International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

A Perioperative Prospective Study of WALANT in Open Reduction Internal Fixation of Ankle Fractures: A Malaysian Experience

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Abstract: ***Introduction: The method of anaesthesia for an ORIF of the ankle includes spinal and epidural anaesthesia, general anaesthesia, peripheral nerve block and local anaesthesia with intravenous sedation, with the use of a tourniquet. The Wide - Awake anaesthesia technique alleviates the need of a tourniquet, and they can provide equivalent amount of pain control and haemostasis. Patients and methods: We report a prospective 6 - case series of patients who presented with ankle fractures that underwent ORIF with anaesthesia via the Wide - Awake Local Anaesthesia No Tourniquet (WALANT) technique. Four cases were performed in Hospital Universiti Kebangsaan Malaysia (HUKM), Cheras and the remaining 2 cases, in Hospital Cyberjaya (HCJ), Selangor between August 2023 and August 2024. The mixture was a cocktail of 50ml of Lignocaine 2%, 10ml of Sodium Bicarbonate and 1ml of adrenaline (1: 1000), added into 39ml of normal saline to render a 100ml WALANT solution. Five patients with bimalleolar fractures, 1 with an isolated lateral malleolar fracture, and 4 patients with associated syndesmotic disruptions. Results: This study reported low levels of perioperative Visual Analog Scale (VAS) with perioperative low levels of anxiety (Hamilton Anxiety Rating Scale). There were no local or systemic complications documented. One patient had 300ml of blood loss intraoperatively, possibly due to the abundant callus and fibrous tissue present as it was a delayed fixation. Conclusion: This case series demonstrated the low pain and anxiety levels experienced by patients undergoing bimalleolar ankle fracture fixation under wide - awake local anaesthesia without tourniquet. WALANT for ankle fracture ORIF is safe and provides an alternative option to reduce postoperative pain, anxiety and tourniquet related complications.***

Keywords: ankle fracture, WALANT, wide - awake local anaesthesia, tourniquet, bimalleolar, lateral malleolus, medial malleolus

1. Introduction

Ankle fractures particularly bimalleolar fractures, are common orthopedic injury that often require surgical intervention to restore anatomical alignment and joint stability (Izzi et al., 2002) . Ankle fractures constitutes 9% of all fractures, in which, bimalleolar fractures constitutes 60% of all ankle fractures (Hoenig et al., 2010) with an incidence of 187 fractures per 100, 000 people (Koujan & Saber, 2024)

These bimalleolar fractures commonly necessitates open reduction and internal fixation to achieve anatomic restoration and joint stability (Gaurav et al., 2019) . The operative treatment traditionally requires an anesthesia team and involves the options of general anesthesia, spinal or epidural anesthesia, regional nerve blocks, and local anesthesia with or without intravenous sedation. They carry a higher risk of anesthetic complications leading to prolonged hospital stay (Reilley et al., 2004) . Care should be taken in patients with multiple comorbidities such as ischaemic heart disease, cerebrovascular disease and pulmonary deficiency (Dale & Checketts, 2013) .

Lalonde first described the use of wide - awake local anaesthesia with no tourniquet (WALANT) in many elective hand and wrist elective surgeries (Lalonde, 2015) . Wide - awake local anaesthesia approach of surgery is characterized by administration of a mixture of local anaesthetic for pain control and adrenaline for hemostasis into the operative site (Warrender et al., 2018) . The principle behind this technique is that the local anaesthetic results in an extravascular Bier block only at the desired site. Bicarbonate is added to reduce acidity of the operating field (Lalonde, 2013).

