Medial Collateral Ligament Reconstruction in Hallux Valgus Surgery: A Retrospective Review of Outcome in Consecutive Cases

Troy J. Boffeli, DPM, FACFAS, Catlea M. Gorman, DPM
Regions Hospital / HealthPartners Institute for Education and Research - Saint Paul, MN

Regions Hospital®
Foot & Ankle Surgical Residency Program
HealthPartners®

STATEMENT OF PURPOSE

Recurrent or persistent hallux valgus following reconstructive surgery is common despite years of procedure refinement. Few reports of outcome related to soft tissue reconstruction have been reported. We routinely incorporate medial collateral ligament reconstruction (MCLR) as an adjunctive procedure in hallux valgus surgery as a way to both achieve and maintain long term hallux valgus correction. This technique has mainly been used as an adjunctive procedure for Lapidus fusion, however we have seen similar success when applied to McBride bunionectomy and distal metatarsal osteotomy (DMO) procedures. The purpose of this retrospective study was to assess if using MCLR as an adjunctive procedure in Lapidus fusion would assist in obtaining initial correction of hallux valgus as well as maintain correction at 12 months postop. Furthermore, we aimed to assess pain relief, patient satisfaction, functional outcome and complications at intermediate term follow up.

LITERATURE REVIEW

Currently, there is very little literature discussing capsulorrhaphy techniques or evidence to support their role in maintaining hallux valgus correction. While it is important to take into account the degenerative changes to the 1st metatarsophalangeal joint (MPJ) in long-standing deformity, it is just as important to consider the degenerative changes to the surrounding soft tissues. Capsulotomy techniques such as lenticular, T-shaped, L-shaped and dorsolinear are commonly performed. While a variety of capsulotomy and capsulorrhaphy techniques have been described, evidence to support one technique over another is lacking and there is no standardized technique in hallux valgus surgery. Goldfarb et al. proposed a teardrop capsulectomy and capsulorrhaphy used in 288 procedures with 87.15% reported to have excellent result although his article lacked radiographic criteria or long term follow up. Wenig et al. described a two-stage V-Y capsulorrhaphy approach that was a modification of the Silver Y-shaped capsulorrhaphy. These authors focused on the technique and did not include patient outcomes. Kitaoka et al. discussed a medial longitudinal capsulotomy at the MPJ level and a vertical capsulotomy at the base of the proximal phalanx and reported long-term results at mean follow up of 4.8 years in 33 patients and 49 feet. Unfortunately many developed recurrence and 41% were dissatisfied with results.
Gould et al. proposed an L-shaped capsulotomy with an anchor-enhanced capsulorrhaphy in addition to either a distal chevron osteotomy with modified McBride for mild bunion deformity or a proximal metatarsal concentric shelf osteotomy with modified McBride for more severe deformity. These groups were then compared to those without anchor-enhanced capsulorrhaphy. The authors focused on loss of correction at two weeks postop. They noted a statistically significant greater loss of correction in the non-anchor group versus the anchor group and concluded that anchor based capsulorrhaphy enhances correction by preventing capsular slippage. The down side of implantable anchors is cost, limited ability to adjust tension intraoperatively and inability to reuse the implanted anchor if toe position is not ideal. We believe that our approach to medial collateral ligament reconstruction is a low-cost, adjustable alternative that can be used as an adjunctive procedure in primary and revision hallux valgus surgery. We aim to provide a retrospective analysis of results using this technique in initial deformity correction, maintaining correction over time, avoiding complications and achieving high patient satisfaction.

