Tips and Tricks: Minimally Invasive Surgery with Transverse Osteotomy for Hallux Valgus Correction

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Minimally invasive bunionectomy techniques have emerged as a promising alternative to traditional open surgery for the correction of hallux valgus deformities. Minimally invasive bunionectomy offers several potential advantages, including reduced soft tissue trauma, faster recovery times, improved cosmesis, and comparable correction of deformity without significant difference in complication rate. However, challenges such as surgeon experience and learning curve, patient selection, and long-term outcomes remain important considerations. By addressing these topics, this article aims to assist orthopaedic surgeons in making informed decisions regarding the adoption and optimization of minimally invasive techniques for hallux valgus correction.

Background

Over 150 procedures have been described in the orthopaedic literature for treatment of hallux valgus deformity. Minimally invasive techniques have become increasingly popular, especially within the past 10 years. Minimally invasive surgery (MIS) techniques for bunionectomy broadly fall into three categories: first generation is the Isham procedure, a medial closing wedge osteotomy without fixation;[1] second generation is the Bösch procedure or modified Hohmann osteotomy;[2] and third generation, which includes minimally invasive chevron and akin osteotomies (MICA) with headless compression screws.[3]

There has been an increasing number of prospective cohort studies, randomized controlled trials (RCTs), and meta-analyses performed to determine the differences in outcomes between open and MIS procedures. Almost all of these studies focus on three categories of interest: radiographic outcomes, including hallux valgus angle (HVA), first intermetatarsal angle (IMA), and distal metatarsal articular angle (DMAA); clinical outcomes, including American Orthopaedic Foot and Ankle Society (AOFAS) functional score, visual analog scale (VAS) pain score, patient satisfaction, and complication rate (i.e. infection, recurrence, nonunion, screw irritation); and health systems considerations, including operative time, length of stay and cost.

While earlier RCTs only included patients with mild to moderate hallux valgus deformities,[4] more recent trials have included patients severe deformity,[5,6] and all of these trials found no difference in radiographic correction or functional outcomes. Studies did find a significant advantage of MIS in various patient satisfaction measures including cosmesis,[4] post-operative pain,[5] or overall satisfaction with surgery.[6] Two recent meta-analyses by Singh et al. and Ji et al. reviewed 9 and 22 studies respectively, and each found no overall differences in radiographic outcomes between MIS and open techniques.[7,8] When comparing subgroups of MIS generation to open, third generation MICA procedure had significantly lower HVA and second generation Bösch procedure had significantly lower IMA.8 Additionally, sesamoid position correction was significantly greater with MIS techniques.8 While Singh et al. concluded functional outcomes were higher in open procedures, more recent literature, including Ji et al, concluded that functional outcomes were higher in MIS procedures and pain scores were significantly lower in the immediate post-operative period, although no different from open procedures by the time of final follow up. There was significantly higher patient satisfaction after MIS procedures and no difference in rate of complications. Both meta-analyses concluded operative time was significantly shorter in MIS as well, although few details about surgeon experience and training were provided or included in the analysis.

Hochheuser discusses the differences in complications between open and MIS bunionectomy, concluding there is overall no difference in possible complications or outcomes between the two (Table 1).[9] The comprehensive review notes decreased infection rate given the decreased size of incisions, delayed radiographic union but no difference in overall nonunion rate or

Table 1. Benefits and Drawbacks of MIS bunionectomy compared to open surgery

Benefits	Drawbacks	No difference
Increased patient satisfaction	Potentially more difficult to correct severe deformity or address joint instability	Radiographic correction of HVA, IMA, DMAA
Decreased operative time*	Increased use of radiation[3]	AOFAS functionality score**
Lower pain score in immediate post-op period	Delayed radiographic union (noting no difference in overall nonunion rate or symptoms)[9]	Pain score at final follow up appointment
Decreased infection rate	Increased rate of transient post-op paresthesias[9]	Overall complication rate and need for revision
Improved cosmesis		

*Meta-analysis data indicates decreased time, but more recent prospective cohort study found no difference although does not account for differences in surgeon familiarity with techniques.
**Meta-analysis data indicated no difference, while some studies report increased scores for MIS and others report increased scores for open.

symptomatic nonunion, and comparable rates of avascular necrosis and stiffness. Their data suggest that even for less experienced surgeons, there is low to no risk of neurovascular or tendon injury.

Most recently, Balesar et al. conducted a prospective cohort study in which two-thirds of patients underwent MICA osteotomies and one third underwent open Chevron osteotomy, and they found no differences in radiographic hallux valgus correction, functional outcomes, pain, patient satisfaction, or operative time.[10] It is worth noting that the differential in number of patients in the MIS vs open groups is likely multifactorial but may be due to increasing patient awareness of and desire to undergo MIS procedures, as well as increasing surgeon familiarity with MIS indications and techniques.