The advantages of wide - awake approach have been discussed in many literature (Lalonde, 2013) (LeBlanc et al., 2007) . No sedation is required therefore eliminating the need for preoperative assessment, intravenous insertion, intraoperative and postoperative monitoring (Lalonde, 2013) . No tourniquet is required, hence patient is more comfortable and reducing tourniquet associated complication (Lalonde & Martin, 2014) . Tourniquet associated risks include pain, paralysis, nerve palsy, compartment syndrome, skin complications including necrosis and rhabdomyolysis (Steiner & Calandruccio, 2017) (Kamath et al., 2016) (Koegst et al., 2011) (Gangadharan et al., 2020) . The surgeon can constantly communicate with patient throughout the surgery, therefore patient general well being can be assess while providing them greater insight regarding the ongoing surgery (MacNeill & Mayich, 2016) . It is proven efficient and effective, with low complication rate, high patient satisfaction and cost savings (Lalonde, 2013) . It is and alternative for patient with multiple comorbidities such as cardiovascular event or poor lung function, which are unsuitable for general anaesthesia (MacNeill & Mayich, 2016) . It does not require a highly demanding technique such as giving a sciatic or popliteal block and can easily performed at operation theatre without ultrasound device.

Wide - awake local anaesthesia is gaining popularity in the field of foot and ankle surgery particularly involving the forefoot, as evidence in previous studies (MacNeill & Mayich, 2016) . Documented foot and ankle surgeries in which WALANT technique has been used as the form as anesthesia includes procedures focused on addressing structural deformities and tendon pathologies, such as bunion

correction, hammertoe repair, fusion of the first metatarsophalangeal joint, flatfoot reconstruction, Achilles tendon lengthening, and ankle trauma fixations (Bugada et al., 2017) . The evidence for wide - awake technique in ankle trauma fixation is limited. This study aims to present a case series of 6 patients using wide - awake technique for bimalleolar fracture fixation.

2. Methodology

We report six cases of bimalleolar fractures surgery using wide - awake local anaesthesia technique. Four of the cases were performed in Hospital Universiti Kebangsaan Malaysia (HUKM), Cheras and the remaining 2 cases, in Hospital Cyberjaya (HCJ), Selangor between August 2023 and August 2024. Surgeries were performed by the senior orthopedic surgeon of both the centers, respectively. The 4 patients in HUKM were admitted and had the procedure done as in - patients whereas the 2 patients in HCJ had the surgery done as ambulatory care (daycare)

Our inclusion criteria were patients with acute closed lateral malleolar fractures without or without syndesmotic injuries, simple medial malleolus fractures that can be adequately fixed with screw fixation technique, ASA grade 1 or 2, and no contraindication to WALANT technique. Exclusion criteria were patients with open fractures, Maisonneuve fracture, trimalleolar fractures, comminuted medial malleolus fractures that require plate osteosynthesis, peripheral vascular disease, poorly controlled diabetes, BMI of 34 and above and any contraindications to WALANT technique. Patients with lower limb infections or who had surgeries involving intramedullary devise such as nailing were also excluded. An informed written consent was taken from the patient explaining the WALANT technique.

Contraindication to WALANT technique includes patient unwilling to be awake during surgery, anxiety disorder, lack of cooperative patient, inability to comply with instructions, alcohol or substance abuse, history of neurological deficits affecting the operative extremity, and history of complex regional pain syndrome.

Parameters measured were pain and anxiety scores using visual analog scale and Hamilton anxiety rating scale at multiple time points preoperatively, intraoperatively and postoperatively. Other parameters were surgical time, blood loss and intraoperative anaesthesia related complications.

