

## SAFE SINGLE INJECTION DIGITAL INTRATHECAL NERVE BLOCK TECHNIQUE FOR FINGER SURGERIES IN ACCIDENT AND EMERGENCY

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### ABSTRACT

#### BACKGROUND

To know the efficacy of a safe and simple digital block for anaesthesia in A&E for suturing in finger lacerations and other minor finger surgeries that need not require hospital stay and surgery can be done at the earliest.

#### MATERIALS AND METHODS

After getting ethical committee approval, and written consent from the patients this study was carried out with the help of the Plastic surgery department and Casualty (A&E) of ACS Medical College and hospital from May 2015 to May 2018. Patients aged 16 to 80 years with finger lacerations were enrolled. After standard wound preparation and lignocaine test dose, all wounds, lacerations were randomized to anaesthesia with digital infiltration of 1% lignocaine. Pain of needle insertion, anaesthetic infiltration, and suturing were recorded on a validated 100-mm Visual Analog Scale (VAS) from 0 (none) to 10(worst); also recorded were percentage of patients requiring rescue anaesthesia; time until anaesthesia; percentage of wounds with infection or numbness at day 7. A sample of 100 patients were selected who were able to detect a 15-mm difference in pain scores.

#### RESULTS

100 patients aged 16 to 76 years of age were given digital block in the minor OT in casualty which had all back up for GA and any emergency. Mean age (SD) was 38.1 (16.8) years, 29% were female. Only one patient in the digital anaesthesia group required rescue anaesthesia. Not only single injection digital block is equally effective in delivering anaesthesia but also in a single injection making it less invasive, easier to perform and teach, and avoids the risk of damaging the finger nerves. All the patients were discharged from hospital from as early as 6 hours to maximum 3 days and followed thoroughly.

#### CONCLUSION

Intrathecal single digital block of fingertip injuries to all wounds results in similar pain of needle insertion, anaesthetic infiltration, and pain of suturing.

#### KEYWORDS

Intrathecal, Digital Block, Visual Analogue Score, 25 Gauge Needle, A&E, Lignocaine.

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#### BACKGROUND

Skill in providing digital nerve block for Injuries in A&E is very important for a clinician. Infection of the digits are extremely common in form of paronychia (collection of pus in the nail bed) which is very painful condition and requires emergency intervention and even nail removal. Adequate analgesia is mandatory to properly address the presenting condition and to minimize the patient's discomfort. Digital blocks are useful in many conditions in which local infiltration of an anaesthetic agent would require several injections into the already painful site of injury. Furthermore, local infiltration around the wound may create increased swelling,

making the repair more difficult. Several techniques are available for performing digital blocks.

Each finger has three bones (phalanges); the thumb has two. The fingertip consists of the uppermost phalanx with surrounding muscle, tissue, nerves, and nail. A fingertip is a highly complex structure, with many specialized features, one of which is a rich network of sensory nerves. The fingernail is called the nail plate. Underneath the nail plate is the nail bed, the mostly pink tissue seen under the nail. The pulp is the area of skin opposite the fingernail and is usually very vulnerable to injury. Fingertip injuries are extremely common and varied. Blunt or crush injuries can cause bleeding under the nail plate (subungual hematomas), which can be very painful. Nails can also be torn off (nail avulsions), and the fingertip bone can be broken (fracture). Sharp or shearing injuries from knives and glass result in cuts (lacerations) and puncture.<sup>1,2</sup> Occasionally, the end of the fingertip is amputated or partially amputated. When the finger is cut more than halfway through, the injury is described as a subtotal amputation. Burns and frostbite also commonly injure fingertips. Fingertip injuries are one of the frequent situation we face in emergency department.

