

# REDUCING THE PERCENTAGE OF ADULT PATIENTS EXPERIENCING MODERATE OR SEVERE PAIN DURING LOCAL ANAESTHESIA ADMINISTRATION OF MAXILLARY DENTAL EXTRACTION PROCEDURE IN *KLINIK PERGIGIAN CHEMOR*

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## Abstract

A survey conducted at *Klinik Pergigian (KP) Chemor* showed that 77.5% of adult patients experienced moderate or severe pain during local anaesthesia (LA) administration. Pain during a procedure may significantly impact patient satisfaction and delay patients seeking dental treatment, leading to poor oral health care. This study aimed to reduce the percentage of adult patients experiencing moderate or severe pain during LA administration of maxillary dental extraction in KP Chemor. The contributing factors identified were patients not receiving physical comfort prior to injection (100%), no clear standard operating procedure of LA administration (100%), speed of injection (83%), and fear of needles (92%). Remedial measures were implemented from 1<sup>st</sup> January 2020 to 30<sup>th</sup> March 2020, followed by two cycles of re-evaluation; 1<sup>st</sup> April to 30<sup>th</sup> June 2020 and 1<sup>st</sup> January 2022 to 30<sup>th</sup> March 2022. The remedial measures include introducing ice sticks, providing a clear standard operating procedure of LA administration, training sessions for dental officers performing LA guidelines, turning on the radio while treating the patient, and indiscreet instrument set-up. The post-intervention study showed a successful reduction from 77.5% to 18.3% in cycle 1 and 17.1% in cycle 2. This showed that the measures were effective and sustainable. All contributing factors had improved and the model of good care was up to standard.

KEYWORDS: Local anaesthesia, Painless dentistry, Quality improvement study

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## Problem

Local anaesthesia (LA) is an essential part of treatment in dentistry, and approximately 300 million cartridges of anaesthesia are used annually for dental treatment in the United States (1). LA is widely used in several dental treatments especially tooth extraction as it provides temporary loss of sensation in a specific part of the oral cavity without affecting the level of consciousness. Unfortunately, many patients perceive the LA procedure as the most painful and in some cases as the only painful part of the treatment (2).

Dental extraction is one of the most commonly performed procedures in primary dental clinics. Dentists administer LA via needle injection to prevent pain during dental extraction. However, some patients mentioned that they experienced intolerable pain during LA administration. This situation warrants serious attention as it can affect patients' satisfaction towards healthcare services.

Managing pain and anxiety in patients has always been an important part of dentistry, as 10% of the general population is affected by needle phobia (3). Although some patients are needle-tolerant, the LA injection itself is painful, which prevents most patients from receiving necessary dental treatment. Furthermore, avoidance of dental treatment due to dental fear may lead to severe deterioration of oral health, including oro-facial infections (4).

*Klinik Pergigian (KP) Chemor* is one of the primary dental clinics in the Kinta district of Perak, a state in the northwestern part of Peninsular Malaysia. It consists of four units of primary care dental chairs, six dental officers and 14 healthcare staff, serving a population of approximately 30,461 people. All dental officers in KP Chemor have the privilege to perform LA administration as well as dental extraction procedures. Based on the daily outpatient records, 42.0% of adult patients underwent dental extractions under LA in 2019. However, the biannual outpatient customer satisfaction survey found that patients reported experiencing moderate or severe pain during LA administration. A more detailed survey was conducted to verify the customer satisfaction survey findings and obtain feedback regarding LA administration among patients and among dental officers.

The verification study showed 77.5% of patients experienced moderate or severe pain during LA administration of maxillary dental extraction. The project then shifted its focus on dental extraction of maxillary region as local infiltration technique in maxillary region reported highest needle insertion discomfort. This problem could be due to inadequate pre-procedural step, variation of LA administration among dental officers, low pain threshold of patient and uncondusive environment of dental clinic. The study aimed to reduce the percentage of adult patients who experienced moderate or severe pain during LA administration of maxillary dental extraction to less than 20%.