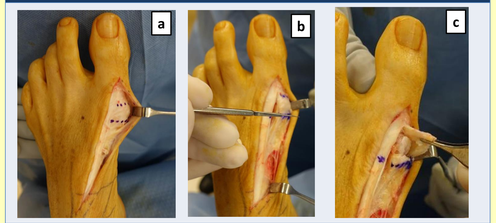
METHODOLOGY

A level 4 retrospective study of consecutive cases was performed from December 2015 to December 2016. Consecutive cases were identified through Current Procedural Terminology (CPT) codes for Lapidus fusion. 20 patients who underwent Lapidus fusion with MCLR for correction of hallux valgus with were identified. All procedures were performed by one surgeon (TJB). Inclusion criteria for this study consisted of patients who underwent Lapidus fusion combined with MCLR for correction of hallux valgus deformity with weight bearing (WB) radiographs preoperatively, 10 weeks postop, and 12 month months postop. Patients were excluded if they had Lapidus fusion without MCLR, Lapidus fusion for other conditions, or if documentation, imaging or follow up was incomplete. Pain relief was assessed based on preop and 12 month postop Visual Analog Scale (VAS). Functional outcome and 1st MPJ ROM was assessed using 12 month postop ACFAS first ray scoring scale. An independent board certified foot and ankle surgeon not associated with this study evaluated radiographs to assess for complications and measured the hallux abductus angle (HAA). The mean degree of HAA correction obtained was calculated using the preop and 10 week postop AP WB xrays. Maintenance of deformity correction based on HAA was calculated using the 10 week postop and 12 month postop AP WB xrays. Statistical significance was set at p = 0.5 for initial correction of HAA deformity, maintenance of HAA deformity correction, overall correction of HAA, and improved pain scale. Patient satisfaction was assessed with a survey asking the patient to rate their satisfaction with their outcome on a range of "not satisfied" to "very satisfied", in addition to answering if they would recommend the procedure to a friend with similar symptoms. We hypothesized that MCLR when used as an adjunctive procedure in Lapidus fusion would effectively correct hallux valgus deformity, maintain intermediate term rectus toe alignment without risk of overcorrection, preserve functional range of motion (ROM), and contribute to high patient satisfaction.

PROCEDURE

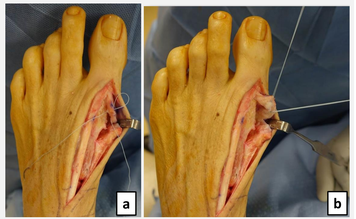
The MCLR technique is an adjunctive procedure in hallux valgus surgery. The surgeon needs to make a deliberate decision to perform MCLR early in the case since the traditional medial capsulotomy is performed at the level of the 1st MPJ which does not provide a sufficient length of tissue to perform ligament repair. When performing MCLR, the capsulotomy is moved about 1.5 centimeters proximal to the MPJ in an effort to preserve a ligamentous and capsular flap that will later be used to anchor into the head of the metatarsal head **(Figure 1a)**. An outside-in capsulotomy is performed at the designated proximal location as opposed to the traditional inside-out joint level capsulotomy **(Figure 1b)**. The medial ligamentous flap is raised as one full-thickness flap to preserve the integrity of the medial collateral ligament **(Figure 1c)**. The distal aspect of the ligament should remain firmly attached to the base of the proximal phalanx, without attempts at distal dissection. Bone procedures should be performed at this time including resection of the medial bump to expose cancellous bone which promotes ligamentous healing.
A 2-0 braided composite suture is used to place one superior and one inferior mattress suture into the flap using an inside-out technique **(Figure 2a)**. The superior and inferior mattress sutures are then knotted at the interior aspect of the ligamentous flap **(Figure 2b)**. The toe is then held in rectus alignment while the sutures are used to pull the ligamentous flap into tension. A skin marker is used to indicate the superior and inferior drill holes at the medial aspect of the first metatarsal head **(Figure 3a)**. The dots are placed just proximal to the desired endpoint location of the deep suture knots with care taken to correct hallux valgus while not overcorrecting into hallux varus **(Figure 3b)**. Dorsal lateral dots are then placed on the metatarsal neck to indicate the two lateral exit points. There should be a bone bridge between the two dorsal lateral dots with one distal and one proximal **(Figure 3c)**. A 0.045" k-wire is used to drill two bone tunnels from medial to lateral, aiming high to exit at the dorsal lateral cortex. Proper placement of the dorsal lateral exit points avoids fishing the sutures out of the inter-metatarsal space and avoids dorsal knots that could cause EHL tendon irritation **(Figure 4a)**. A 26-gauge monofilament wire loupe is used to pass the sutures through the bone tunnels from medial to lateral. Both of the superior suture ends are passed through the superior bone tunnel, while both of the inferior suture ends are passed through the inferior bone tunnel **(Figure 4b)**. Tensioning of the medial ligamentous flap is then performed while an assistant holds the hallux in rectus alignment. The surgeon can assess alignment at maximum tightness and adjust accordingly to obtain the optimal toe alignment. Two individual knots are tied creating two independent anchors **(Figure 4c)**.
Once completed, the MCLR allows the medial tissues to lay flat against the metatarsal, avoiding the typical puckered or everted edges commonly seen with traditional medial capsulorrhaphy techniques **(Figure 5a)**. Clinical exam is then performed to assess toe alignment and ROM. Intra-operative AP imaging is used to assess 1st MPJ alignment to confirm that the ligament is not over or under tightened and that the toe is not in a varus position. Upon completion, a stress exam and ROM is performed intra-operatively to ensure proper function of the medial collateral ligament **(Figure 5c)**. In the event of over or under correction, the sutures can simply be cut out and replaced to achieve a more desirable toe position. Postoperatively, Lapidus patients who undergo MCLR are non-weight bearing for 6 weeks followed by 4 weeks of progressive weight bearing in a removable surgical boot. Early 1st MPJ ROM is encouraged postoperatively.

