ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 7, Issue – 4, August – 2024, Page No. : 293 - 301

Efficacy of Hypodermic Vs Cartridge Syringes for Local Anaesthesia Administration: A Case Controlled Comparative Study

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Citation of this Article: Joyce P. Sequeira, Anish Patole, Jagadish Chandra, "Efficacy of Hypodermic Vs Cartridge Syringes for Local Anaesthesia Administration: A Case Controlled Comparative Study", IJDSIR- August – 2024, Volume –7, Issue - 4, P. No. 293 – 301.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: To compare the pain levels experienced by patients during the injection process and the overall ease of use of hypodermic and cartridge syringes by the operator,

Material and Methodology: A comparative questionnaire survey was carried out to assess the level of pain perceived upon injection of the hypodermic and cartridge syringe by the patient and the ease of use of the syringes by the operators. A convenient sample of 54 was drawn which will include patients requiring bilateral extraction. A specially designed close-ended questionnaire consisting of two sections was used. Experienced subject experts were involved to validate the questionnaire for content**.**

Results: Descriptive statistics and paired T-test was used to evaluate and compare the ease of use of and level of pain perceived by the patient upon using hypodermic and cartridge syringe. Wilcoxon signed rank test was used to compare the VAS score given by patients upon using Cartridge syringe and Disposable Hypodermic Syringe since the VAS Score is a type of ordinal data.

Conclusion: The current study conducted via questionnaire showed that patients preferred cartridge syringes over hypodermic syringes due to the reduced pain experienced when administering local anesthetic solution. This suggests that the use of cartridge syringes may have contributed to improved patient comfort during procedures.

Keywords: Physiological Factors, Desensitization, Syringes, Hypodermic, VAS Score.

Introduction

Pain is a complex phenomenon influenced by psychological and physiological factors[1]. Dental visits can be significantly challenging due to the expected pain, particularly in the case of anticipated injections.

This can lead to uncooperative behaviour and delay the treatment[2]. When painful stimuli, such as injections, are experienced repeatedly, various reaction patterns may arise[3]. Pain-related behavior can either intensify during subsequent appointments, or a desensitization to the painful stimulus may take place.

Local anesthetic injections are regularly utilized to reduce pain, although they cannot be administered entirely painlessly. Various approaches, such as applying topical gel or spray, using thinner needles, cartridge syringe injections, jet injections, and computer-controlled local anesthetic delivery (CCLAD) systems, have been used to minimize this discomfort[4].

The term "gauge" refers to the size of the needle's lumen. A lower gauge number indicates a larger needles lumen diameter. Dentists are increasingly using smaller-diameter needles, assuming that they cause less trauma to the patient than larger-diameter needles[5].

Administering a large amount of local anesthetic requires careful attention to avoid accidentally injecting into a blood vessel. Thinner needles, such as 30-gauge, provide more resistance to blood aspiration compared to larger-diameter needles like 27- or 25-gauge. It's important to assess needle deflection and the risk of breakage. Smaller diameter needles tend to deflect more, with 30-gauge needles showing significant deflection, while 25-gauge needles deflect very little. Additionally, 25-gauge needles rarely break during an intraoral injection, with 99% of broken needles being 30-gauge[6].

There are two commonly used syringes for giving local anesthesia: disposable syringes, made of plastic for one-time use, and cartridge-based syringes, made of metal and reusable. Dental offices often use disposable syringes due to their low cost and reduced risk of infection, while hospitals and surgical centers prefer cartridge-based syringes because they are more durable and can be sterilized[7]

The ongoing debate on the efficacy of disposable versus cartridge syringes for local anesthesia administration has yielded conflicting results. While some studies suggest that disposable syringes may be less effective and cause more pain during injection, others have found no significant difference in pain, success rate, or operator satisfaction between the two types of syringes[7.]

Thus the aim of the current study is to compare the pain levels experienced by patients during the injection process and the overall ease of use of hypodermic and cartridge syringes by the operator.

Material and Methodology

Study Design

This study was a questionnaire-based study with convenience sampling technique.

Source of Data

Subjects reporting to the Department of Oral and Maxillofacial surgery, Yenepoya Dental College, Mangalore, were randomly recruited for the present study based on the inclusion criteria. Study protocol was explained and informed consent was obtained from the subjects before the start of the study.