3. Case Report

1) A 63 years old male who alleged fall in toilet due to slippery floor. He fell forward and twisted his left ankle. Post trauma he complaint of pain, swelling and deformity over his left ankle. He is unable to stand or walk. Radiograph reveal fracture - subluxation of left ankle evidence by displaced fracture of medial malleolus and comminuted fracture of lateral malleolus with disruption of the syndesmotic joint (Fig.1a). Close manipulation reduction and backslab was applied to stabilize the fracture site. The limb is elevated and cryotherapy was applied prior to surgery.
2) A 76 years old female with background history of Hypertension. She tripped and twisted her left ankle in a slippery toilet. Post trauma she complaint of pain, swelling and inability to walk. Her skin and soft tissue condition is good with minimal bruises. Radiograph show fracture over the lateral malleolus at the level of syndesmosis and fracture of the medial malleolus with intraarticular extension (Fig 1b). There is no comminution or widening of the syndesmosis.
3) A 48 years old lady with underlying Hypothyroidism and Rheumatoid arthritis. She lost balance in the slippery kitchen and fell down. Her left ankle is twisted and inverted. Following the injury she complaint of pain and swelling over her left ankle. Radiograph show oblique fracture over the lateral malleolus with avulsion fracture of the medial malleolus. No widening of the syndesmosis. (Fig.1c)
4) A 27 years old male alleged fall while doing parasailing at the beach. He was hit by a strong wind and landed awkwardly on his right ankle. Following injury, he sustained pain and swelling over the right ankle. Radiograph reveal undisplaced oblique fracture of lateral malleolus with widening of the syndesmotic joint. No fracture involving the medial malleolus or the articular surface. (Fig.1d)
5) A 32 years old male, alleged road traffic accident while riding a motorcycle. He was hit by a car coming from the wrong direction. Following impact, he sustained injury to his left lower limb. Radiograph shows comminuted fracture of lateral malleolus, Weber B, with displaced medial malleolar fracture and widening of syndesmotic joint space. (Fig.1e)
6) A 45 - year - old gentleman with a history of type 2 diabetes mellitus (well controlled with oral medication), presented to our institution after sustaining an ankle injury. He was working at a construction site when he slipped and fell onto his right ankle. Radiographs demonstrated lateral malleolus fracture with no signs of syndesmotic disruption. (Fig.1f)

All six patient's clinical and radiological evaluation were consistent with Weber B fracture of the lateral malleolus. Patients were given the option of wide - awake local anaesthesia versus regional/general anaesthesia. Advantage and disadvantages of the technique explained. All patients agreed for WALANT and informed consent signed. All patients underwent open reduction and internal fixation with plate and screws according to standard procedure. Four patients underwent plating of the fibula with 3.5mm locking plate and 2 patients with a 3.5mm non - locking one third tubular fibula plate. All medial malleolus fractures underwent open reduction and screw fixation with 2 3.5mm fully threaded cortical screws. Syndesmotic disruptions were fixed using a single 3.5mm screw, with a fixation of 3 cortices.

Figure 1: Radiograph of the ankle of respective patient showing fracture involving the medial and lateral malleolus.

Anaesthetic Technique

The technique was standardized with all patients, in both the centers. The WALANT solution was prepared and administered by the surgeons themselves for all patients in the similar manner.100ml normal saline drip bottles were used as the dilutional agent, where - in 61ml of Saline were aspirated out leaving the bottle to contain 39ml of normal saline. The bottle was then added - in with 50ml of Lignocaine 2%, 10ml of Sodium Bicarbonate and 1ml of adrenaline (1: 1000), making it altogether 100ml of "cocktail". The WALANT solution was then aspirated into several 10cc syringes and labelled. The patients were wheeled into the operation room, and positioned supine with sandbag below the ipsilateral hip region to stabilize the limb in anatomical position. The surgical site and the area for local infiltration of the anaesthesia was marked. The distal half of the leg was then cleaned with alcohol, and positioned on the green sterile cloth.

The needle for initial injection was positioned 90 degrees to the skin. Using a 27 Gauge needle, one to 2 ml of local anaesthesia infiltrated subcutaneously until the formation of a wheal was apparent. The "blow slow before you go" injection technique was used here where - in, the anesthetic is injected slowly before the needle is progressed down to bone. Once at the periosteum, fan technique was used to administer 2 to 3 ml of anesthetic solution onto a wider area of periosteum (subperiosteal block).

A larger needle of 22G was then used, and the same step is repeated along the planned incision line at the distance of 2 to 3cm apart until all the marked area were adequately anaesthetized. The syndesmosis was further blocked by injecting 2 to 3ml of local anaesthesia from anterior, approximately 3 to 4 cm proximal to the ankle joint line (Fig 2c). A total of 20ml of local anaesthesia was injected in each patient.