## Background

Administration of LA is crucial in medical and dental settings, allowing for pain-free procedures and significantly enhancing patient comfort. According to Gaffen et al., the average dentist administers more than 1,500 cartridges of dental local anaesthetic annually, underscoring their extensive use in dental practice. This high frequency of usage highlights the essential role of LA in facilitating routine dental treatments and more complex procedures, ensuring patients experience minimal discomfort during their visits (5).

LA enables dental procedures such as root canal treatments, periodontal surgeries, and tooth extractions to be performed pain-free. However, failure of LA can cause severe pain to patients, hindering the completion of these treatments. Despite its critical role in dental care, the process of administering anaesthesia can trigger significant anxiety or fear, deferring patients from seeking necessary dental treatment. Patients who suffer from high levels of anxiety typically have lower pain thresholds, resulting in a decreased success rate of anaesthesia. Therefore, it is often necessary to employ complementary methods to enhance anaesthesia effectiveness. More importantly, the efforts of dentists to minimise patient pain is crucial in maintaining a calm and relaxed environment, which can significantly improve the overall experience and outcomes of dental treatments (6).

Around 10-20% of people experience dental anxiety, often triggered by fear of local anaesthetic injections (7). This fear can

lead to avoiding essential treatments like dental extractions, risking oral health and consequently causing deterioration of the disease leading to the need for more complex procedures under general anaesthesia. Addressing patient concerns and anxiety is crucial to encourage timely dental care and better oral health outcomes. As noted by Davoudi et al., local anaesthetic injections frequently evoke fear and anxiety across all age groups, often resulting in delayed dental visits or even refusal of treatment altogether. Thus, it is important to implement good strategies to alleviate anxiety surrounding dental procedures, ultimately promoting better oral health outcomes (8).

An effective LA administration depends on several factors which include having a good knowledge of anatomical structures, neuroanatomy, devices, and methods of delivering LA. According to Kulkarni et al, 2019, the most common cause of pain during LA administration was poor injection technique, technical errors and anatomical variability, infection and inflammation, pathological processes, and psychological causes, such as fear and anxiety (9). Previous studies also found some variables that might be involved in painful LA injections including tissue distensibility, speed of injection, patient characteristics and effects of temperature (10). Besides, environmental noise has also been associated with negative developmental outcomes and stress in clinics (11).

Pain experienced during LA administration for dental clinical procedures is almost a universal concern. Multiple studies reported clinicians have used various methods to prevent pain while administering LA such as using topical anaesthetics, using a smaller diameter needle for injection suggestion, slow infiltration, distraction, and vibration technique (12). Besides, the impact of cold application on injection pain in pain management during dental treatment, via application of an ice stick for 1 minute to the buccal mucosa before anaesthesia significantly reduced the pain associated with LA (13).

## Measurement

In view of the alarmingly high percentage of moderate or severe pain during LA prior to dental extraction, up to

77.5% during the verification study from 1 November 2019 to 31 December 2019 in our setting, the urgency for intervention was identified. Assessment of pain was done by using a visual analogue scale (VAS) and a numerical rating scale (NRS) based on pain as the 5<sup>th</sup> vital sign guideline for doctors: Management of pain in adult patients by the Ministry of Health (MOH) (14). The primary outcome of this study was the percentage of patients with a pain score of 4 to 10 during LA administration. In this context, moderate pain referred to a score of 4 to 7, while severe pain referred to a score of 8 to 10. Following LA administration, each patient underwent a pain evaluation, which was documented by the treating dental officer. The patient was asked to point along a scale to indicate how much pain they were experiencing. The pain score is recorded as a number between 0 and 10 on the numerical scale.

Due to limited references regarding the appropriate percentage of patients who experienced pain during LA administration, we engaged an Oral Maxillofacial Surgeon (OMFS) from the Taiping Hospital for expert opinions and consensus. The standard was set at not more than ( $\leq$ ) 20% of patients experiencing moderate or severe pain during LA administration. The formula used to calculate the indicator is as follows:

<p><i>Percentage of adult patients experiencing pain during local anaesthesia prior to maxillary dental extraction</i></p>	$=$	<p><i>Number of adult patients subjected to maxillary dental extraction under LA who reported pain scores between 4 to 10</i></p> <hr style="width: 100%; border: 0.5px solid black;"/> <p><i>Number of adult patients subjected to maxillary dental extraction under LA</i></p>	$\times 100$
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A quality improvement study was conducted using a purposive sampling technique. All adult patients above 18 years old who require LA injection for maxillary dental extraction and are willing to be enrolled were included, and consent was taken. Hypertensive patients with a blood pressure readings of more than 140/90 mm/hg were excluded from the study and tooth extraction procedure as there is a high risk of prolonged bleeding post-extraction procedure. The study also excluded patients with underlying Diabetes Mellitus with random blood sugar (RBS) of more than

10mmol/l due to risk of infection and poor socket healing process.