Selection Criteria

Inclusion Criteria

- Patients requiring bilateral extraction of teeth.
- Patients who are willing to participate in the study.

Exclusion Criteria

- Patients with uncontrolled systemic diseases.
- Active local and/or systemic infection.
- Patient not willing to participate in the study

Methodology

A comparative questionnaire survey was carried out to assess the level of pain perceived upon injection of the

hypodermic and cartridge syringe by the patient and the ease of use of the syringes by the operators. A convenient sample of 54 was drawn which will include patients requiring bilateral extraction. A specially designed close-ended questionnaire consisting of two sections was used. Experienced subject experts were involved to validate the questionnaire for content. The questionnaire, participation information sheet, and informed consent was provided to the patient and the operating surgeon. The informed consent was obtained from all the participants after explaining the study and its purpose.

The first part of the questionnaire consists of questions based on the knowledge of the operating surgeon regarding the different types of syringes used for the administration of LA followed by the ease of use of hypodermic and cartridge syringe post-treatment.

Second section is based on the level of pain perceived by the patient post injection with a hypodermic and cartridge syringe.

Anonymity was guaranteed to the participants and they will be encouraged to attempt all questions.

Ethical clearance was obtained from the Yenepoya Ethics Committee 2, Yenepoya University before the onset of the study.

Statistical Analysis

Data analysis was done using SPSS (Statistical package for social sciences) 24.0 software. The level of significance in the present study was set for 5%. The level of significance in the present study was 10% with 80% power and effect size of 0.5. P value<0.05 was considered to be statistically significant.

Descriptive statistics and paired T-test was used to evaluate and compare the ease of use of and level of pain perceived by the patient upon using hypodermic and cartridge syringe. Wilcoxon signed rank test was used to compare the VAS score given by patients upon using Cartridge syringe and Disposable Hypodermic Syringe since the VAS Score is a type of ordinal data.

In our current study, conducted through a questionnaire-based approach, we rigorously compared the pain levels reported by patients during the injection process and the overall ease of use of hypodermic and cartridge syringes as perceived by the administering operators.

Results

This questionnaire-based study aimed to assess and evaluate the ease of use of hypodermic and cartridge syringes from the operator's perspective. Additionally, the study aimed to compare and analyze the level of pain perceived by patients during the needle insertion process for both types of syringes.

This study enrolled 54 patients requiring bilateral tooth extractions. After obtaining informed consent, a questionnaire was provided to the operator, divided into two sections: the operator's questionnaire and the patient's questionnaire.

On the day of the initial visit, patients underwent tooth extraction with local anesthesia administered using 4% articaine via a cartridge syringe. Patients were asked to provide their VAS (Visual Analog Scale) score upon needle insertion. Following the extraction, the operator completed a set of questions regarding the use of the syringe.

During the follow-up visit, the contralateral extraction was performed using 2% lignocaine via a hypodermic syringe. The same set of questions was asked of both the patient and the operator, and their responses were recorded.

After the operator had used both types of syringes, they answered additional questions to assess their preference between the two. Similarly, at the end of the treatment, the patient's preference was also noted.

Age Distribution

A total of 54 patients were enrolled in this study with a mean age group of 24.09. Table 1 shows the minimum and maximum age groups followed by the mean and standered deviation

Table 1:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	54	18	53	24.09	6.452

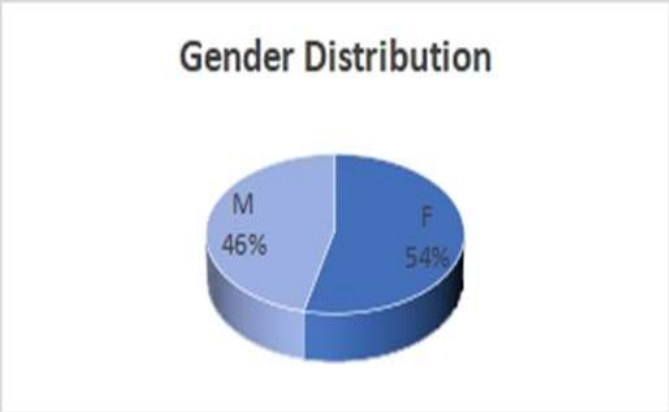
Sex Distribution

Table 2 shows the sex distribution and it was noted that out of 54 patients 25 were male and 29 were female.