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Other indications include treatment and repair of many acute conditions, including finger lacerations beyond the mid-proximal phalanx, nail bed injuries, paronychias, nail avulsions, and foreign bodies of the digit. The common injuries are work spot injuries, trap door injuries, domiciliary injuries and retained foreign bodies. All of them need procedures ranging from simple dressing after debridement to fracture reduction and soft tissue reconstruction under analgesia. This technique is contraindicated in cases of infection, including felon, tenosynovitis, and overlying cellulitis, Allergy to lignocaine or bupivacaine. Complex laceration or other injury involving multiple digits that can be more easily and adequately anesthetized with a nerve block at the wrist.<sup>1,3,4,5</sup>

*Aims and objectives*

The objective of this study was to evaluate and analyse the effectiveness of intrathecal digital nerve block.

**MATERIALS AND METHODS**

In this study we compare various parameters of the single-injection modified digital block to 100 patients who attended the Casualty (A&E) of ACS Medical College Hospital, Chennai with an age range of 16 to 80 year for Baseline Digital Block. This was a single blinded, prospective, randomized controlled trial within done in our hospital casualty. Two-percentage Lignocaine was used as an anaesthetic agent. Doses of 2 and 4 ml were used in the single-injection intrathecal digital block. The primary outcome of successful anaesthesia was measured, and secondary outcomes of patient distress score and clinician satisfaction were measured. There were 72 male patients and 16 female patients with fingertip injuries (Distal to the Distal-Interphalangeal Joint, (DIPJ)) requiring a digital nerve block. 66 were men, 16 were women and 12 were children aged 16-18 years. Digital nerve blockade using lignocaine is a commonly performed procedure in Accident and Emergency (A&E) departments. The local infiltration of lignocaine is often associated with considerable discomfort. Digital blocks were more effective than local infiltration. As a result, most finger lacerations are repaired after this procedure. However, the study does not include application of a topical anaesthetic to reduce the pain of needle insertion and infiltration before local anaesthesia. We can also hypothesize the pretreatment of finger lacerations with a topical anaesthetic, followed by direct local infiltration of lidocaine, would be less painful, less likely to require additional anaesthesia, and faster in onset than would performance of a digital nerve block before laceration repair.

*Inclusion Criteria*

Patients with simple, short injury distal to the base of finger.

- a) Patients more than 16 years with no dermatological or systemic illness.
- b) Patients who are willing for one week telephone follow up.

*Exclusion Criteria*

- a) Multiple trauma
- b) Peripheral vascular disease
- c) Insulin dependent diabetes mellitus
- d) Bleeding diathesis

**RESULTS**

100 patients who attended the casualty of ACS Medical College Hospital, Chennai (A&E) were entered in the study, with an age range of 16 to 76 years.

78 patients recorded the injection as being less painful comparatively. 10 patients indicated there was no difference between the two injections. 12 patients scored the injection as being more painful and needed to be calmed down with midazolam 2 mg intravenously. Out of these 3 patients had more than a single digit injury.

Number of patients	100
Number of digits	106
Index: Middle: Ring: Little	79:15:7:8
Number of digits with total anaesthesia	106
<b>Table 1. Number of Blocks Given</b>	

Operative Procedure	Number
Tenoarthrolysis	17
Arthrodesis of finger joint	2
Laceration debridement and repair	42
Extensor tendons surgery	12
Local flaps	5
Excision of finger tumours or foreign bodies	2
Nail surgery	20
<b>Table 2. Types of Injuries</b>	

The differences in pain scores for each patient were analysed using Visual analogue scoring. This gave a mean difference in pain scores of 0.739 with a 95% confidence interval of 0.47 to 1.01. Analysis varied base in age, sex and severity of the injury and illness. The order site of injection and digit type did not have any significant effect. The differences in pain scores were small and that other factors such as needle size, speed of injection, and the temperature of lignocaine may all affect the pain of infiltration.

Pain was assessed using a visual analogue scale and verbal response score. The time to loss of pinprick sensation and extent of analgesia recorded for all the patients and analysed.

