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ORIGINAL ARTICLE
Reconstructive

Successful Use of WALANT in Local and Regional Soft Tissue Flaps: A Case Series

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Background: The wide awake local anesthesia no tourniquet (WALANT) technique has been proven to be safe and effective for upper extremity surgery. WALANT does not require extensive medical clearance and allows for intraoperative assessment of range of motion. Additionally, it is frequently associated with lower costs and less postoperative pain when compared with traditional methods of anesthesia. Despite its expanded use for hand procedures, there are sparse data to support the use of WALANT in local and regional soft tissue flaps.

Methods: A retrospective review was performed. Twenty-one patients who underwent a local or regional soft tissue flap surgery using the WALANT technique from February 2, 2018 to February 25, 2022 were included in our analysis.

Results: Overall, one Louvre flap, two posterior tibial artery perforator propeller flaps, two reverse radial forearm flaps, two Quaba flaps, six cross finger flaps, one reverse homodigital island flap, three first dorsal metacarpal artery flaps, two thenar flaps, and two Moberg flaps were performed. Patients were followed up for an average of 11.9±8.1 weeks. During this time, no postoperative complications occurred. All patients demonstrated appropriate healing at donor and recipient sites. Full range of motion was regained for all patients.

Conclusions: WALANT is safe and effective for use in local and regional soft tissue flap surgery. Surgeons should consider this technique for more involved procedures such as flap surgery, as preliminary results demonstrate positive outcomes and potentially superior recovery for patients. *(Plast Reconstr Surg Glob Open 2023; 11:e4756; doi: 10.1097/GOX.0000000000004756; Published online 13 January 2023.)*

INTRODUCTION

The wide awake local anesthesia no tourniquet (WALANT) technique has been proven to be a safe and effective alternative to the traditional forms of anesthesia for the management of an array of upper extremity surgical procedures.[1] This method was first described by Lalonde for the management of local hand and soft tissue procedures.[2] In recent years, the literature has indicated that it may also be used for more involved upper extremity procedures such as distal radius fractures and zone V flexor tendon injuries.[3,4]

There are numerous benefits of WALANT over the typical anesthetic methods, such as local anesthesia with tourniquet and general anesthesia. WALANT does not require the extensive medical clearance required for general anesthesia, and therefore allows for administration in patients who may be at a high risk under general anesthesia.[5] It may be performed in a procedure room of an office, rather than in a large operating theater, given the minimal equipment that it requires. Only one nurse, in addition to the operative surgeon, is needed for the surgery; the presence of an anesthesiologist is not required.[1] All such benefits reduce the cost

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of the WALANT case when compared with the same procedure performed in an operating theater.[6–9] In addition, WALANT eliminates the pain associated with tourniquet use in local anesthesia with tourniquet, while still allowing the patient to be awake to assess range of motion.[10–14]

Despite the expanded use of WALANT for many hand procedures, there are sparse data to support the use of WALANT in local and regional soft tissue flaps. This is likely because of concern for flap necrosis due to the vasoconstrictive effects of epinephrine. Fortunately, epinephrine causes vasoconstriction of arterioles and venules, not capillaries, thereby allowing it to be used in flap cases without threatening flap survival.[15] Epinephrine use has even been shown to be safe for digital revascularization procedures performed using the WALANT technique.[16]

We have had excellent success with the use of WALANT for a variety of local and regional soft tissue flaps, both on the upper and lower extremities. In this retrospective case series, we present 21 patients who underwent WALANT for local or regional soft tissue flaps. We describe the technique for administering the anesthetic for local and regional flaps and will review the associated outcomes. Additionally, the existing literature regarding the use of WALANT in local and regional soft tissue flaps will be discussed.

Takeaways

Question: Can WALANT be safely applied to local and regional soft tissue flaps?

Findings: One Louvre flap, two posterior tibial artery perforator propeller flaps, two reverse radial forearm flaps, two Quaba flaps, six cross finger flaps, one reverse homodigital island flap, three first dorsal metacarpal artery flaps, two thenar flaps, and two Moberg flaps were performed under WALANT. No post- or intraoperative complications occurred. Surgeons should consider this technique for more involved procedures such as flap surgery, as preliminary results demonstrate positive outcomes and potentially superior recovery.

Meaning: WALANT is safe and effective for use in local and regional soft tissue flap surgery.

MATERIALS AND METHODS

A retrospective case series was performed with a total of 21 patients. All patients who underwent a local or regional soft tissue flap using the WALANT technique, by a single surgeon from February 2, 2018 to February 25, 2022 were included. Patients were excluded if the WALANT technique was not used for their local or regional soft tissue flap.