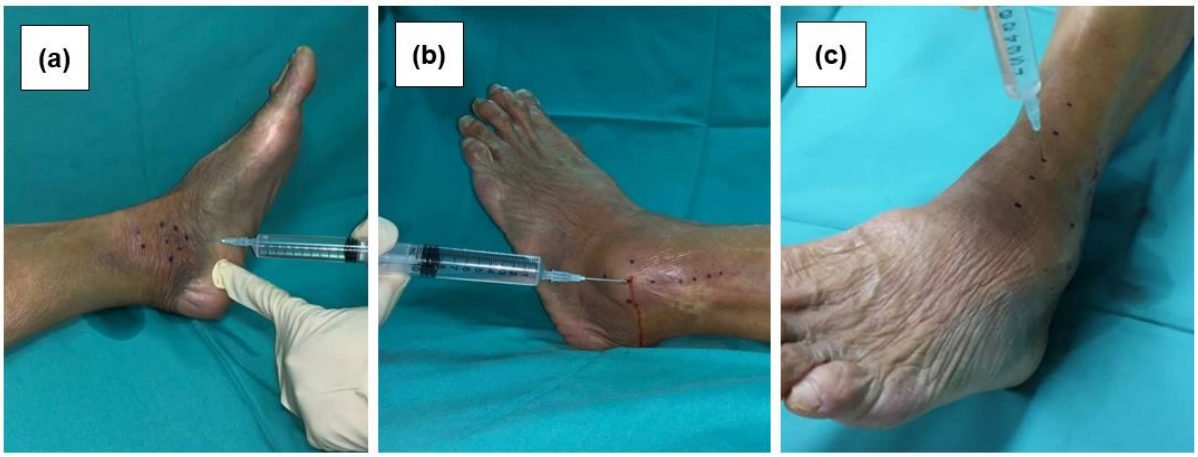

Figure 2: (a) Local anaesthesia given over the medial malleolus. (b) Local anaesthesia given over the lateral malleolus. (c) Local anaesthesia administered into the syndesmotic joint from anterior.

Surgical Procedure

After administration of the WALANT solution, we allow a 20 minutes delay until full local anaesthesia was achieved. During which, the surgeon and assistant scrubbed up, cleaned and draped the limb from foot to knee under aseptic technique.

Before the start of surgery, the adequacy of anaesthesia was first tested by palpation the fracture site and pinching the skin with a Gillis forceps. The patient's response to the stimuli was acknowledged. Once the patient confirmed that the pains score was zero on pinching, the incision was made. Lateral incision was made and soft tissue released until reach the bone. The fracture site is cleared of haematoma, debrie and soft tissue interposition (Fig 3a). Fracture is reduced and held with a bone clamp.

Plate and screws inserted according to standard procedure. Four patients underwent plating of the fibula with 3.5mm low profile distal fibula lock plate (Fig 3c) and 2 patients with a 3.5mm non - locking one third tubular fibula plate (Fig 3b). All medial malleolus fractures underwent open reduction and screw fixation with 2 3.5mm fully threaded cortical screws.

Syndesmotic disruptions were fixed using a single 3.5mm screw, with a fixation of 3 cortices.

If patient complaints of pain during drilling, additional 2 to 3 ml of local anaesthesia is injected into the periosteal layer on the medial aspect of fibula (Fig 3b), without exceeding the safe limit of 7mg/kg for lignocaine with adrenaline. Throughout surgery the surgeon regularly communicates with the patient to assess pain and anxiety especially during skin incision, deep dissection, fracture reduction and during plate and screw insertion. Patients do give regular feedback during surgery, and do convey that they feel sensation of movement and pulling during fracture reduction and fixation without any pain which is considered normal. Occasionally reassurances were given intraoperatively.