While MIS bunionectomy is rapidly gaining popularity, surgeon inexperience with minimally invasive techniques is often cited as an argument for open bunionectomy. Palmanovich et al. sought to define the learning curve of the third generation MIS bunionectomy technique and found the learning curve plateaued at 21 cases, fluoroscopic time plateaued at 27 cases, and mean operative time decreased by more than half over the first 50 cases.[11] While there is no better preparation than prior experience and repetition, the tips and tricks in this article may aid in jumpstarting the learning curve and perceived barrier for surgeons interested in incorporating MIS bunionectomy procedures into their practice.

Redfern and Vernois have previously detailed surgical techniques and troubleshooting for MICA osteotomies,[12] whereas this article provides tips and tricks for using a transverse osteotomy and external guide system. One benefit of this technique is the relative ease and speed with which a transverse osteotomy can be completed compared to a Chevron osteotomy. Another benefit is the ability to use the guide to translate and position the distal fragment rather than requiring the surgeon to manually lever and maintain its position while placing guidewires.

Tips and Tricks for MIS Bunionectomy with Transverse Osteotomy

Pick Your Patient

There are a number of considerations to keep in mind when deciding whether minimally invasive techniques may be appropriate for your patient.

- **Severity of deformity**: MIS techniques may be less difficult in patients with mild to moderate deformity. While MIS bunionectomy can be performed in patients with severe deformity, it should be considered only once the surgeon is well versed in the technique. It is worth noting that MIS technique will not allow for stabilization of an unstable joint, in which case an open procedure may be required.
- **Comorbidities**: Patients with medical comorbidities that put them at increased risk for wound healing complications such as diabetics or smokers may be good candidates for MIS bunionectomy given the smaller incisions and decreased soft tissue injury. The prospective cohort study by Balesar et al. had more smokers in the MIS group than open and found no increased rate of wound healing complications or nonunion.
- **Prior surgery**: Patients who have undergone prior surgery likely have altered anatomy or scar tissue that may make MIS more difficult, in which case open procedure should be considered. However, MIS may actually become a more viable option if prior incisions and concerns regarding inadequate skin bridge make a dorsal or medial incision less likely to heal.

Guide, Don't Guess

There is a variety of surgical equipment that can be used to perform minimally invasive bunionectomy. The most commonly used system at this institution includes a capital fragment guidewire and shifting device, trajectory guide, K-wire guides, and parallel guides. The procedure can be broken down into a few key steps:

- **Osteotomy**: Make the transverse osteotomy with a burr through a medial stab incision at the distal metadiaphysis of the first metatarsal (Figure 1a).
- **Guide placement**: Place the hook of the shifting guide through the stab incision and into the intramedullary canal of the first metatarsal. Ensure careful and accurate guide placement of the device where the capital fragment shifter contacts the metatarsal head (Figure 1b).
- **Correction**: Derotate the toe, advance the capital fragment guidewire through the shifter to the lateral cortex, and turn the shifter clockwise to shift the fragment laterally about 50-75% and confirm under fluoroscopy. (Figure 2a).
- **Pinning**: Attach the aiming arm with K-wire positioning knob to the capital fragment guidewire in line with the first metatarsal, making a stab incision to ensure the guide is seated flush on the medial surface of the metatarsal. Advance a K-wire through two cortices of the proximal metatarsal and one of the distal fragment, then place a second K-wire parallel and distal to the first using the parallel guide (Figure 1c). It is sometimes helpful to place K-wires in the proximal segment prior to capital fragment translation when utilizing a free-hand technique.
- **Fixation**: Drill over the first K-wire, measure, and place cannulated screws prior to K-wire removal (Figure 2b). It is helpful to place the first screw prior to drilling for the second to ensure no loss of fixation. You may either drill through the drill sleeves of the guide or remove the guide to drill and place screws over the K-wires. Confirm screw placement on fluoroscopy (Figure 1d) and close your 3-4 stab incisions.

Figure 1. Intraoperative fluoroscopy showing **(A)** transverse osteotomy at the first metatarsal distal metadiaphysis; **(B)** insertion of the shifting guide into the intramedullary canal; **(C)** parallel K-wire placement through two cortices of the metatarsal and into the capital fragment; **(D)** headless canulated screw placement and K-wire removal.

