop outs in each treatment group) assessed as:

- Yes- Dropouts were explained
- No- Dropouts were not explained
- None- No dropouts or withdrawals

Other methodological criteria examined included

1. Presence or absence of sample size calculation
2. Comparability of groups at the start
3. Clear inclusion/exclusion criteria

Table 6. Evidence level of selected articles.

AUTHOR	YEAR	STUDY DESIGN	LEVEL OF EVIDENCE
Vivek Aggarwal et al	2010	In vivo	Level 1b
Hamid Razavian	2013	In vivo	Level 1b

Table 7. Risk of bias - major criteria.

S.No	Author	Year	Randomi-zation	Allocation concealment	Assessor blinding	Dropouts described	Risk of bias
1	Vivek Aggarwal et al	2010	Yes	No	Unclear	Yes	High
2	Hamid Raza-vian et al	2013	No	No	No	No	High

TABLE 8

S.No	Author	Year	Sample justified	Baseline comparison	I/E criteria	Method error
1	Vivek Aggar-wal et al	2010	Yes	Yes	Yes	No
2	Hamid Raza-vian et al	2013	Yes	Yes	Yes	No

Figure 1. Search flow chart.

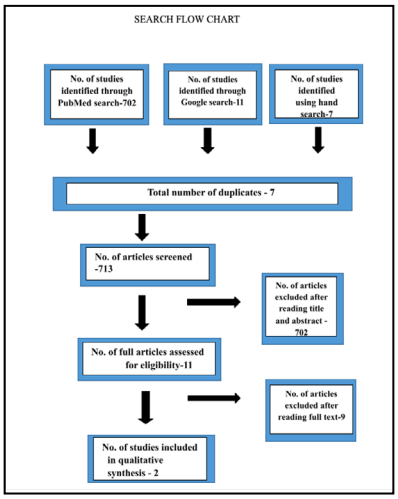


Figure 2. Risk of bias summary.

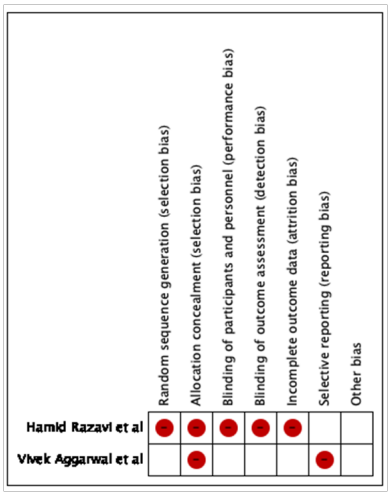
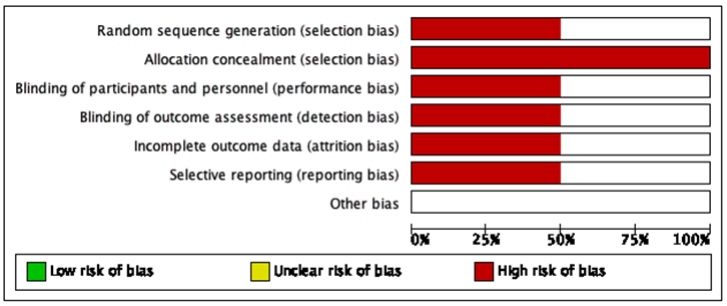


Figure 3. Risk of bias graph.



The purpose of this systematic review was to evaluate the anaesthetic efficacy of alternative local anaesthesia techniques in patients with irreversible pulpitis. Two invivo studies fulfilled the criteria for being included in this review.

(Vivek Aggarwal et al, Hamid Razavian et al)

Meta - Analysis

Mostly, systematic reviews perform meta-analysis, which involves the statistical pooling of data from individual studies when the studies are similar. A meta-analysis can yield a more precise overall estimate of the treatment effect. However, meta-analysis may not be appropriate in many situations. Owing to the heterogeneity among the studies such as sample size and follow up periods, meta-analysis could not be performed to summarize the data of included studies. Hence, only descriptive evaluation of data has been provided.