Pain is scored using standard Visual Analogue Scale (VAS) scoring, blood pressure and heart rate is documented in every step. VAS is also assessed at 30 minute and 2 hours after operation. After hardware insertion the surgeon do instruct the patients to perform dorsiflexion and plantarflexion to assess stability of fixation. Wound is then wash and close accordingly. Systemic side effect of local anaesthesia such as nausea, headache, palpitation, sweating and itchiness is also assessed.

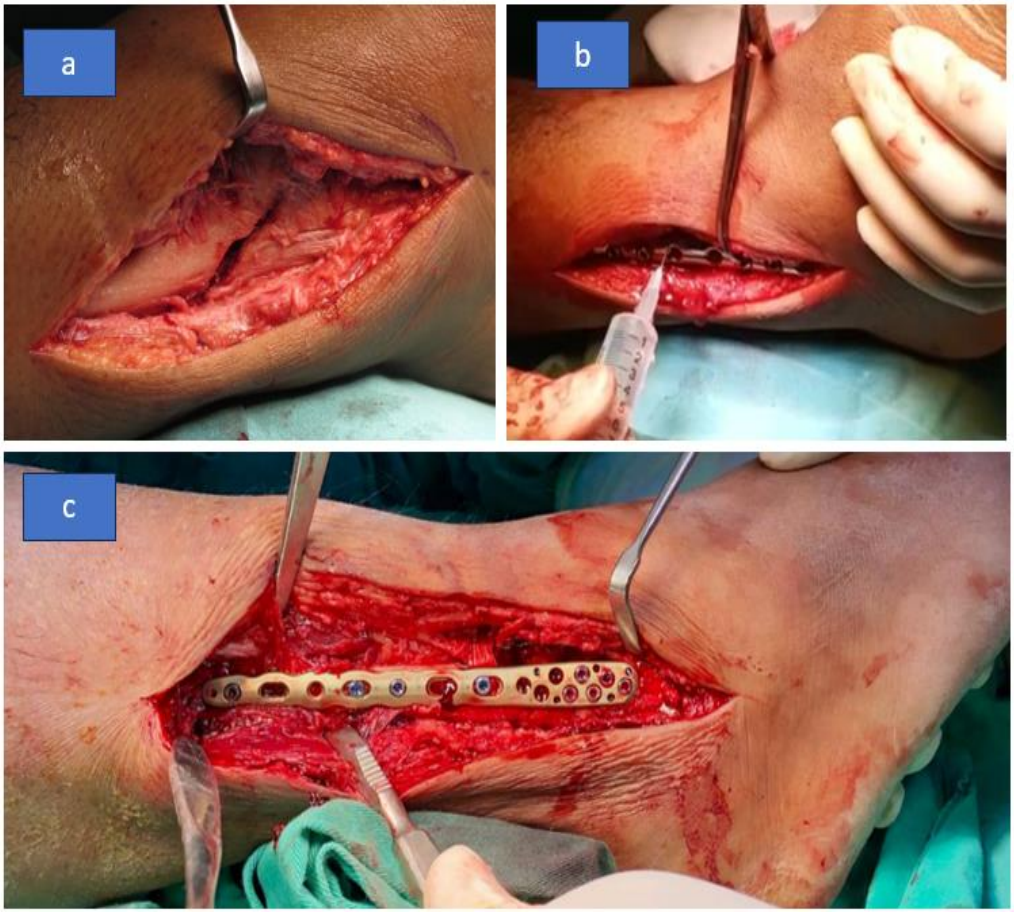

Figure 3: (a) The fracture site is cleared prior to insertion of implant. (b) Additional 2 to 3 ml of local anaesthesia introduced to the medial aspect of fibula via the drill hole. Fixation with a non - locking 1/3rd tubular fibular plate. (c) A completed fixation with a low - profile distal fibula lock plate.