Pre-intervention data was collected from 1 November to 31 December 2019 among selected patients (n=151) and all dental officers (n=6). A self-administered questionnaire, as shown in Appendix 1, which consisted of seven questions, was distributed to all dental officers to determine the magnitude of the identified contributing factors. Apart from that, observation by a senior dental officer of every dental officer was also performed to assess the appropriateness of techniques and procedures during LA procedures (Appendix 2). For patient-related factors, a questionnaire (Appendix 3) on potential pain factors during LA administration was distributed to patients.

Remedial measures were implemented starting from 1 January 2020 until 30 March 2020. Data collection for Cycle 1 re-evaluation was performed from April 1 to June 30, 2020, involving 82 patients. Due to the COVID-19 pandemic, the study was postponed from July until December 2021. Subsequent data collection for Cycle 2 re-evaluation was carried out from January 1 to March 30, 2022, with a sample size of 76 patients. There were significant differences in sample size during the pre-intervention, Cycle 1 and 2 post-intervention studies due to the pandemic COVID-19, as majority of the dental officers were involved in the vaccination programme and the number of outpatients visiting dental clinics was restricted.

## Initial Assessment of the Problem

The potential factors contributing to the high percentage of patients experiencing moderate to severe pain during LA in the maxillary region are shown in Figure 1. These include: i) inadequate pre-procedural steps, ii) variation of LA administration technique, iii) uncondusive environment of the dental clinic, and iv) low pain threshold of the patient.

A dental examination was performed by dental officers. All patients indicated for maxillary tooth extraction were explained on the procedure and consent was taken to be included in the project. Upon observing the process of care, we identified two main

contributing factors which were inadequate pre-procedural steps and variation of LA administration technique. The results showed that all dental officers (n=6) did not apply physical comfort before injection due to the high cost of topical LA; they also did not use any distraction technique, such as a black-out goggle. Additionally, 83% (n=5) did not apply slow injection technique. Upon theoretical assessment on pain relief, 83% (n=5) of them failed.