Demographic data, including the patient's age, sex, laterality, and location of injury were collected. Flap size and dosage of anesthetic used were also evaluated. Postoperative complications and postoperative range of motion were assessed.

RESULTS

A total of 21 patients were included in our analysis and were composed of 16 male and five female patients with a mean age of 37.2±15.6 years (range: 8–62 years). Nine different types of flaps were performed, the most common of which was a reverse cross finger flap (Fig. 1). Six right hands, 13 left hands, and two right ankles were included as recipient sites. Of the operative hands, six thumbs, two index fingers, five middle fingers, two ring fingers, three small fingers, and one first webspace, were the recipient sites (**See table, Supplemental Digital Content 1,** which displays demographic, treatment, and follow-up information. **http://links.lww.com/PRSGO/C341**). Overall, one randomized, pedicled flap from the abdomen (Louvre flap), two posterior tibial artery perforator propeller flaps, two reverse radial forearm flaps (RRFF) two distally pedicled dorsal metacarpal artery perforator flaps (Quaba flaps), six cross finger flaps, one reverse homodigital island flap, three first dorsal metacarpal artery flaps (FDMA), two thenar flaps, and two volar advancement flaps (Moberg flaps) were performed (Figs. 1–7).

Flap size and local anesthesia dosage varied based upon location and flap type (**SDC1**, **http://links.lww.com/PRSGO/C341**). Local anesthesia was composed of lidocaine with epinephrine 1% at 1:100,000. The author did not dilute the injectate for tumescent anesthesia and regularly will inject dosages up to 22 mg/kg.[17] Finger, arm, or leg tourniquets were not used in any cases. There were

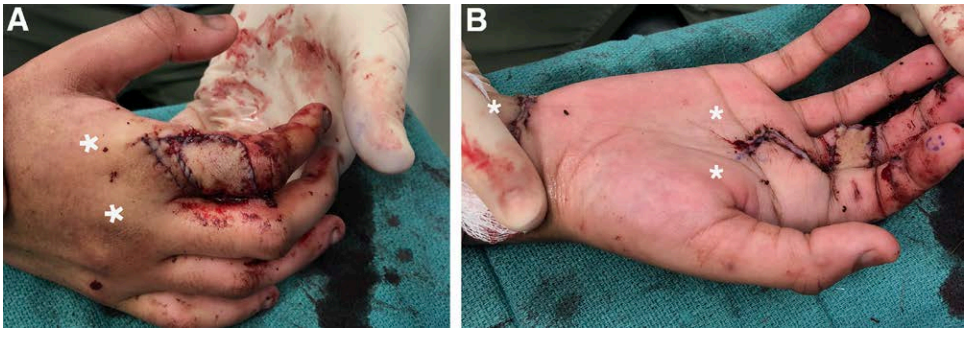

Fig. 1. Intraoperative and postoperative images of regional flap coverage performed by a single surgeon using WALANT technique. Pictures of the reverse cross finger flap postoperatively (A, B), with asterisks denoting injection sites. In total, 25 cm^3 of 1% lidocaine with epinephrine 1:100,000 was injected at five sites, consisting of 5 cm^3 at each site.

Fig. 2. Intraoperative and postoperative images of regional flap coverage performed by a single surgeon using WALANT technique. Pictures of the Louver flap immediately postoperatively (A) and 12 weeks postoperatively (B). An estimated 25 cm^3 of 1% lidocaine with epinephrine 1:100,000 was injected at five sites, consisting of 5 cm^3 at each site.

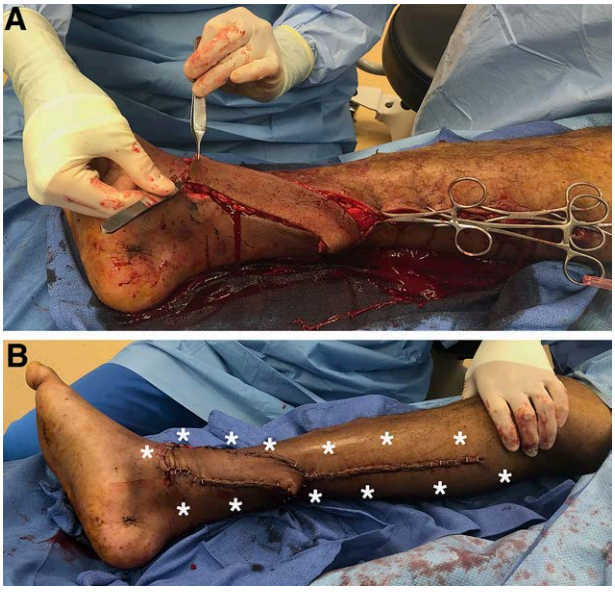

Fig. 3. Intraoperative and postoperative images of regional flap coverage performed by a single surgeon using WALANT technique. Pictures of the posterior tibial artery perforator propeller flap intraoperatively (A) and immediately postoperatively, with asterisks denoting injection sites (B). In total, 130 cm^3 of 1% lidocaine with epinephrine 1:100,000 was injected at 13 sites, consisting of 10 cm^3 at each site.

no intraoperative complications. Patients were followed up for an average of 11.9±8.1 weeks. During this time, no postoperative complications were noted. All 21 patients demonstrated appropriate healing at the donor and recipient sites. Full range of motion was regained for all patients.