All the blocks were successful. Only one patient was uncooperative but could be managed with this technique. Onset of analgesia starts in 5 seconds to 50 seconds (mean 19.4). Extent—palmar aspect of the finger distal to the injection site, nail & nail bed complex and dorsum of the hand distal to the distal interphalangeal joint. Complete analgesia was achieved in 42 – 204 seconds.

Parameters	Patients in Study Group
Number	100
Age	16 years - 75 years
Weight	45 kgs - 80 kgs
Duration of study	May 2015 to January 2018
ASA physical status	1 and 2
Needle size used	25 gauge
Average concentration of drug	2% xylocaine without adrenaline
Amount of drug given	3 ml to 5 ml
Onset of action	3 seconds to 30 seconds
Duration of action	45 minutes to 90 minutes
Surgery procedure time	less than 1 hour
First call for pain	2 to 2.5 hours
Time of discharge from hospital	6 hours to 3 days

**Table 3. Demographic Characteristics, Intraoperative Management, and Recovery Times of Patients in the Study Group**

*Complications of Digital Block*

The choice of the type and concentration of local anaesthetic for a digital block is based on the desired duration of blockade. The onset times and duration of anaesthesia are different for same anaesthetic agent too in different individuals. Also, different anaesthetic agents have different onset and duration of action. Adjuvants can have some effect in onset and duration of action.<sup>3,5</sup>

*Expected Complications and how to Avoid*

- 1) Haematoma
- 2) Vascular injection
- 3) Gangrene of digit
- 4) Nerve injury
- 5) Infection

*How to Avoid*

- 1) Intermittent aspiration should be performed to avoid intravascular injection
- 2) Test dose of the local anaesthetic agent should be given.
- 3) Residual paraesthesias are likely due to an inadvertent intraneuronal injection<sup>[5]</sup>
- 4) Systemic toxicity is rare because of the distal location of the blockade<sup>[5]</sup>
- 5) Do not inject when the patient complains of pain or when high pressures on injection are met.
- 6) Use of epinephrine should be avoided.
- 7) Strictly aseptic precautions should be followed.

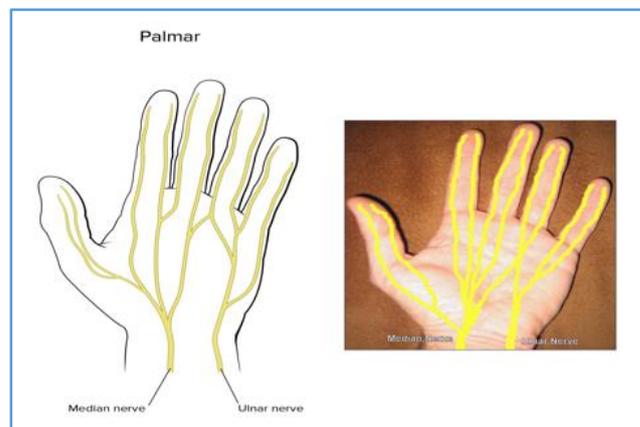
**DISCUSSION**

*Nerve Supply to Fingers up to the Distal Inter Phalangeal Joint-*

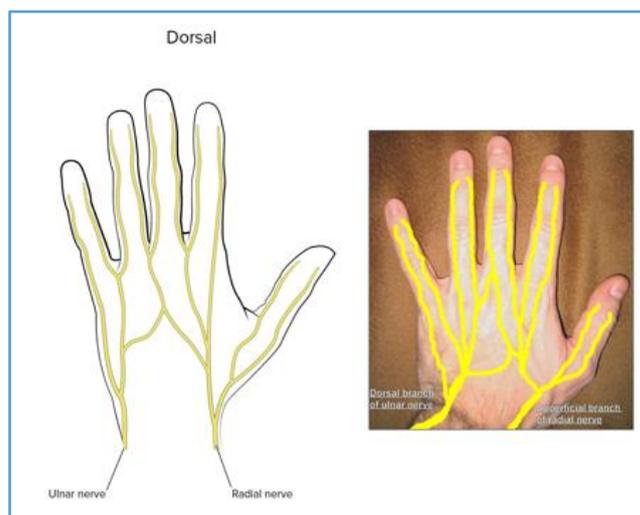
- 1) Thumb- All four nerves must be blocked for fingertip and nail bed anaesthesia. The common digital nerves divide into two pairs of nerves corresponding to the dorsal and volar sides of the digits
- 2) Palmar Nerve- Located at the 4 and 8 o'clock positions when looking at a cross section of the digit Supplies the volar surface of the digit and the dorsal surface distal to