Table 2:

Gender		
	Frequency	Percent
F	29	53.7
M	25	46.3
Total	54	100.0

Graph 1:



Frequency Distribution of the Responses after Using Cartridge Syringe

Three set of questions were asked to the operator after using cartridge syringe and here are the total responses to each:

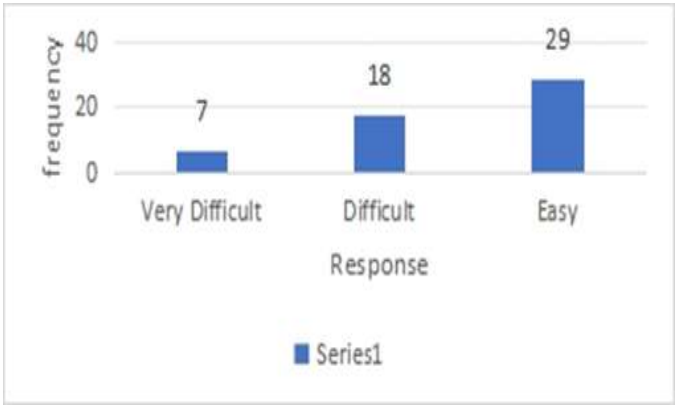
Question 1) How Easy or Difficult Was It to Use the Cartridge Type of Syringes (Table 3, Figure 2)

Out of 54 operators 53% found it easy to use the cartridge syring where as 18% found it to be difficult to use and 7% found it to be very difficult to use the syringe

Table 3:

Q 1:How easy or difficult was it to use the cartridge type of syringes		
	Frequency	Percent
Very Difficult	7	13.0
Difficult	18	33.3
Easy	29	53.7
Total	54	100.0

Graph 2:



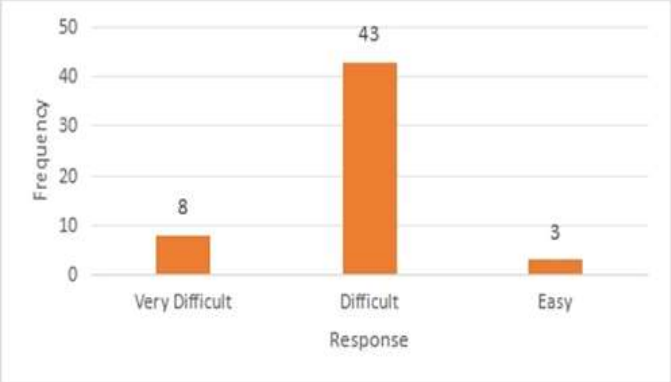
Question 2: How Easy or Difficult Was It To Aspirate Using Cartridge Type Of Syringes (Table 4, Figure 3)

It was noted that 43% of the operators found it difficult to aspirate using the cartridge syringe where as 8% found it very difficult and only 3% found it easy to aspirate using cartridge syringe.

Table 4:

Q 2:How easy or difficult was it to aspirate using cartridge type of syringes		
	Frequency	Percent
Very Difficult	8	14.8
Difficult	43	79.6
Easy	3	5.6
Total	54	100.0

Graph 3:



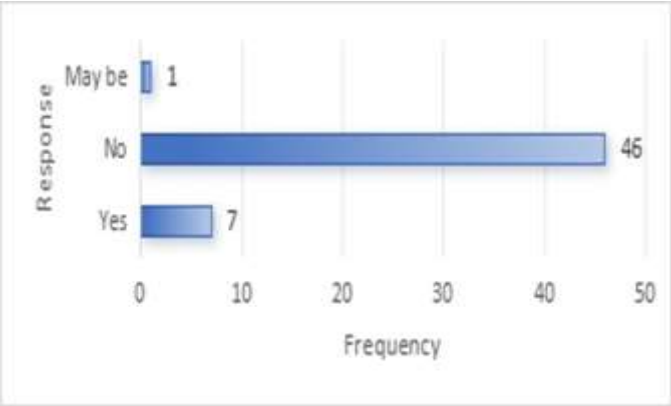
Question 3: Is the Use of Cartridge Syringe Time Effective? (Table 5, Figure 4)

Out of 54 operators 46% felt that the use of cartridge syringe was not time effective whereas only 7% of the operators felt it was time effective.