Anesthetic Techniques

Epinephrine vasoconstricts arterioles and venules, but not capillaries.[15] This principle allows for the use of epinephrine in flap cases, without threatening flap survival. The chief consideration for injection of anesthesia in local and regional flaps is that epinephrine should only be injected adjacent to the incision for flap harvest, not over, or deep to, the vascular pedicle. For more involved flaps such as the reverse radial forearm flap, our anesthesia technique consists of injecting up to 130 cm^3 of 1% lidocaine with epinephrine 1:100,000 at 13 injection sites adjacent to the incision, consisting of 10 cm^3 at each site (Fig. 4C). Care is taken to avoid injection adjacent to the radial artery. This can be achieved by mapping the course of the artery with preoperative Doppler. Similarly, for the posterior tibial artery perforator propeller flap, 130 cm^3 of 1% lidocaine with epinephrine 1:100,000 is injected at 13 sites adjacent to the incision, consisting of 10 cm^3 at each site (Fig. 3B). We allowed 1 hour for anesthesia to take effect before making the incision in both types of regional flap procedures to achieve a hemostatic field.

Workflow

Prior to surgery, patients undergoing WALANT procedures are taken into a holding area, and are consented,

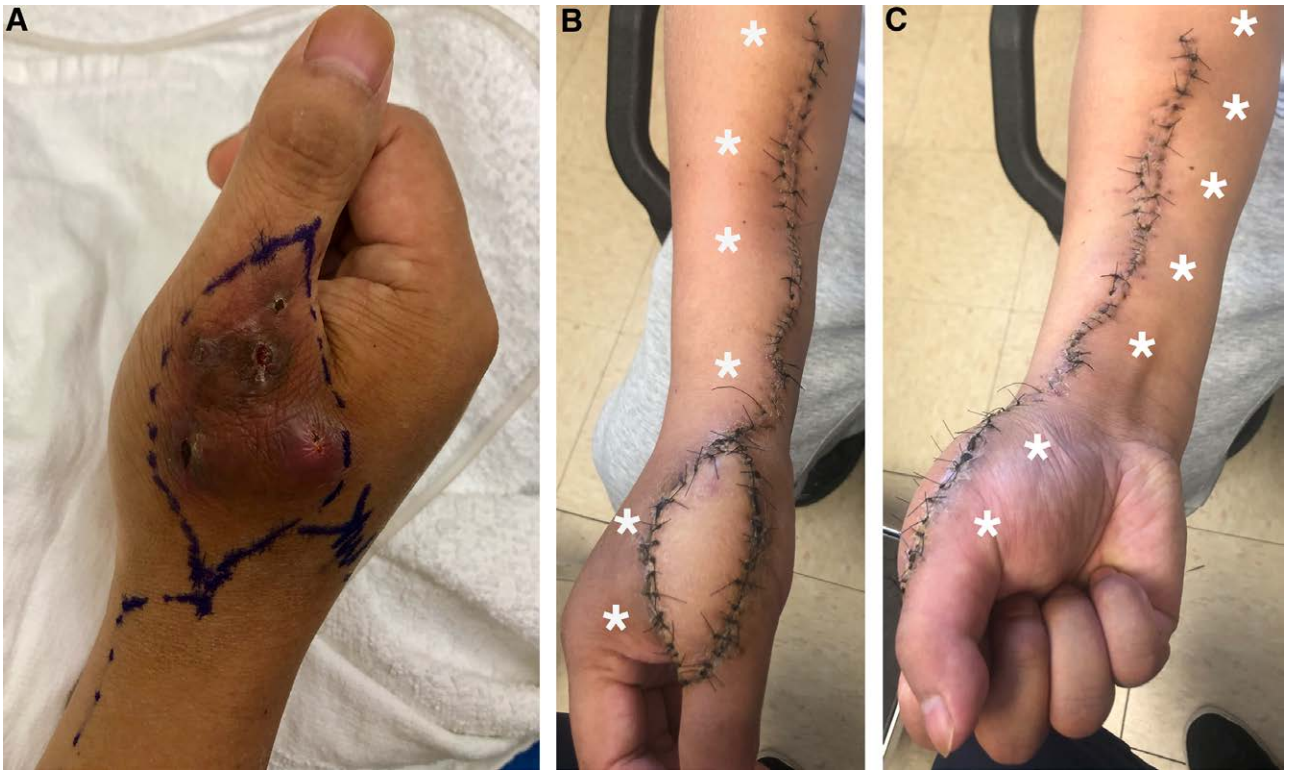

Fig. 4. Intraoperative and postoperative images of regional flap coverage performed by a single surgeon using WALANT technique. Pictures of the reverse radial forearm flap preoperatively (A) and postoperatively with asterisks denoting injection sites (B, C). An estimated 130 cm^3 of 1% lidocaine with epinephrine 1:100,000 was injected at 13 sites, consisting of 10 cm^3 at each site.

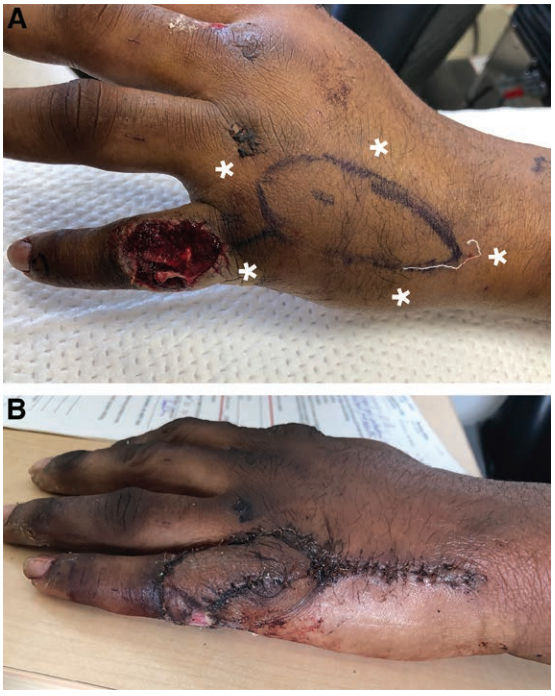