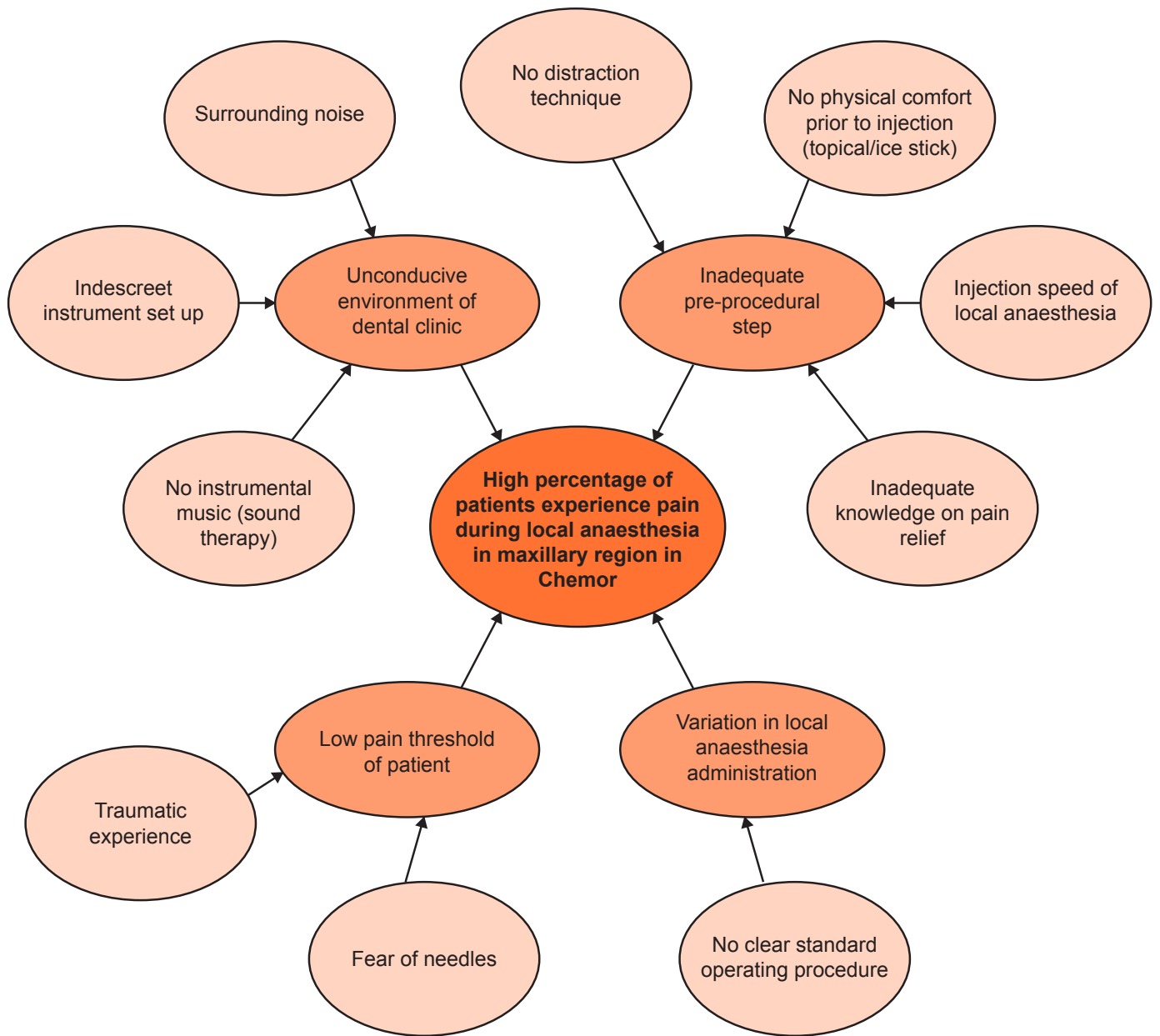
The self-administered questionnaire responded by 151 patients identified other contributing factors such as the uncondusive environment of the dental clinic and the low pain threshold of the patient. These include not having instrumental music (sound therapy) (86%, n = 130), indiscreet instrument set-up (60%, n = 90), surrounding noise (79%, n = 119), and unpleasant smells (46%, n = 69). Ninety-two percent (n = 139) and 40% (n = 60) of patients were affected by fear of needles and traumatic experiences, respectively.

## Strategy

After reviewing the current LA procedure, an additional critical step was included in the refined flowchart (Figure 2). The Model of Good Care (MOGC) (Table 1) elaborated on each critical step, emphasising the criteria that can aid in reducing pain during LA. A few strategies of change were implemented, aiming at improving the MOGC in the intervention period from January 1 to March 30, 2020.

The introduction of ice sticks (Appendix 4) before the LA procedure as a pre-local preparation was one of the strategies. This innovation help patients reduce pain during LA and having a better experience while doing dental treatment. The ice sticks requires only distilled water, straw, and heat sealer. It is practical to handle by direct application to the buccal mucosa for 10 seconds prior to injection. Each ice stick costs approximately MYR 0.045, produced in-house by team members and dental staff, making them a more economical option compared to topical LA which is limited in quantity and costs around MYR 46 per bottle. The topical LA, with its jelly-like consistency, costs about RM0.92 per patient, as one bottle can be used for up to 50 patients. The ice stick was also convenient to use as it