Table 5:

Q: Is the use of cartridge syringe time effective?		
	Frequency	Percent
Yes	7	13.0
No	46	85.2
May be	1	1.9
Total	54	100.0

Graph 4:



Frequency Distribution of the Responses after Using Disposable Hypodermic Syringe

Three set of questions were asked to the operator after using hypodermic syringe and here are the total responses to each:

Question 1: How Easy or Difficult Was It to Use the Hypodermic Type of Syringes All 54 operators found the use of hypodermic syringe easy (TABLE 6)

Table 6:

Q:How easy or difficult was it to use the hypodermic type of syringes		
	Frequency	Percent
Easy	54	100.0
Total	54	100.0

Question 2: How Easy or Difficult Was It to Aspirate Using Hypodermic Type of Syringes All 54 operators found that it was easy to aspirate using the hypodermic type of syringe. (Table 7)

Table 7:

Q:How easy or difficult was it to aspirate using hypodermic type of syringes		
	Frequency	Percent
Easy	54	100.0
Total	54	100.0

Question 3: Is the Use of Hypodermic Syringe Time Effective?

All 54 operators found that it was time effective to use the hypodermic type of syringe.

Table 8:

Q: Is the use of hypodermic syringe time effective?		
	Frequency	Percent
Yes	54	100.0
Total	54	100.0

Frequency Distribution of the Responses after Using Both

Four set of questions were asked to the operator after they had used both the syringes:

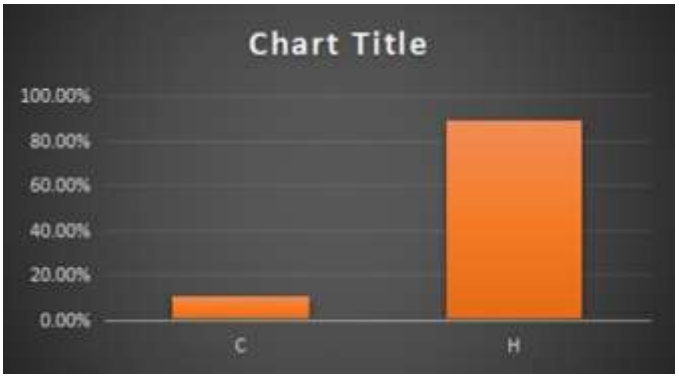
1) Question 1:_Which Of The Following Would You Rather Use .(Table 9, Figure 5)

Out of the 54, 48 (88.9%) operators opted to use the hypodermic type of syringe whereas only 6 (11.1%) choose to use the cartridge syringe.

Table 9:

Q:Which Of The Following Would You Rather Use		
	Frequency	Percent
Cartridge Syringe	6	11.1
Hypodermic Syringe	48	88.9
Total	54	100.0

Graph 5:



Question 2: Which Of The Following Was Easier To Aspirate With? (Table 10)

All 54 operators found that it was easier to aspirate using hypodermic syringe.

Table 10:

Q:Which of the following was easier to aspirate with		
	Frequency	Percent
Hypodermic	54	100.0
Total	54	100.0

Question 3: Which of the Following Was More Time Effective? (Table 11)

All 54 operators found the use of hypodermic syringe more time effective

Table 11:

Q:Which of the following was more time effective		
	Frequency	Percent
Hypodermic	54	100.0
Total	54	100.0

Question 4: Which Of The Following Was More Cost Effective? (Table 12)

All 54 operators opted hypodermic syringe to be cost effective compared to the cartridge syringe.

Table 12:

Which of the following was more cost effective		
	Frequency	Percent
Hypodermic	54	100.0
Total	54	100.0

Patient Questionare

VAS Score: VAS score of the patients were assessed upon the insertion of the needle of each type of syringe, hypodermic and cartridge syringe respectively. We used Wilcoxon signed rank test to compare the VAS score given by patients upon using Cartridge syringe and Disposable Hypodermic Syringe since the VAS Score is a type of ordinal data. (TABLE 13)

It was noted that patients who were administered LA using cartridge syringe perceived a much lesser pain in comparison to the patients who were injected using the hypodermic syringe.