Fig. 5. Intraoperative and postoperative images of regional flap coverage performed by a single surgeon using WALANT technique. Pictures of the Quaba flap preoperatively with asterisks denoting injection sites (A) and postoperatively (B). In total, 25 cm^3 of 1% lidocaine with epinephrine 1:100,000 was injected at five sites, consisting of 5 cm^3 at each site.

prepped with povidone iodine, and injected with 1% lidocaine with epinephrine 1:100,000. There is no monitoring of patients during this time. Ensuring an optimal order in which patients receive injections and undergo procedures is critical. In our experience, the workflow depicted in has proven success (Fig. 8).

In this series, flap surgery took no longer than 2 hours. For longer procedures, patients are given an iPad with access to TV to facilitate comfort and relaxation. On average, patients remain anesthetized for 5–7 hours total. This is due to the epinephrine potentiating the lidocaine effect. The epinephrine effect dissipates around 3–4 hours and is a slow taper-off once operating.

Patient Considerations and Contraindications

Patients with vascular diseases, Raynaud phenomenon, scleroderma, Buerger disease, or vasculitis are not suitable for flap surgery under WALANT.[1,18] Furthermore, patients with allergies to lidocaine or epinephrine do not qualify for WALANT.[1] Patients' personalities should be taken into consideration, as well as any psychological conditions. Wide-awake procedures may not be appropriate for certain patients. It is important that surgeons provide an accurate, realistic description of the WALANT technique as well as the administration of the anesthetic before surgery so that patients can make informed decisions about their procedure. At our center, we have found that with proper counseling, most patients choose to undergo WALANT