the distal interphalangeal (DIP) joint for the middle three fingers. Blocking only the palmar nerves will provide adequate anaesthesia on fingertip injuries distal to the DIP for the three middle fingers.

- 3) Digital Nerve- Located at the dorsal 2- and 10 o'clock positions when looking at a cross section of the digits Supplies the nail beds of the thumb, fifth digit, and dorsal aspects of all three middle (Miller 7<sup>th</sup> edition).



**Figure 1. Nerves in the Palmar Aspect of Hand**



**Figure 2. Nerves in Dorsal Aspect of Hand**



**Figure 3. Landmark for Intrathecal Digital Injection**



**Figure 4. Intrathecal Injection into the Flexor Sheath**

Fill 5-mL syringe with 2% lignocaine. Insert 25-gauge needle at a 90-degree angle at the midpoint of the proximal digital crease and advance until bone is struck. Withdraw needle approximately 2 to 3 mm (should be in the flexor tendon sheath) and redirect at a 45-degree angle to the long axis of the digit. Aspirate and inject 1.5 to 3 mL lidocaine while palpating tendon sheath with other hand; continue until resistance is felt, after removing the needle, apply pressure over the tendon proximally to facilitate distal spread. Wait for 2 to 3 minutes to test for efficacy of anaesthesia

Hand and finger injuries can be crippling and affect all ages, none more so than the working-class adults and children. In adults, injuries are commonly due to occupational activities. Lacerations are the major type of injury, followed by crush and avulsion injuries. Most injuries tend to be singular and of minor severity, and can be treated as an outpatient. However, powered machines and non-powered hand tools are more likely to result in multiple types of injuries.<sup>6</sup>

Making the local anaesthetic agent more basic or warming the local anaesthetic may have resulted in less pain for both local and digital blocks.<sup>4,7</sup> In our study, we used a 25-gauge needle than described elsewhere, which was very effective as a single injection. Although use of small needles, warming and adding sodium bicarbonate have been shown to reduce the pain during injection of drug, there is no evidence based direct comparison between these methods. We have not used any topical anaesthetic before the block which would have otherwise must have still more reduced the pain during injection.

Chiu et al in their studies have first described transthecal in a case report from 1990.<sup>8</sup> Sarhadi and Shaw Dunn have contributed a good explanation of the anatomical basis for transthecal digital nerve block. After an injection of methylene blue, it was found that the injected solution escaped from the flexor tendon sheath around the vincular vessels and then flowed through the loose perivascular areolar tissue alongside the digital nerves, vessels, and their branches.<sup>8</sup>

Based on that finding it is believed that the block works by the infiltration of drug into the flexion sheath which means intrathecal. The original transthecal technique is a single injection of a small volume of local anaesthetic agent with limited risk of damaging the neurovascular bundle either directly or indirectly because of the compartment pressure increase in the digit under the sheath and rapid onset of action.<sup>8</sup>

There were no reports in the literature regarding damage to the flexor tendon. Many modifications to the procedure were suggested following the transthecal injection single injection technique including the single volar injection at the level,<sup>9,10,11</sup> and intrathecal digital block. The present study clearly explains the effectiveness of modified intrathecal and single injection digital subcutaneous block.

#### *Intrathecal Injection Route has the Following Advantages*

- Simple
- Single injection
- 100% Effective
- Safe-No significant morbidity with the procedure and the risk of injury to the neurovascular bundle is remote.