Post Surgical Care

Once dressing has been applied over the closed wound, a below knee backslab (short splint) was applied to protect the fixation and to immobilize the foot in plantigrade position. Patient vital signs is monitored at the recovery bay. Pain score reassessed at 30 minutes and 2 hours after the operation. The 4 patients that had their surgery done in HUKM were inpatients - the limb is elevated on a pillow and the patients vital signs, pain score and peripheral circulation was monitored. The wound is inspected on day two of surgery and discharge home after wound condition is satisfactory. The 2 other patients that had their surgery done in HCJ were done as a daycare procedure, where - in the patients were discharged well from the daycare ward 3 hours after surgery, and seen in the orthopaedic specialist clinic on day 3 of surgery for wound inspection. All patients were later seen in their respective orthopaedic specialist clinics 2 weeks post - op for wound inspection and removal of skin sutures.

4. Results

In our study, patient reported low level of intraoperative and postoperative pain. Maximum intraoperative VAS was 2/10 according to standard Visual Analogue Score (VAS). Three patients reported no pain throughout the perioperative period, while another three reported pain scores of 1 to 2 intraoperatively, and reduce to zero or 1 postoperatively. Preoperative anxiety score results varied from as low as 1 to as high as 8. However, all patient report that postoperative anxiety is markedly reduce with median score of 1.5. The duration of surgery ranges from 1 hour 50 minutes to 2 hours

and 35 minutes. No patient required change to regional or general anaesthesia. No patient exceeding maximum dose of 7mg/kg. There is also no reported local or systemic complication. Without the use of tourniquet, estimated blood loss range from 50cc to 300cc. The patient's demographics, fracture classification, and perioperative variables including VAS and anxiety scores prior to until after the surgery are tabulated into Table 1. Patients in the ambulatory ward were discharged well 3 hours post operatively.

Table 1: Demographic data, fracture pattern, VAS and Anxiety Score, and intraoperative parameters

Case	1	2	3	4	5	6
Gender	Male	Female	Female	Male	Male	Male
Age	63	76	48	27	32	45
Admission/daycare	Ward	Ward	Ward	Ward	Daycare	Daycare
Fracture type	BM	BM	BM	LM	BM	LM
Weber classification	B	B	B	B	B	B
Syndesmotic disruption	Y	N	N	Y	Y	N
VAS preoperatively	0	1	0	1	2	0
VAS intraoperatively	0	1	0	1	2	0
VAS 30 minutes postoperatively	0	1	0	0	1	0
VAS 2 hours postoperatively	0	0	0	0	0	0
Preoperative anxiety score	2	6	8	3	3	1
Postoperative anxiety score	1	2	2	2	1	1
Intraoperative blood Loss (ml)	120	300	50	150	100	150
Surgery duration (minutes)	127	155	110	125	122	140
Complications	-	-	-	-	-	-

Abbreviations: BM – Bimalleolar fracture; LM – Lateral malleolar fracture; VAS – Visual Analog Score

5. Discussion

The purpose of this study was to perform a prospective analysis of pain, anxiety and complication associated with wide - awake surgery. Results were consistent with past study involving wide - awake hand surgery and foot surgeries (Teo et al., 2013) (Bajuri et al., 2022) , where patient who receive wide - awake local anaesthesia reported less intraoperative pain. Other study show that intraoperative pain was typically negligible and significantly less than the day - to - day pain that characterized patients' injuries or conditions (MacNeill & Mayich, 2016) . The reported postoperative pain is as low as zero. This is attributed to short duration of surgery that allow longer action of analgesia and correct technique of administration of analgesia, whereby the local anaesthesia is given subcutaneously and subperiosteally to address the nerve endings. A prospective study comparing general anaesthesia and wide - awake local anaesthesia suggest that the given anaesthesia blocks the transmission of pain signal during surgery whereby general anaesthesia put the patient unconscious but does not block the synaptic transmission (Wright et al., 2017) . This explains the low level of postoperative pain.

Regarding perioperative anxiety, three out of six patients report low level of anxiety and one patient report higher level of anxiety. The high anxiety is probably attributed to patient with previous history of successful surgery under regional anaesthesia and her understanding of the whole procedure despite thorough explanation. Nevertheless, all the patients show significant low level of postoperative anxiety. This result is consistent with previous studies that show patient's anxiety was low and showed a steady decline over the duration of the perioperative period.