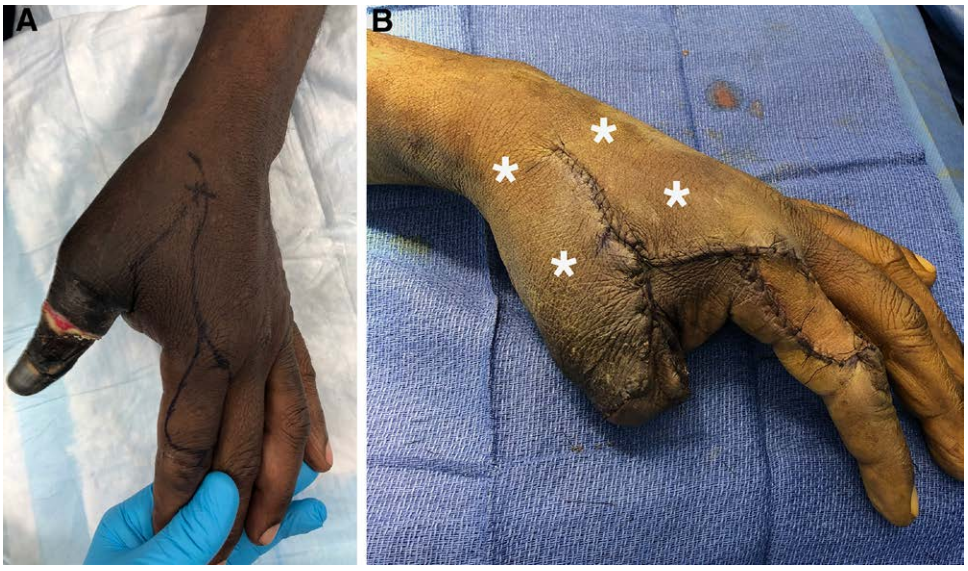

Fig. 6. Intraoperative and postoperative images of regional flap coverage performed by a single surgeon using WALANT technique. Pictures of the first dorsal metacarpal artery flap preoperatively (A) and postoperatively with asterisks denoting injection sites (B). In total, 20 cm^3 of 1% lidocaine with epinephrine 1:100,000 was injected at four sites, consisting of 5 cm^3 at each site.

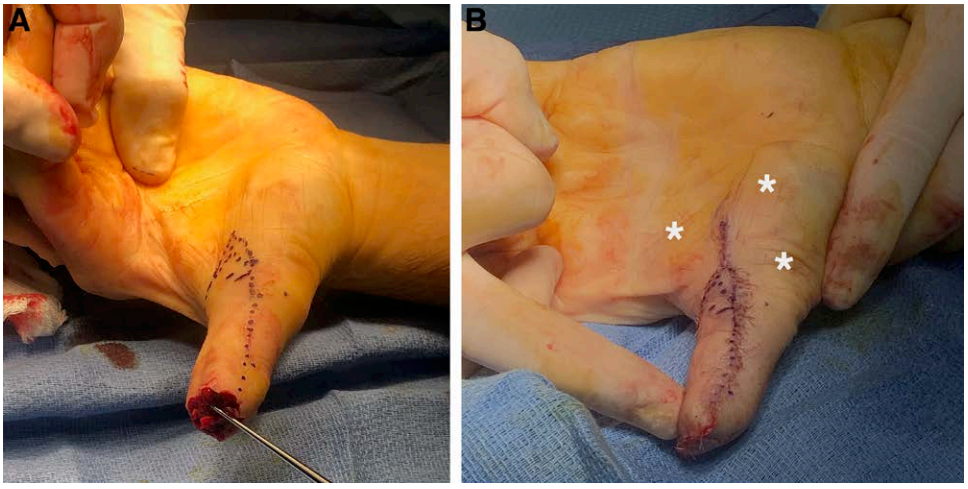

Fig. 7. Intraoperative and postoperative images of regional flap coverage performed by a single surgeon using WALANT technique. Pictures of the Moberg flap preoperatively (A) and postoperatively with asterisks denoting injection sites (B). An estimated 15 cm^3 of 1% lidocaine with epinephrine 1:100,000 was injected at three sites, consisting of 5 cm^3 at each site.

surgery. We have also found that preoperative video viewing and hearing patient testimonials makes patients more comfortable and enthusiastic about WALANT.

As expected, patients may experience anxiety or stress during or after receiving anesthetic injections. It is important that surgeons are prepared to provide comfort and counseling to patients during these situations. Additionally, patients may experience an adrenaline rush during or after anesthesia administration.[17,19] Preemptive counseling is important here because it can relieve concern in patients. These symptoms usually dissipate quickly. Finally, injecting patients supine and/or elevating their feet helps alleviate any vasovagal symptoms.[20]

DISCUSSION

Local and regional soft tissue flaps can be safely performed using the WALANT technique. In our study of 21 patients, followed up for an average of 11.9±8.1 weeks, no complications were reported. Furthermore, all patients regained full range of motion postoperatively.