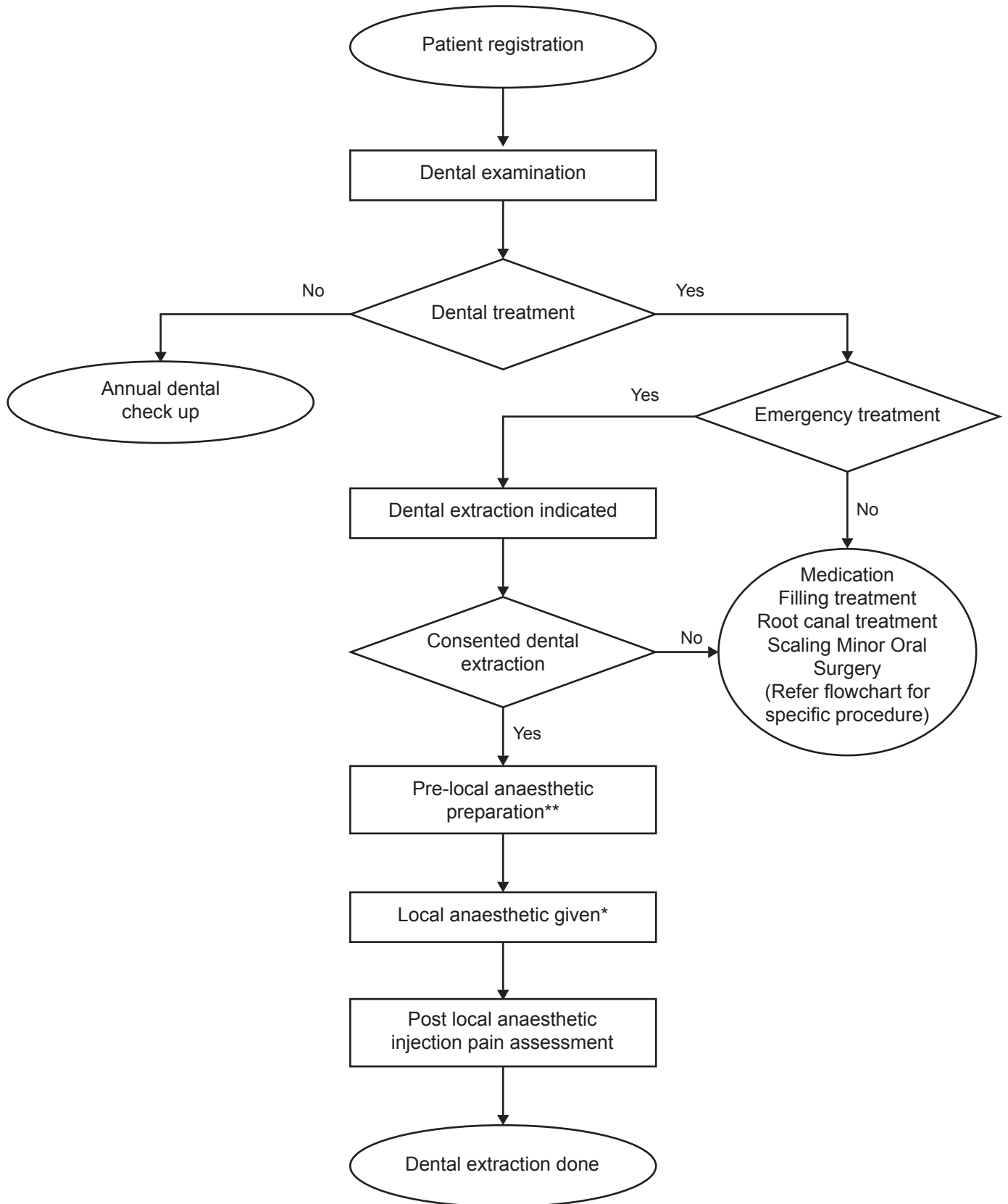


**Figure 1:** Problem analysis chart on potential factors contributing to high percentage of patients experience pain during local anaesthesia in maxillary region

did not require the drying of buccal mucosa as compared to topical LA. Hence, we saw better compliance and tolerance towards the pre-LA treatment using the ice stick.