Pain management during endodontic therapy has been a major concern among the dentists since many years [25]. Achieving profound local anesthesia is an important step in performing root canal treatment. The aim of administering local anesthesia is to minimize pain and maximize comfort for patients undergoing dental treatment. It is very difficult to obtain successful anesthesia in teeth with inflamed pulp [26]. It has been said that patients with irreversible pulpitis have 8 times more chances of failure of local anesthesia compared with normal patients [27]. In the study conducted by vivek aggarwal et al, 3 different local anesthesia techniques were compared with conventional IANB in terms of pain during access cavity preparation in patients with irreversible pulpitis [3, 28]. Twenty-five patients received Gow-Gates mandibular conduction block anesthesia, 24 patients received Vazirani-Akinosi nerve block, 26 received only buccal-plus-lingual infiltrations, and 22 patients (control) received conventional IANB anesthesia in the included study. Endodontic access preparation was initiated after 15 minutes of anesthesia. Pain during treatment was recorded using a Heft-Parker visual analog scale. Gow-Gates gave a success rate of 52%, which was statistically higher than control IANB (36%). Vazirani-Akinosi and infiltrations gave 41% and 27% success rates, respectively, with no statistically significant differences from control IANB. They concluded that Gow -Gates mandibular conduction block may increase the success rate in patients with irreversible pulpitis in mandibular molars. In a randomized clinical trial conducted by Hamid Razavian et al, X-tip intraosseous injection system was used as primary anesthesia for irreversible pulpitis of posterior mandibular teeth [29]. Forty patients with an irreversible pulpitis of mandibular posterior teeth were randomly divided to receive either intraosseous injection using the X-tip intraosseous injection system or IAN block as the primary injection method for pulpal anesthesia. Pulpal anesthesia was evaluated using an electric pulp tester and cold test at 5-min intervals for 15 min. Intraosseous injection system resulted in successful anesthesia in 17 out of 20 patients (85%). Successful anesthesia was achieved with the IAN block in 14 out of 20 patients (70%). Success rate of the intraosseous injection of anesthesia was 15% more than the conventional IAN block (85% vs. 70%). However, there was no significant difference between X-tip intraosseous injection system and Inferior alveolar nerve block.

Our institution is passionate about high quality evidence based research and has excelled in various fields [30-40].

Interpretation Of The Result

Of the two studies reviewed, one study evaluated the anesthetic efficacy of Gow-Gates mandibular conduction anesthesia, Vazirani-Akinosi technique, buccal-plus-lingual infiltrations, and conventional inferior alveolar nerve anesthesia in patients with irreversible pulpitis. Gow-Gates mandibular conduction block had higher success rate in patients with irreversible pulpitis in mandibular molars, another study used X-tip intraosseous injection system as a primary anesthesia for irreversible pulpitis of posterior mandibular teeth. It was observed that the success rate of the intraosseous injection of anesthesia was 15% more than the conventional IAN block (85% vs 70%) but there was no statistically significant difference. According to the overall results, there was no significant difference between alternative local anesthesia techniques and conventional local anesthesia techniques.

Implications For Practice

Alternative local anesthesia techniques can be used as an alternative to conventional local anesthesia administration. Length of the nerve exposed to the anesthetic solution in alternative local techniques is more when compared to conventional local anesthesia technique. This not only increases the efficacy of anesthesia but also results in faster and effective pain management. In conventional local anesthesia techniques the length of nerve exposed to anesthetic solution is less which causes incomplete anesthesia.

Implications For Research

These studies used alternative local anesthesia techniques for administration of local anesthetic solution for management of pain, were standardized and had low quality of evidence. Included studies used alternative local anesthesia techniques. Evaluation of the anesthetic efficacy of alternative local anesthesia technique has to

be standardized. In teeth undergoing endodontic treatment, the pain site is very specific and the surface area is small. Therefore further studies have to be carried out to standardize the safe and effective use of alternative local anesthesia techniques.

Summary

The aim of this systematic review was to assess the anaesthetic efficacy of alternative local anaesthesia techniques in patients with irreversible pulpitis. An electronic search was carried out on PUBMED Advanced Search, Google Search and Hand Search for articles which could be used to evaluate the effectiveness of alternative local anesthesia techniques in patients with irreversible pulpitis.

Article search was narrowed down based on the inclusion and exclusion criteria. The search identified 713 publications out of which 702 were excluded after reviewing the title or abstract. 9 studies were excluded after reading the full article. Therefore only 2 articles fulfilled all criteria of inclusion.

This review included 2 studies in which one study evaluated the anesthetic efficacy of Gow-Gates mandibular conduction anesthesia, Vazirani-Akinosi technique, buccal-plus-lingual infiltrations and conventional inferior alveolar nerve anesthesia in patients with irreversible pulpitis, one study used X-tip intraosseous injection system as a primary anesthesia for irreversible pulpitis of posterior mandibular teeth. Both the studies included in this review had high risk of bias. The included studies in this review, indicated there was no significant difference between alternative local anesthesia techniques and conventional local anesthesia techniques.