Table 13:

Test Statistics	
	VAS SCAORE H - VAS SCORE C
Z	-5.536
p value	<0.001

The value of the test computed is <0.001.So, reject H0 and conclude that the difference between pain felt by patient after using CARTRIDGE SYRINGE and Disposable Hypodermic Syringe statistically significant

Patient Preference

Out of 54 patients, 90.7% preferred the cartridge syringe for future treatments, finding it less painful and more comfortable than the hypodermic syringe. (Table 14)

Table 14:

Cartridge Syringe/Disposable Hypodermic Syringe		
	Frequency	Percent
Cartridge Syringe	49	90.7
Disposable Hypodermic Syringe	5	9.3
Total	54	100.0

Discussion

Dental practitioners need to administer safe and effective local anaesthesia, which can be challenging to achieve without causing discomfort for patients. It requires a thorough understanding of anaesthetic agents, neuroanatomy, and optimal techniques and devices. There are various options available today for managing pain associated with dental procedures effectively[8].

In this questionnaire-based study, we compared the efficacy and ease of use of hypodermic and cartridge syringes for the administration of local anaesthesia. The questionnaire was divided into two parts. The first section evaluated the operator's perception of the two syringes, assessing ease of use, aspiration, administration time, and cost-effectiveness. After using both syringes, operators answered related questions. The second part focused on patients, who rated their pain on a Visual Analog Scale (VAS) from 0 to 10 after needle insertion and indicated their syringe preference.

Beegum, Fahanna et al .[9] studied two types of local anaesthesia delivery devices in children: a metallic syringe and the I-Ject computer-controlled device. They assessed anxiety levels using the Modified Child Dental Anxiety Faces Scale before administering anaesthesia, and used the Faces Pain Scale-Revised to measure discomfort after anaesthesia administration. They found that children reported greater comfort with the I-Ject device compared to conventional anaesthesia.

Sundararaman Prabhu et al.[10] conducted a study to compare the pain experienced during Nasopalatine block administration using a disposable insulin syringe versus a conventional 3 mL syringe. Forty patients undergoing maxillary central incisor extractions were divided into two groups: one receiving the block with a 3mL syringe and the other with an insulin syringe. Patients rated the injection pain on a visual analog scale (VAS), with Group A averaging a score of 1.55 and Group B scoring 1. The Chi Square Test yielded a value of 8.603 (degree of freedom = 3, P value = 0.0351), indicating no significant difference in anesthesia effectiveness between the groups.

In our study we used two types of syringes: hypodermic and cartridge syringe. it was noted that patients perceived a lesser VAS score when they were administered LA using cartridge syringe compared to when a hypodermic syringe was used. Kenneth L. Reed et al .[5] in his review article discussed the importance to the safe and effective delivery of local anaesthesia, including needle gauge, traditional and alternative injection techniques, and methods to make injections more comfortable to patients.

In our study two different syringes with different gauges were used. The hypodermic syringe had a guage of 26 gauge needle and the cartridge syringe had a gauge of 27. The ease of use of these syringes were assessed by asking the operator a set of questions after using each syringe, followed by a comparative set of questions after having used both. It was noted that out of 54, 29 operators found it easy to use the cartridge syringe, and 18 and 7 operators found it difficult and very difficult to use it, respectively.

In comparison all 54 operators found the use of hypodermic syringe easy. When comparing the ease of aspiration between hypodermic and cartridge syringes, several factors come into play, In a hypodermic syringe, aspiration often requires manual plunger manipulation,

which can be cumbersome and may provide less immediate feedback, making it harder to confirm blood aspiration. Some Cartridge syringes have built-in aspiration mechanisms, making the process easier and more consistent. They provide clearer and quicker feedback, allowing for more precise control and confirmation of blood aspiration.

MJ Kotze et al.[11] conducted a study comparing three local anesthetic techniques used in tooth extraction. They looked at the presence of blood in the cartridge, needle lumen, and needle surface when using 27G or 30G needles. The study found a significant association between needle diameter and visible blood in the cartridge (P=0.006) and in the needle lumen (P=0.029), particularly with the 27G needle.

In our study it was noted that out of 54 operators, 43 found the ease of aspiration difficult while 8 found it very difficult to aspirate upon using cartridge syringe. Where as all 54 operators found it easy to aspirate using the hypodermic syringe. When comparing the time effectiveness of administering local anesthesia (LA) with hypodermic versus cartridge syringes, several factors influence the overall efficiency:

The manual process of injecting and aspirating with a hypodermic syringe can be slower, especially if multiple aspirations are needed to ensure correct placement. Many cartridge syringes have built-in features that streamline the injection and aspiration process, making it quicker and more efficient.