A classical music was turned on while the patient was being treated to create a relaxing and comfortable atmosphere (15), and the instruments were discreetly arranged. A new standardise LA administration steps was introduced to address the clinical aspect. Once the patient was seated comfortably on the dental chair and the procedure was explained, mouthwash was given to disinfect the oral

cavity. Next, the dental officer started pre-local anaesthetic preparation, the patient needed to wear a black-out goggle as a distraction technique from seeing the needle, and the ice stick was placed on the injection site for 10 seconds. Then, the dental officer applied local anaesthesia by placing the bevel of the needle towards the bone and the injection was given slowly at the rate of 30 seconds per cartridge. After that, the site of injection was gently massaged for 10 seconds. The patient was placed upright while waiting for the anaesthesia to take place. Pain assessment is taken for local



\* indicates critical step  
 \*\* additional critical step

**Figure 2:** Flowchart of workflow on dental extraction procedure.

anaesthetic injection procedure. Guidance and proper training on LA techniques were given under the supervision of the Oral Maxillofacial Surgeon (OMFS) from Taiping Hospital as well as training on distraction and hide-needle techniques. Continuous dental education (CDE) sessions were carried out for dental officers and dental assistants, which involved theoretical and practical lessons followed by an assessment. All CDEs were delivered by the senior dental officer and Oral Maxillofacial surgeon which focused on LA procedure updates, ice stick preparation and method.

The next strategy was theoretical and practical assessments for the personnel involved. Two assessments were administered; first, a questionnaire evaluated their understanding of LA for dental treatment and their knowledge of pain relief with the passing mark set at 80%. Second, a practical evaluation was conducted, led by an Oral Maxillofacial Surgeon (OMFS), to reinforce the topic covered. Upon successfully passing both the theoretical and practical assessments, with additional LA injection procedures performed under the supervision of senior dental officers and Oral Maxillofacial Surgeon, dental officers successfully performed a high-quality skilled

and effective LA administration. Similar interventions were conducted in Cycle 2.