To our knowledge, there are only four articles that address the WALANT technique and flap surgery. The earliest report of use of the WALANT technique for flap surgery was Wong et al, who described the use of WALANT for five digital revascularization procedures and eight amputations (13 digits) in 2017.[16] The authors utilized 2% lidocaine with 1:100,000 epinephrine, which allows for 10

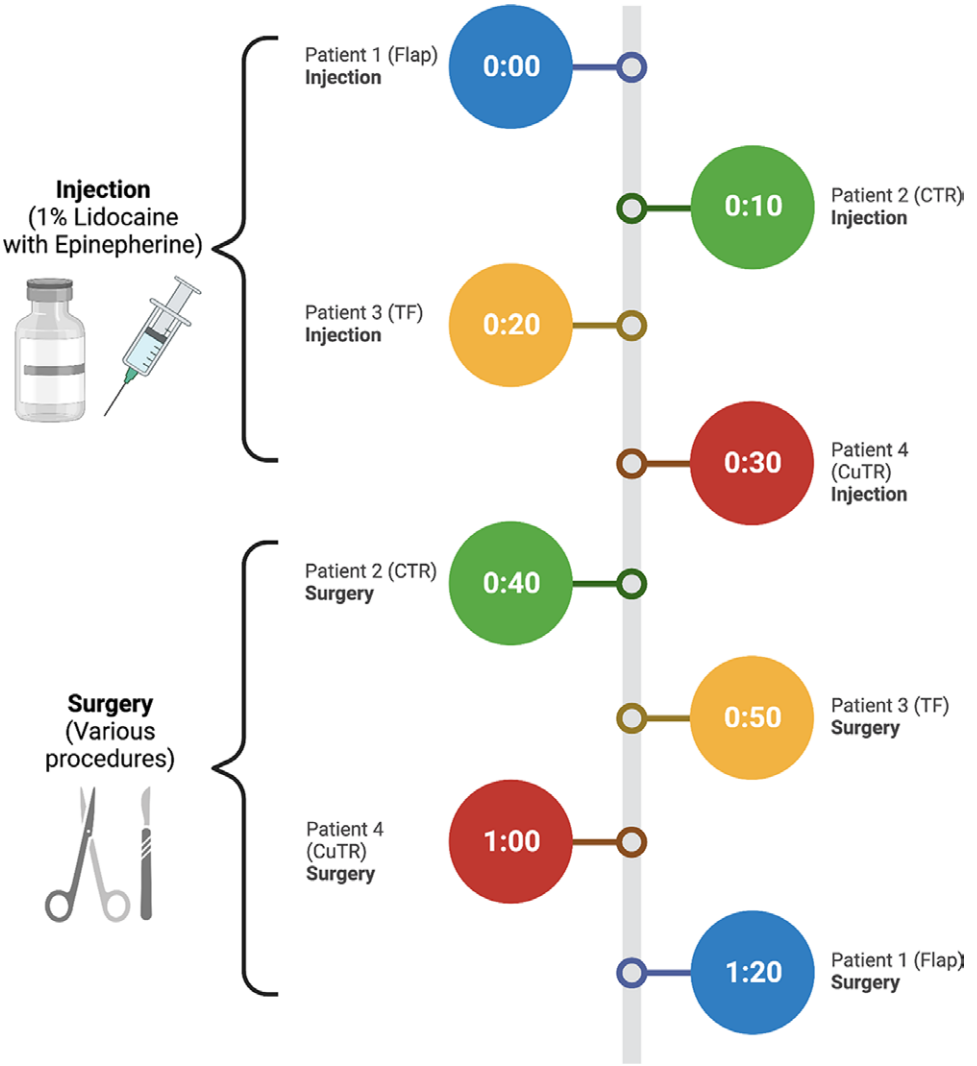

Fig. 8. This diagram depicts a typical workflow for one WALANT flap procedure and three smaller, standard WALANT procedures [Carpal Tunnel Release (CTR), Trigger Finger Release (TF), and Cubital Tunnel Release (CuTR)]. Four patients are brought in at once, one flap and three regular cases (ie, CTR, TF, and CuTR). The flap is injected first and the patient is instructed to wait. The remaining 3 patients are then injected. Once the fourth patient is injected and consented, the second patient is taken into the procedure room and surgery begins. This workflow allows enough time, 25–35 minutes, for the local anesthetic to take effect after each injection. After the second, third, and fourth patient undergo surgery, the flap case is begun. If there are more WALANT cases, those patients are consented and injected during the turnover time in between procedures. This allows enough time for the local anesthetic to take effect and eliminates waiting time in the OR.

hours of anesthesia, as originally described by Lalonde in 2005.[21] With an average of 7 months follow-up, Wong and colleagues reported that at least partial recovery was achieved in all cases and that all patients returned to work. Four patients had minor superficial necrosis, which healed by secondary intention. This report laid the groundwork for future studies on the application of WALANT for flap procedures.