In our study out of 54 operators , 46 found the use of cartridge syringe was not time effective in comparision to the use of hypodermic syringe where all 54 found the use more time effective. In terms of cost effectiveness all the operators opted for the hypodermic disposable syringes to be cheaper and more cost effective. At the end of the use of both the syringes the out of 54 patients, 49 opted for the use of cartridge syringe for future oral surgical procedures.

The limitations of the current study is that study cannot be generalised for the entire treatment procedure. The operator and subjects were not blinded to the mode of local anesthetic delivery. The study concluded that irrespective of the visit, injections with cartridge syringe produced lesser pain response and disruptive behaviour than hypodermic syringe. Use of cartridge can be considered as a possible step towards achieving a relatively pain-free dental practice and also in developing a positive attitude towards dental treatment.

Conclusion

The current study conducted via questionnaire showed that patients preferred cartridge syringes over hypodermic syringes due to the reduced pain experienced when administering local anesthetic solution. This suggests that the use of cartridge syringes may have contributed to improved patient comfort during procedures. On the contrary, healthcare providers indicated a preference for hypodermic syringes due to their ease of use, the convenience of aspiration, and their cost and time-effectiveness. This sheds light on the practical considerations that influenced their choice of syringe type for administering local anesthetics.

References

1. Hembrecht EJ, Nieuwenhuizen J, Aartman IHA, Krikken J, Veerkamp JSJ. Pain-related behaviour in children: a randomised study during two sequential dental visits. Eur Arch Paediatr Dent. 2013;14:3–8.
2. Klingberg G, Berggren U, Carlsson SG, Noren JG. Child dental fear: cause-related factors and clinical effects. Eur J Oral Sci. 1995;103:405–12.
3. Venham LL, Gaulin-Kremer E, Munster E, Bengston-Audia D, Cohan J. Interval rating scales

for children's dental anxiety and uncooperative behaviour. Pediatr Dent. 1980;2:195–202.

4. Thoppe-Dhamodhara YK, Asokan S, John BJ, Pollachi-Ramakrishnan G, Ramachandran P, Vilvanathan P. Cartridge syringe vs computer controlled local anesthetic delivery system: Pain related behaviour over two sequential visits - a randomized controlled trial. J Clin Exp Dent. 2015 Oct 1;7(4):e513-8. doi: 10.4317/jced.52542. PMID: 26535099; PMCID: PMC4628807.
5. Reed KL, Malamed SF, Fonner AM. Local anesthesia part 2: technical considerations. Anesth Prog. 2012 Fall;59(3):127-36; quiz 137. doi: 10.2344/0003-3006-59.3.127. PMID: 23050753; PMCID: PMC3468291.
6. Malamed SF, Reed KL, Poorsattar S. Needle breakage: incidence and prevention. *Dent Clin North Am*. 2010;54:745–756.
7. Basnet P, Bhattarai B, Singh RK, et al. Efficacy of Disposable vs Cartridge Syringes for Local Anesthesia Administration: A Case Controlled Comparative Study. JNMA J Nepal Med Assoc. 2019;57(218):123-126
8. Patel BJ, Surana P, Patel KJ. Recent advances in local anesthesia: a review of literature. Cureus. 2023 Mar;15(3).
9. Beegum F, Monier E, Elshaboury SN, Alghofaili AI, Habibullah MA, Karthika S. Comparison of Automatically Controlled Injection System with a Traditional. Syringe for Multiple Infiltrations in Children Aged 6–12 Years: A Randomized Controlled Trial. Journal of Pharmacy and Bioallied Sciences. 2024 Apr 1;16(Suppl 2):S1535-8.
10. Prabhu S, Faizel S, Pahlajani V, Prabhu SJ. Making Nasopalatine Blocks Comfortable: A Randomised Prospective Clinical Comparison of Pain Associated with the Injection Using an Insulin Syringe and a Standard Disposable 3 mL Syringe. J Maxillofac Oral Surg. 2013 Dec;12(4):436-9. doi: 10.1007/s12663-012-0412-4. Epub 2012 Aug 1. PMID: 24431884; PMCID: PMC3847027.