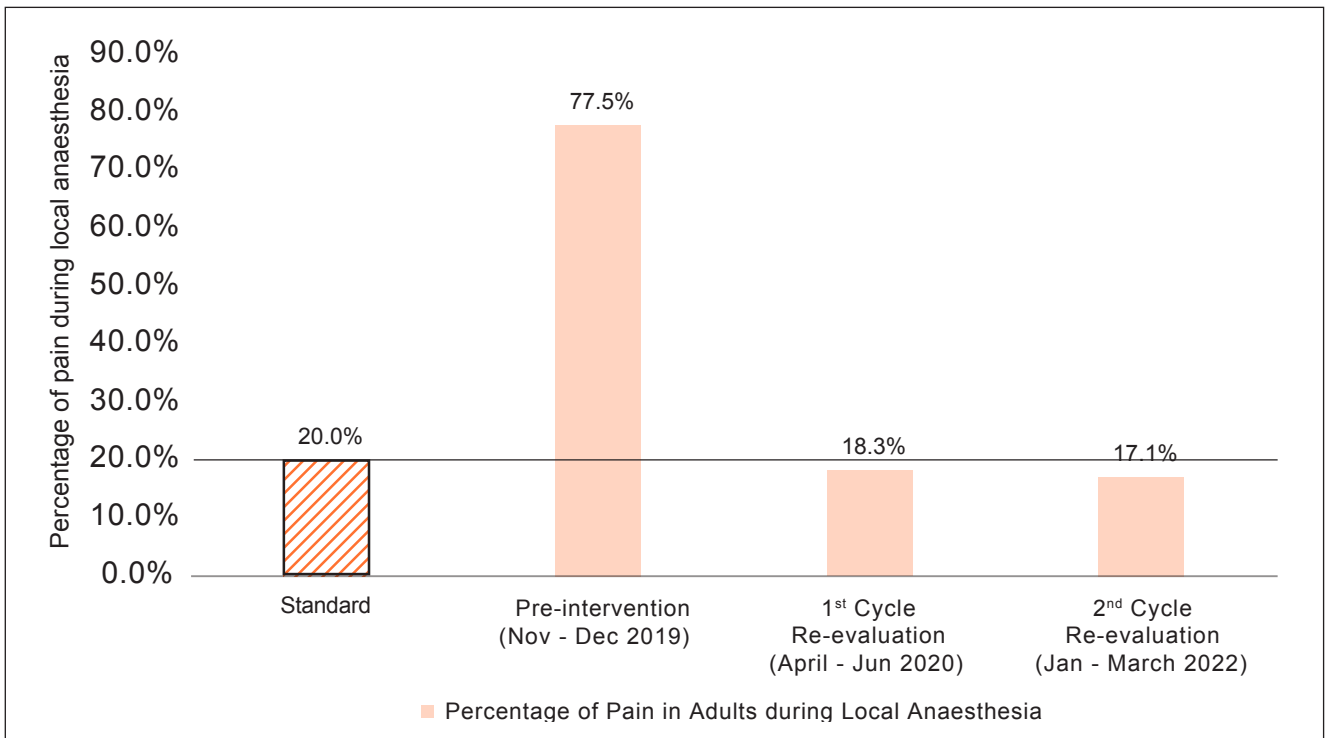
## Results

The post-intervention analyses showed improvement in all MOGC criteria (Table 1). All operators complied with pre-local anaesthetic preparation, applied slow injection of infiltration of more than 30 seconds per cartridge, following the new standardised LA steps, and used the distraction technique named the hide-needle technique. All patients wore blackout google before the dental procedure. According to the post-test findings of the theoretical and practical assessment, all dental personnel (n=6) had passed with an achievement of over 80%.

The percentage of adult patients experiencing moderate or severe pain during LA administration of maxillary dental extraction was reduced from 77.5 % (n = 117) to 18.3% (n = 15) in Cycle 1, and further reduced to 17.1% (n = 13) in Cycle 2. Achievable Benefit Not Achieved (ABNA) has reduced from 58.0% (pre-intervention) to -1.8% in cycle 1 and -2.9% in cycle 2 as illustrated in Figure 3, showing that the measures were effective and sustainable.

**Table 1:** Model of good care for reducing the percentage of adult patients experiencing moderate to severe pain during LA administration.

No	Procedure	Criteria	Standard	Pre-remedial	Post-remedial (1 <sup>st</sup> cycle)	Post-remedial (2 <sup>nd</sup> cycle)
1	Pre-local anesthetic preparation	i. Patient wear black-out google prior to dental procedure ii. Application of ice stick on site of injection before LA procedure for 10 seconds.	100%	0%	100%	100%
2	LA administration technique	A new standard operating procedure are performed by a dental officer using a short needle ensuring: <ul style="list-style-type: none"> <li>• hide-needle technique.</li> <li>• bevel facing bone slow injection</li> <li>• technique within 30s' per cartridge estimated by dental officer</li> </ul>	100%	0%	100%	100%



**Figure 3:** Percentage of adults experiencing moderate or severe pain during maxillary LA before dental extraction.

## Lessons and limitations

This study was able to reduce the percentage of patients who experienced moderate or severe pain during LA injection, and sustained in the subsequent re-evaluation phase. Additionally, a comprehensive understanding and good skills regarding LA administration are very useful to the operator in delivering the best services to the patients.

Apart from that, this study proved that non-invasive and non-pharmacological methods significantly reduced pain for patients during LA. Improved communication skills between healthcare providers and patients were able to reduce anxiety symptoms related to unpleasant and painful experiences. Several techniques could be applied during the LA procedure including the use of ice sticks, hide-needles, and slow injection technique to improve the pain experience. A clear and effective standardised step of performing LA helps improve operators' skills and enhance rapport with patients, thus increasing their compliance with the treatment.

Despite all the success, several challenges emerged during the study. One of the most significant hurdles was the way to successfully comfort anxious and traumatic

patients before the dental extraction procedure, dental officers were trained to tell the patients "I will count to 3. When I get to 2, take a nice deep breath. When I get to 3 try not to move when you might feel a little sting. If you move, the needle might come out and might have to sting you twice because I need to put it back in." Although the cost of ice sticks is low, the process requires cooperation from dental staff due to manpower limitations. Additionally, the project was unable to fully address the issue of unpleasant odours, as the source of these smells remained unidentified.

Moving forward, we aim to optimise workflow processes and improve task delegation to maximise the efficiency of ice stick productions. Despite these challenges, the interventions implemented in this study were deemed impactful to be adopted by primary clinic in Perak and potentially nationwide.