Xing and Tang conducted a study in 2019, in which WALANT was utilized in 27 patients who underwent extended Segmuller flaps, homodigital reverse digital artery flaps, Atasoy flaps, and dorsal metacarpal artery perforator flaps.[22] In contrast to Wong et al, the authors used 1% lidocaine with 1:100,000 epinephrine buffered with 8.4% sodium bicarbonate in a 10:1 ratio. Blood supply was adequate for all flaps, no patients required termination of the procedure because of pain, and all flaps, except for one, survived without ischemia. Phentolamine was used for one dorsal metacarpal artery perforator flap to help verify its vascular supply, and one patient in the extended Segmuller flap group experienced partial necrosis at the most distal part of the flap, which healed without further surgery. The authors hypothesized that this occurred because epinephrine was injected close

to or in the perforator, demonstrating the importance of avoiding epinephrine injection in the vicinity of the pedicle. Although the authors only had to use phentolamine in one patient, they suggest injection of lidocaine with epinephrine 15 minutes before the flap harvest, and injection of phentolamine immediately after flap transfer to assess perfusion and viability of perforator flaps. In our study, phentolamine was not utilized, with no penalty to flap outcomes, and we do not advocate for its routine use. However, this study highlights the importance of having phentolamine readily available for emergency rescue while performing flap procedures under WALANT.

A larger-scale study was conducted in 2019 by Tang et al, who analyzed outcomes of 12,000 patients who underwent WALANT surgery in two centers in China.[23] Of the 12,000 patients, 50 were flap cases. Surgeons utilized WALANT flap techniques described in Xing and Tang's earlier article.[22] Notably, the authors describe applying a temporary tourniquet for 5 minutes for patients who had open hand trauma in order to reduce active bleeding at the trauma site and allow 5 minutes for the epinephrine to take effect. This is in contrast to prior studies as well as our study, in which a tourniquet was not used in any cases.

In a more recent study, published in 2021, Xu et al describe the application of the WALANT technique for repairing finger skin defects with random skin flaps.[24] In the retrospective case series, 12 patients underwent finger skin defect repairs with abdominal skin flaps or thoracic skin flaps. The fingers were anesthetized with WALANT, and donor sites were harvested under WALANT. All patients tolerated the procedure well, and all flaps survived without necrosis or other complications. Similar to previous studies, surgery began soon after anesthesia was injected, averaging 5 minutes. WALANT was advantageous for ensuring that the flaps were in the optimal position as patients had the ability to adjust and reposition the injured hand during surgery. This prevented subsequent pulling of flap pedicles during the postoperative course.

Finally, Alexander and colleagues published a case report describing coverage of a firecracker blast injury of the right hand using a flap from the chest wall under WALANT.[25] This is the first reported case of hand coverage from a chest wall flap under WALANT. This technique was utilized due to limited anesthesia availability during COVID-19. The first stage of the reconstruction was successfully completed under WALANT, highlighting the versatility and wide applicability of the technique, especially in challenging times.

Our case series further demonstrated the safety and utility of WALANT and adds to an expanding repertoire of successful WALANT application in complex, involved cases such as flap surgery. Importantly, no patients were prescribed opioids after surgery. Opioids are routinely prescribed for upper extremity surgery, and recent studies have found that surgeons prescribe two to five times more opioids than patients consume.[26,27] This poses a risk for patients, as opioids are regularly abused and overprescribed, contributing to the ongoing opioid epidemic. WALANT surgery does not require postoperative opioids. In fact, this practice is described by a prior study which found that patients who underwent WALANT hand surgery experienced less postoperative pain than those who underwent hand surgery with monitored anesthesia care with and without opioids postoperatively.[26] The extended application of WALANT may mitigate the use of postoperative opioids in flap surgery and reduce the risk of opioid abuse.

CONCLUSIONS

WALANT is safe and effective for use in local and regional soft tissue flap surgery. Its safety and utility are demonstrated by data from prior studies described in this article and further supported by the results from our case series of 21 patients. Surgeons should consider this technique for more involved procedures such as flap surgery, as preliminary results demonstrate positive outcomes and potentially superior recovery for patients.