The other concern about surgery without tourniquet is blood loss. Huang et al reported that the average blood loss in distal radius fracture treated with wide - awake local anaesthesia no tourniquet technique is 18.9ml (Huang et al., 2018) and the mean estimated blood loss for WALANT surgery of the lower limb was 91ml (Bajuri et al., 2022) . However, the amount of blood loss in the conventional tourniquet group may be significantly higher than that in the no tourniquet group because of the blood oozing that occurs following release of tourniquet. The highest documented intraoperative blood loss in our series is 300cc. This is possibly due to the injury sustained two weeks prior to surgery. It is understandable that the later the surgery, the more fibrous tissue and soft callus develop, hence the more bleeding. For this reason, we would recommend to proceed with general or regional aenesthesia with the use of a tourniquet in cases with possibility of significant callus, scar tissue or fibrous tissue.

When asked about their future anaesthetic preferences, one patient was unsure whether they would recommend wide - awake technique for a similar procedure, whilst the remaining 5 patients would 'probably' choose WALANT for the same procedure. This result is consistent with previous studies where - in 87% of patients would prefer to WALANT for a similar procedure (MacNeill & Mayich, 2016) .

The limitations of this study include smaller sample size and lack of control group.

6. Conclusion

This case series investigation confirmed the low levels of pain and anxiety experienced by patients undergoing ankle fracture fixations utilizing the wide - awake local anaesthesia no tourniquet technique. The WALANT approach for open reduction and internal fixation of ankle fractures is a safe intervention that offers an alternative option to mitigate postoperative pain, anxiety, and tourniquet - related complications. Without the need for sedation, patients were able to actively mobilize their ankle joints to assess the stability of the fixation intraoperatively. This procedure can

be performed in an outpatient setting, thereby avoiding potential delays associated with general anaesthesia scheduling

References

[1] Bajuri, M Y., Saidfudin, N S., Mazli, N., Azriq, N A., & Azemi, A F. (2022, September 9). Safety of wide - awake local anesthesia with no tourniquet (WALANT) in for lower limb surgery: A potential alternative in times of emergency. Frontiers Media, 9. https: //doi. org/10.3389/fsurg.2022.848422

[2] Bugada, D., Chelly, J E., & Mariano, E R. (2017, October 1). Continuous regional anesthesia: a review of perioperative outcome benefits. Edizioni Minerva Medica, 83 (10). https: //doi. org/10.23736/s0375 - 9393.17.12077 - 8

[3] Dale, M., & Checketts, M R. (2013, April 1). Complications of regional anaesthesia. Elsevier BV, 14 (4), 142 - 145. https: //doi. org/10.1016/j. mpaic.2013.02.011

[4] Gangadharan, R., Roslee, C., Kelsall, N., & Taylor, H. (2020, December 30). Retrospective review of complications following long tourniquet time in foot and ankle surgery. Elsevier BV, 16, 189 - 194. https: //doi. org/10.1016/j. jcot.2020.12.023

[5] Gaurav, S., Gunaki, R B., Patil, V., & Garud, A. (2019, April 1). A study of functional outcome of bimalleolar fracture after internal fixation. Orthopaedic Surgeon And Practitioner's Society, 5 (2.1), 64 - 69. https: //doi. org/10.22271/ortho.2019. v5. i2b.15

[6] Hoenig, M., Gao, F., Kinder, J M., Zhang, L., Collinge, C A., & Merk, B R. (2010, January 1). Extra - Articular Distal Tibia Fractures: A Mechanical Evaluation of 4 Different Treatment Methods. Lippincott Williams & Wilkins, 24 (1), 30 - 35. https: //doi. org/10.1097/bot.0b013e3181c29bc0

[7] Huang, Y., Hsu, C., Renn, J., Lin, K., Yang, S., Tarng, Y., Chang, W., & Chen, C. (2018, August 6). WALANT for distal radius fracture: open reduction with plating fixation via wide - awake local anesthesia with no tourniquet. BioMed Central, 13 (1). https: //doi. org/10.1186/s13018 - 018 - 0903 - 1