The findings of the present study demonstrate that a single-injection is more convenient for the patient as well as physician and has more values. This is an easy technique because of the straight forward landmark. Landmark is the distance between the finger's middle line (the area of injection in single-injection method) and the finger's nerves.<sup>6</sup> This simple technique also saves the time of anaesthesia and cause less discomfort to patient. Also, it reduces the waiting time before surgery. We also recommend this single injection technique instead of the traditional method because this is easy to teach and learn. Due to the fact that in this method injection is performed in the finger's middle line, there is less risk of trauma in finger's nerves and capillaries. Finally, the most important advantage of the single injection subcutaneous digital block method, as compared to two injection dorsal digital block method is the lower dosage of the anaesthetic drug for achieving full digital anaesthesia.

In our research surgeons were also equally satisfied with the single injection simple digital block technique giving good patient satisfaction and feedback. This satisfaction difference was statistically significant. There were some probable reasons to explain why patients were more satisfied with this single injection intrathecal digital block technique, while there was no significant difference in the level of analgesia as compared to any other mode of anaesthesia and mean pain scores. First of all, the subjects were not adequate to reveal the probable difference. Secondly the scale of 0 (no pain) to 10 (the most serious pain) does not likely have enough sensitivity and detailed range to cover all the experienced pain or distinguish the little difference between different intensities of pain. Hence our patients were asked about their satisfaction scores in terms of pain score. On the other hand, patients, regardless of their pain score, most likely prefer single-injection to two

injection method and receiving two and more needle insertions in their fingers.

Single injection digital block is more effective in delivering anaesthesia than the double block technique. Also a single injection has proved less invasive, easier to perform and teach, and avoids the risk of damaging the finger nerves. For these reasons a safe recommendation can be made for the use of the single intrathecal block for repairing finger injuries that need immediate intervention which otherwise can lead to finger loss due to delayed surgery and compromised blood supply to the digit due to injury.<sup>10,12,13</sup>

2% Lignocaine without adrenaline used in our study is known to have shortest mean duration of anaesthesia (1.8 h) whereas ropivacaine the longest mean duration (21.5 h). Lignocaine with adrenaline demonstrated the least mean pain on injection (26 mm on a visual analog scale) and bupivacaine with epinephrine the most mean pain (53 mm).<sup>12</sup>

As history and literature always says it is unsafe to use epinephrine in end organs, and digit is considered as end organ and use of adrenaline as an additive is not evidence-based anaesthesia practice for digital block. However, there are many studies which have shown that using local anaesthetic with epinephrine is safe for use in digits. A Cochrane Review concludes that no complications have been reported with the use of adrenaline and denotes that the level of evidence is poor and further high-quality studies are required.<sup>14</sup>

Also shows no evidence of infection due to the procedure as we are following strict aseptic precautions before the prick. Furthermore, there are no large, multicenter studies demonstrating that patients can accurately self-diagnose wound infections, limiting our ability to validate the presence or absence of wound infections.

## CONCLUSION

With the all above data and results we challenge that Intrathecal local analgesia is the choice of digital block to relieve pain over the fingertip and nail bed lacerations and other procedures mentioned above and both surgeons and patients are benefitted in all ways.

Our study has several limitations as it is a small sample size (100 patients) and has limited the ability to detect differences in the need for rescue anaesthesia or adverse events; it is unlikely that there were sufficient numbers of patients to get the other feedbacks of any delayed side effects that what we have discussed in this abstract.

We conclude that intrathecal digital analgesia is a simple, single injection & 100% effective, safe and no significant morbidity noted with the procedure. Also the risk

of injury to the neurovascular bundle is remote and hence it is the safest choice of anaesthesia to relieve pain over the fingertip and nail bed lacerations without infection.

Digital and other anaesthetic techniques for finger surgeries results in significantly variable differences in pain on injection and pain of suturing.

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