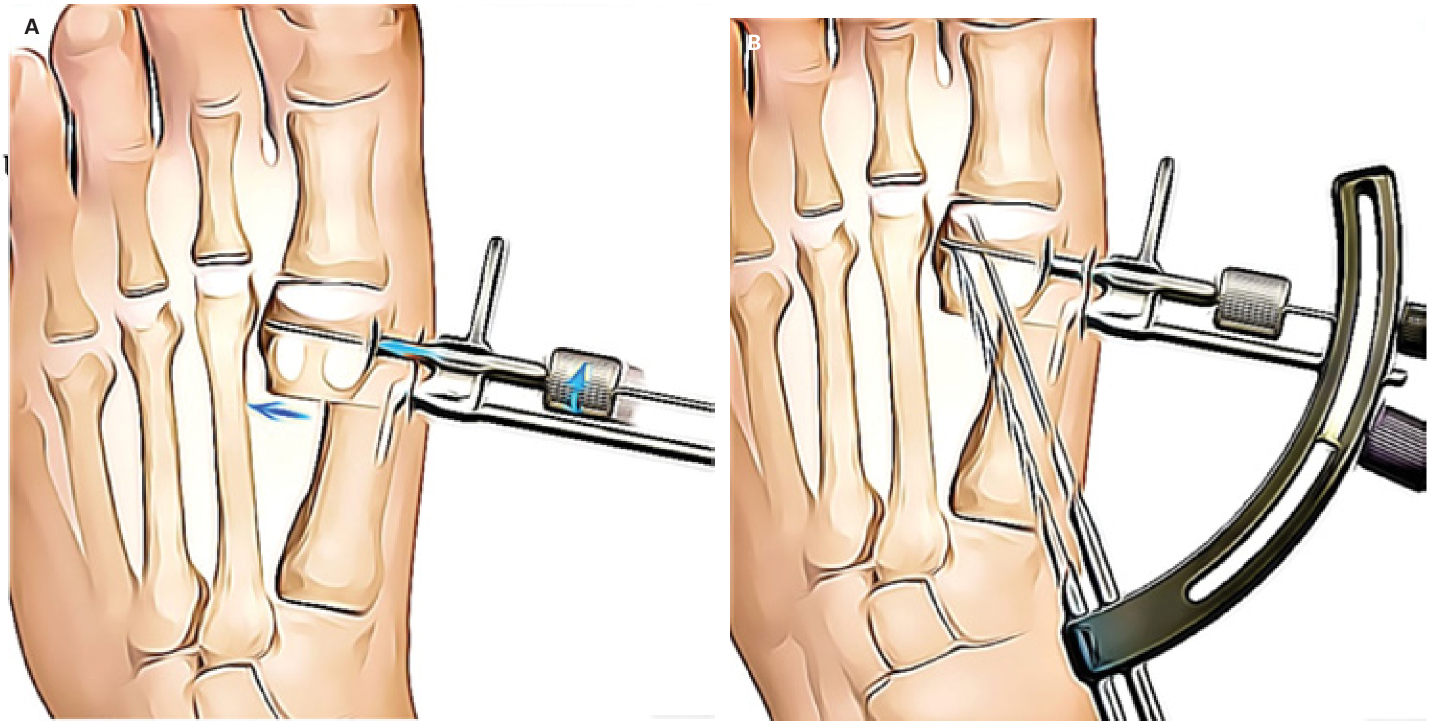

Figure 2. Stylized depictions of external guide system used at this institution showing **(A)** shifting guide with hook in first metatarsal intramedullary canal and capital fragment shifter on metatarsal head with capital fragment guidewire in place. Clockwise turn of shifter results in lateral movement of capital fragment, and **(B)** trajectory guide attached to shifting guide to aid in appropriate parallel K-wire placement, drilling, and eventually screw placement.

Post-operative Protocol

As for any surgery, post-operative care is integral to the success of a surgery both short and long term. In our experience, patients have the best clinical outcomes after MIS bunionectomy when adhering to the following postoperative protocol:

- **Weeks 0-2**: NWB in post-op shoe or CAM boot, sutures out at 2-week appointment.
    - It is helpful to place a spica/bunion dressing for ongoing management of soft tissue tension.
- **Weeks 2-6**: WBAT in post-**op shoe vs** CAM boot, XR at 6-week appointment
- **Weeks 6-8**: WBAT in post-op shoe vs sneaker

This differs from typical open bunionectomy post-operative protocols in that patients are allowed to commence weightbearing more quickly (2 vs 6 weeks) and are able to resume regular shoe wear earlier (6-8 vs 12 weeks).

Conclusion

Minimally invasive procedures for addressing hallux valgus deformities have emerged as a promising alternative to traditional open surgery for addressing hallux valgus deformities. With comparable radiographic outcomes, improved patient reported outcomes, and decreased time and healthcare dollar expenditures, a minimally invasive technique for hallux valgus correction is a great option for the appropriate patient. Given often cited challenges such as surgeon expertise, patient selection criteria, and long-term outcomes, these tips and tricks for the use of a transverse osteotomy and external guide may provide insights to facilitate informed decision-making regarding the adoption and optimization of minimally invasive procedures for hallux valgus correction.

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