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REFERENCES

1. Kurtzman JS, Etcheson JI, Koehler SM. Wide-awake local anesthesia with no tourniquet: an updated review. *Plast Reconstr Surg Glob Open*. 2021;9:e3507.
2. Lalonde DH. Conceptual origins, current practice, and views of wide awake hand surgery. *J Hand Surg Eur Vol*. 2017;42:886–895.
3. Turcotte JJ, Petre BM, Jones CM, et al. Maintaining access to orthopaedic surgery during periods of operating room resource constraint: expanded use of wide-awake surgery during the COVID-19 pandemic. *J Am Acad Orthop Surg Glob Res Rev*. 2020;4:e20.00100.
4. Arik HO, Coskun T, Kose O. Management of spaghetti wrist under WALANT technique. *Hand Surg Rehabil*. 2021.
5. Rhee PC, Fischer MM, Rhee LS, et al. Cost savings and patient experiences of a clinic-based, wide-awake hand surgery program at a military medical center: a critical analysis of the first 100 procedures. *J Hand Surg Am*. 2017;42:e139–e147.
6. Van Demark RE, Becker HA, Anderson MC, et al. Wide-awake anesthesia in the in-office procedure room: lessons learned. *Hand*. 2018;13:481–485.
7. Lalonde D, Martin A. Tumescent local anesthesia for hand surgery: Improved results, cost effectiveness, and wide-awake patient satisfaction. *Arch Plast Surg*. 2014;41:312–316.
8. Leblanc MR, Lalonde J, Lalonde DH. A detailed cost and efficiency analysis of performing carpal tunnel surgery in the main operating room versus the ambulatory setting in Canada. *Hand*. 2007;2:173–178.
9. LeBlanc MR, Lalonde DH, Thoma A, et al. Is main operating room sterility really necessary in carpal tunnel surgery? A multicenter prospective study of minor procedure room field sterility surgery. *Hand*. 2011;6:60–63.
10. Lalonde DH. Wide-awake flexor tendon repair. *Plast Reconstr Surg*. 2009;123:623–635.

11. Higgins A, Lalonde DH, Bell M, et al. Avoiding flexor tendon repair rupture with intraoperative total active movement examination. *Plast Reconstr Surg.* 2010;126:941–942.
12. Huang YC, Hsu CJ, Renn JH, et al. WALANT for distal radius fracture: open reduction with plating fixation via wide-awake local anesthesia with no tourniquet. *J Orthop Surg Res.* 2018;13:1–11.
13. Lalonde D, Martin A. Epinephrine in local anesthesia in finger and hand surgery: the case for wide-awake anesthesia. *J Am Acad Orthop Surg.* 2013;35:97–102.
14. Mustoe TA, Buck DW, Lalonde DH. The safe management of anesthesia, sedation, and pain in plastic surgery. *Plast Reconstr Surg.* 2010;126:65e–176e.
15. Abell RG, Page IH. The reaction of peripheral blood vessels to angiotonin, renin, and other pressor agents. *J Exp Med.* 1942;75:305–314.
16. Wong JKF, Lin CH, Chang NJ, et al. Digital revascularization and replantation using the wide-awake hand surgery technique. *J Hand Surg Eur Vol.* 2017;42:621–625.
17. Avoricani A, Dar Q-A, Levy KH, et al. Walant hand surgery: do the AORN Guidelines apply? *J Surg Orthop Adv.* 2021;30:156–160.
18. Connors KM, Guerra SM, Koehler SM. Current evidence involving WALANT surgery. *J Hand Surg Glob Online.* 2022;9:e3659.
19. Greene BHC, Lalonde DH, Seal SKF. Incidence of the "adrenaline Rush" and vasovagal response with local anesthetic injection. *Plast Reconstr Surg Glob Open.* 2021.
20. Pires Neto PJ, Moreira L de A, Las Casas PP de. Is it safe to use local anesthesia with adrenaline in hand surgery? WALANT technique. *Rev Bras Ortop (English Ed).* 2017;52:383–389.
21. Lalonde D, Bell M, Benoit P, et al. A multicenter prospective study of 3,110 consecutive cases of elective epinephrine use in the fingers and hand: the Dalhousie project clinical phase. *J Hand Surg Am.* 2005;30:1061–1067.
22. Xing SG, Tang JB. Extending applications of local anesthesia without tourniquet to flap harvest and transfer in the hand. *Hand Clin.* 2019;35:97–102.
23. Tang JB, Gong KT, Xing SG, et al. Wide-awake hand surgery in two centers in China: experience in Nantong and Tianjin with 12,000 patients. *Hand Clin.* 2019;35:7–12.
24. Xu J, Yin L, Cao S, et al. Application of WALANT technique for repairing finger skin defect with a random skin flap. *J Orthop Surg Res.* 2021;16:164.
25. Alexander ST, Abdullah S, Narin Singh PSG, et al. Coverage of a firecracker blast injury of the right hand with a chest wall flap under wide awake local anaesthesia no tourniquet technique. *Cureus.* 2021;13:e16962.
26. Dar QA, Avoricani A, Rompala A, et al. WALANT hand surgery does not require postoperative opioid pain management. *Plast Reconstr Surg.* 2021;148:121–130.
27. Gauger EM, Gauger EJ, Desai MJ, et al. Opioid use after upper extremity surgery. *J Hand Surg Am.* 2018;43:470–479.