## Conclusion and the Next Steps

The administration of LA in dental practice via needle injection causes fear and anxiety among patients as they perceived it is the most painful part of treatment. Adequate pain management before LA administration is very essential. In KP Chemor, percentage



of patient who experienced moderate or severe pain was very high (77.5%), thus effective interventions need to be carried out to achieve less than 20% adult patients experienced pain during LA.

Change begins with us; hence, we developed several strategies to overcome the contributing factors causing pain during LA administration. Using appropriate interventions, the incidence of moderate or severe pain was able to reach the standard set, with full responsibility at all departmental levels to practice all the intervention strategies.

Our interventions can be adopted by other healthcare facilities to improve the quality of care in the management of LA in dentistry. The training module for the new dental officers joining primary dental clinics could be expanded to involve the staff nurses. More regular training sessions should be organised to ensure continuous good practice and sustenance of knowledge and enforcement.

We aim to promote the use of standardised LA administration to ensure consistent and proper injection technique across practices. This initiative has been approved by the District Dental Office for Kinta District, allowing for districtwide implementation of all the strategies. The authors also aspire to expand this initiative to the national level, contributing to the delivery of more efficient and effective dental healthcare services.

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## Conflict of Interest

The authors declare that there was no conflict of interest.

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## Appendix 1

BORANG SOAL SELIDIK KAJIAN QA 2019-2020 (PEGAWAI PERGIGIAN)  
TAJUK : TO REDUCE PAIN IN ADULT PATIENT DURING LA IN KP CHEMOR  
CODE RESPONDEN :

KP :

TAHUN BERKHIDMAT :

1. Do you apply topical anaesthetic before LA injection?  
Yes / no
2. Do you feel you have sufficient knowledge concerning LA technique?  
Yes / no
3. Do you feel confident while giving local anaesthetic injection?  
Yes / no
4. Would you like more information or training on local anaesthetic injection technique?  
Yes / no
5. Do you having trouble while giving instruction or communicating with patient before LA injection?  
Yes / no
6. Do you give local anaesthetic more than 20 seconds at specific site (eg: buccal infiltration)?  
Yes / no
7. Do you use any distraction technique prior to dental injection? (hide needle technique)  
Yes / no

Thank you.

## Appendix 2

### ASSESSMENT FORM QUALITY ASSURANCE PROJECT PEJABAT KESIHATAN PERGIGIAN DAERAH KINTA KP CHEMOR

Name:

A dental officer must pass all the steps.

	<b>Steps of pain management in adults during local anesthetic injection</b>	
1.	Patient is seated comfortably on the dental chair and the procedure is explained.	
2.	Mouthwash is given for disinfection of the oral cavity.	
3.	The mucosa is kept taut using the mouth mirror.	
4.	Ice stick is placed on the injection site for 10 seconds.	
5.	In distraction technique, the patient is asked to close his/her eyes while the operator prepares for the injection (black-out goggle).	
6.	The placement of bevel of the needle should be facing the bone.	
7.	An injection is given slowly at the rate of 30 seconds per cartridge.	
8.	After injection, recap the needle using a needle holder.	
9.	The site of injection is gently massaged for 10 seconds.	

**Appendix 3**

**BORANG SOAL SELIDIK PESAKIT KAJIAN QA 2019**

Nama:

Umur:

Jantina:

Bangsa:

Berapa kali datang klinik:

Pernyataan	Ya	Tidak
Alatan dan bahan pergigian di klinik buat saya gementar ketika menerima rawatan pergigian.		
Saya rasa terganggu dengan bunyi bising ketika menerima rawatan		
Mendengar muzik membantu saya tenang ketika menerima rawatan pergigian.		
Saya pernah ada pengalaman buruk dengan rawatan pergigian sebelum ini		
Saya rasa takut dengan jarum suntik ubat kebas		
Saya faham dengan penerangan yang diberikan oleh doktor gigi berkenaan rawatan pergigian.		

Maklumbalas selepas mendapatkan rawatan anestesia setempat dan cabutan gigi :

.....  
 .....  
 .....

Tandatangan/ Cop Ibu Jari Kiri :.....

Nombor K/P :.....

Nama :.....

Tarikh :.....



## Appendix 4



Innovative ice stick that is applied to buccal mucosa for 10 seconds prior to LA administration