[8] Izzi, J A., Banerjee, R., Smith, A H., McGough, R L., & DiGiovanni, C W. (2002, December 1). Emergency Room External Fixation of Tibial Pilon Fractures. Lippincott Williams & Wilkins, 1 (2), 151 - 157. https: //doi. org/10.1097/00132587 - 200212000 - 00010

[9] Kamath, J., Shenoy, T., Jayasheelan, N., Rizwan, N., Sachan, V., & Danda, R S. (2016, September 1). Timed wake - up anaesthesia in hand: A modification to wide awake surgery of hand. Thieme Medical Publishers (Germany), 49 (03), 378 - 383. https: //doi. org/10.4103/0970 - 0358.197221

[10] Koegst, W H H., Wölfle, O., Thoele, K., & Sauerbier, M. (2011, June 1). Der „Wide Awake Approach" in der Handchirurgie – ein komfortables Anästhesieverfahren ohne Blutleere. Thieme Medical Publishers (Germany), 43 (03), 175 - 180. https: //doi. org/10.1055/s - 0031 - 1280762

[11] Koujan, K., & Saber, A Y. (2024, January 1). Bimalleolar Ankle Fractures

[12] Lalonde, D H. (2013, November 9). Minimally Invasive Anesthesia in Wide Awake Hand Surgery. Elsevier BV, 30 (1), 1 - 6. https: //doi. org/10.1016/j. hcl.2013.08.015

[13] Lalonde, D H. (2015, May 19). Wide awake local anaesthesia no tourniquet technique (WALANT). BioMed Central, 9 (S3). https: //doi. org/10.1186/1753 - 6561 - 9 - s3 - a81

[14] Lalonde, D H., & Martin, A. (2014, July 1). Tumescent Local Anesthesia for Hand Surgery: Improved Results, Cost Effectiveness, and Wide - Awake Patient Satisfaction. Thieme Medical Publishers (Germany), 41 (04), 312 - 316. https: //doi. org/10.5999/aps.2014.41.4.312

[15] LeBlanc, M., Lalonde, J., & Lalonde, D H. (2007, May 29). A Detailed Cost and Efficiency Analysis of Performing Carpal Tunnel Surgery in the Main Operating Room versus the Ambulatory Setting in Canada. SAGE Publishing, 2 (4), 173 - 178. https: //doi. org/10.1007/s11552 - 007 - 9043 - 5

[16] MacNeill, A L., & Mayich, D J. (2016, October 9). Wide - awake foot and ankle surgery: A retrospective analysis. Elsevier BV, 23 (4), 307 - 310. https: //doi. org/10.1016/j. fas.2016.09.004

[17] Reilley, T E., Terebuh, V D., & Gerhardt, M A. (2004, January 1). Regional anesthesia techniques for the lower extremity

[18] Steiner, M M., & Calandruccio, J H. (2017, November 14). Use of Wide - awake Local Anesthesia No Tourniquet in Hand and Wrist Surgery. Elsevier BV, 49 (1), 63 - 68. https: //doi. org/10.1016/j. ocl.2017.08.008

[19] Teo, I., Lam, W., Muthayya, P., Steele, K., Alexander, S., & Miller, G. (2013, January 24). Patients' perspective of wide - awake hand surgery — 100 consecutive cases. SAGE Publishing, 38 (9), 992 - 999. https: //doi. org/10.1177/1753193412475241

[20] Warrender, W J., Lucasti, C J., & Ilyas, A M. (2018, May 5). Wide - Awake Hand Surgery: Principles and Techniques. https: //journals. lww. com/01874474 - 201805000 - 00008

[21] Wright, J., MacNeill, A L., & Mayich, D J. (2017, November 6). A prospective comparison of wide - awake local anesthesia and general anesthesia for forefoot surgery. Elsevier BV, 25 (2), 211 - 214. https: //doi. org/10.1016/j. fas.2017.10.015