Conclusion

This review concludes that the studies reviewed here have a high risk of quality bias. However, there was no significant difference between alternative local anesthesia techniques and conventional local anesthesia techniques. The included were not designed properly with respect to randomization, sample size calculation, blinding etc. Hence further clinical trials need to be conducted with proper sample size calculation, blinding and randomization to obtain accurate results.

References

[1]. Fernandes LA. Evaluation of the pain level of patients submitted to endodontic treatment with varying techniques, in order to identify the one that causes less pain.
[2]. Malik NA. Textbook of Oral and Maxillofacial Surgery. (2016).
[3]. Reader A, Nusstein J, Drum M. Successful Local Anesthesia for Restorative Dentistry and Endodontics. (2011).
[4]. Bergenholtz G, Hörsted-Bindslev P, Reit C, editors. Textbook of endodontology. John Wiley & Sons; 2013 Mar 27.
[5]. Kaye AD, Urman RD, Vadivelu N. Essentials of Regional Anesthesia. Springer.2018.
[6]. Torabinejad M, Walton RE, Fouad A. Endodontics - E-Book: Principles and Practice. Elsevier Health Sciences.2014.
[7]. Cohen S, Hargreaves KM. Pathways of the Pulp. Mosby Incorporated.2006.
[8]. Samdrup T, Kijsamanmith K, Vongsavan K, Rirattanapong P, Vongsavan N. The effect of inferior alveolar nerve block anesthesia of 4% articaine and epinephrine 1:100,000 on blood flow and anesthesia of human mandibular teeth. J Dent Sci. 2021 Jan;16(1):249-255. Pubmed PMID: 33384805.
[9]. Dionne R, Laskin DM. Anesthesia and Sedation in the Dental Office. Elsevier Publishing Company.1986.
[10]. Govindaraju L, Gurunathan D. Effectiveness of Chewable Tooth Brush in Children-A Prospective Clinical Study. J Clin Diagn Res. 2017 Mar;11(3):ZC31-ZC34. Pubmed PMID: 28511505.
[11]. Christabel A, Anantanarayanan P, Subash P, Soh CL, Ramanathan M, Muthusekhar MR, et al. Comparison of pterygomaxillary dysjunction with tuberosity separation in isolated Le Fort I osteotomies: a prospective, multi-centre, triple-blind, randomized controlled trial. Int J Oral Maxillofac Surg. 2016 Feb;45(2):180-5. Pubmed PMID: 26338075.
[12]. Soh CL, Narayanan V. Quality of life assessment in patients with dentofacial deformity undergoing orthognathic surgery--a systematic review. Int J Oral Maxillofac Surg. 2013 Aug;42(8):974-80. Pubmed PMID: 23702370.
[13]. Mehta M, Deeksha, Tewari D, Gupta G, Awasthi R, Singh H, et al. Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases. Chem Biol Interact. 2019 Aug 1;308:206-215. Pubmed PMID: 31136735.
[14]. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019 Feb;48(2):115-121. Pubmed PMID: 30451321.
[15]. Campeau PM, Kasperaviciute D, Lu JT, Burrage LC, Kim C, Hori M, et al. The genetic basis of DOORS syndrome: an exome-sequencing study. Lancet Neurol. 2014 Jan;13(1):44-58. Pubmed PMID: 24291220.
[16]. Kumar S, Sneha S. Knowledge and awareness regarding antibiotic prophylaxis for infective endocarditis among undergraduate dental students. Asian Journal of Pharmaceutical and Clinical Research. 2016;154.
[17]. Christabel SL, Gurunathan D. Prevalence of type of frenal attachment and morphology of frenum in children, Chennai, Tamil Nadu. World J Dent. 2015 Oct;6(4):203-7.
[18]. Kumar S, Rahman RE. Knowledge, awareness, and practices regarding biomedical waste management among undergraduate dental students. Asian Journal of Pharmaceutical and Clinical Research. 2017;10(8):341.
[19]. Sridharan G, Ramani P, Patankar S. Serum metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Cancer Res Ther. 2017 Jul-Sep;13(3):556-561. Pubmed PMID: 28862226.
[20]. Ramesh A, Varghese SS, Doraiswamy JN, Malaiappan S. Herbs as an antioxidant arsenal for periodontal diseases. J Intercult Ethnopharmacol. 2016 Jan 27;5(1):92-6. Pubmed PMID: 27069730.
[21]. Thamaraiselvan M, Elavarasu S, Thangakumaran S, Gadagi JS, Arthie T. Comparative clinical evaluation of coronally advanced flap with or without platelet rich fibrin membrane in the treatment of isolated gingival recession. J Indian Soc Periodontol. 2015 Jan-Feb;19(1):66-71. Pubmed PMID: 25810596.
[22]. Thangaraj SV, Shyamsundar V, Krishnamurthy A, Ramani P, Ganesan K, Muthuswami M, et al. Molecular Portrait of Oral Tongue Squamous Cell Carcinoma Shown by Integrative Meta-Analysis of Expression Profiles with Validations. PLoS One. 2016 Jun 9;11(6):e0156582. Pubmed PMID: 27280700.
[23]. Ponnulakshmi R, Shyamaladevi B, Vijayalakshmi P, Selvaraj J. In silico and in vivo analysis to identify the antidiabetic activity of beta sitosterol in adipose tissue of high fat diet and sucrose induced type-2 diabetic experimental rats. Toxicol Mech Methods. 2019 May;29(4):276-290. Pubmed PMID: 30461321.
[24]. Ramakrishnan M, Bhurki M. Fluoride, Fluoridated Toothpaste Efficacy And Its Safety In Children-Review. International Journal of Pharmaceutical Research. 2018 Oct 1;10(04):109-14.
[25]. Paul A. Rosenberg. Endodontic Pain: Diagnosis, Causes, Prevention and Treatment. Springer.; 2014.
[26]. Malamed SF. Handbook of local anesthesia-e-book. Elsevier Health Sciences; 2014 Apr 25.
[27]. Yuan Q. Dental Implant Treatment in Medically Compromised Patients. Springer Nature.2019.
[28]. Aggarwal V, Singla M, Kabi D. Comparative evaluation of anesthetic efficacy of Gow-Gates mandibular conduction anesthesia, Vazirani-Akinosi technique, buccal-plus-lingual infiltrations, and conventional inferior alveolar nerve anesthesia in patients with irreversible pulpitis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010 Feb;109(2):303-8. Pubmed PMID: 20123413.
[29]. Razavian H, Kazemi S, Khazaei S, Jahromi MZ. X-tip intraosseous injection system as a primary anesthesia for irreversible pulpitis of posterior mandibular teeth: A randomized clinical trail. Dent Res J (Isfahan). 2013 Mar;10(2):210-3. Pubmed PMID: 23946738.
[30]. Vijayashree Priyadharsini J. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. J Periodontol. 2019 Dec;90(12):1441-1448. Pubmed PMID: 31257588.
[31]. J PC, Marimuthu T, C K, Devadoss P, Kumar SM. Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional

study. Clin Implant Dent Relat Res. 2018 Aug;20(4):531-534. Pubmed PMID: 29624863.

[32]. Ramesh A, Varghese S, Jayakumar ND, Malaiappan S. Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study. J Periodontol. 2018 Oct;89(10):1241-1248. Pubmed PMID: 30044495.

[33]. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJL. Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. Clin Oral Investig. 2019 Sep;23(9):3543-3550. Pubmed PMID: 30552590.

[34]. Sridharan G, Ramani P, Patankar S, Vijayaraghavan R. Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Oral Pathol Med. 2019 Apr;48(4):299-306. Pubmed PMID: 30714209.

[35]. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019 Feb;48(2):115-121. Pubmed PMID: 30451321.

[36]. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial. Clin Oral Investig. 2020 Sep;24(9):3275-3280. Pubmed PMID: 31955271.

[37]. Samuel SR. Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life? Int J Paediatr Dent. 2021 Mar;31(2):285-286. Pubmed PMID: 32416620.

[38]. R H, Ramani P, Ramanathan A, R JM, S G, Ramasubramanian A, et al. CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene. Oral Surg Oral Med Oral Pathol Oral Radiol. 2020 Sep;130(3):306-312. Pubmed PMID: 32773350.

[39]. Chandrasekar R, Chandrasekhar S, Sundari KKS, Ravi P. Development and validation of a formula for objective assessment of cervical vertebral bone age. Prog Orthod. 2020 Oct 12;21(1):38. Pubmed PMID: 33043408.

[40]. Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. In silico analysis of virulence genes in an emerging dental pathogen A. baumannii and related species. Arch Oral Biol. 2018 Oct;94:93-98. Pubmed PMID: 30015217.