Figure 1. Modified medial capsulotomy technique



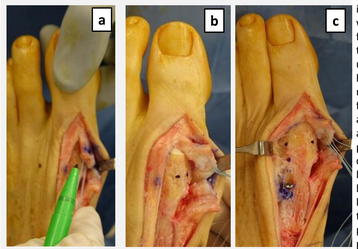
(a) The distal dotted line represents traditional location of medial capsulotomy which is located at the joint level. The more proximal dotted line is used for MCLR in an effort to preserve a ligamentous and capsular flap that will be anchored directly to the metatarsal head. (b) Instead of the traditional inside-out capsulotomy, an outside-in capsulotomy is performed at the designated proximal location. (c) The ligamentous flap is raised full thickness to preserve the integrity of the deep medial collateral ligament. The flap is simply retracted during completion of bone procedures.

Figure 2. Placement of mattress sutures in ligamentous flap



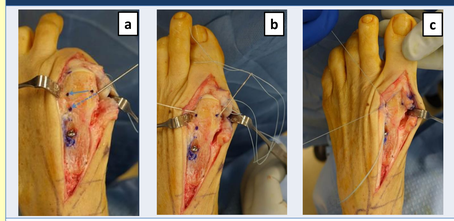
(a) High and low mattress sutures are placed with 2-0 braided composite suture using an inside out technique. (b) Both sutures are knotted at the interior aspect of the ligamentous flap which creates 4 independent strands.

Figure 3. Location of bone tunnels to anchor ligament



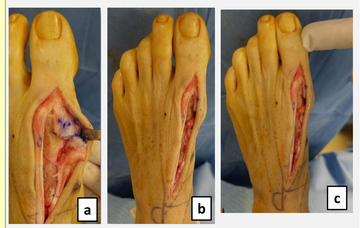
(a) The hallux is held in rectus alignment while the ligamentous flap is pulled into tension. Locations of upper and lower drill holes along the medial aspect of the first metatarsal head are marked. (b) Dots are placed just proximal to the desired endpoint location of the deep knots. (c) Dorsal lateral dots indicate the distal and proximal lateral exit points which are separated by a bony bridge

Figure 4. Pass sutures and tension medial collateral ligament



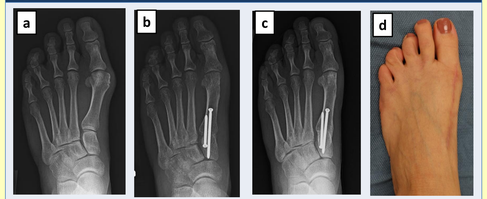
(a) A 0.045" k-wire is used to drill two bone tunnels, aiming high to stay out of inter-metatarsal space yet exiting dorsal laterally to prevent knot prominence under the EHL tendon when tying the sutures. (b) A 26-gauge monofillament wire loupe is used to pass the sutures from medial to lateral through the bone tunnels. The upper mattress suture is shown here. (c) Tensioning of the medial collateral ligamentous flap is performed while an assistant holds the first toe in desired alignment. Two individual knots are tied creating two independent suture anchors.

Figure 5. Completed Lapidus fusion and MCLR



(a) Medial tissues lay flat against bone without everted edges . (b) Hallux in rectus alignment. This technique does not rely on bandaging to hold the toe straight during healing. (c) Stress exam and ROM can be performed intraoperatively to ensure proper function of the medial collateral ligament. Note resistance with forced abduction.

Figure 6. Lasting correction of HAA with MCLR at 1 year



(a) Preop xray shows moderate hallux valgus deformity. Note how HAA is fully corrected at (b) 10 weeks and maintained at (c,d) 1 year postop.

Table 1. Results (N=20 Feet)

Mean Age (yrs)	59.1 (range 23 to 79)
Gender (M:F)	2 M: 18 F
Laterality (R:L)	10 R: 10 L
Mean Preop HAA	29.2 (range 21-42)
Mean 10 week postop HAA	11.9 (range 7-16)
Mean 12 month postop HAA	13.8 (range 8-28)
Mean Preop VAS score	4.4 (range 0-8)
Mean 12 month postop VAS score	0.45 (range 0-2)
Mean 12 month postop ACFAS score	83.6 (range 60-100)

RESULTS

A total of 20 consecutive patients (20 feet) who underwent Lapidus fusion with MCLR for correction of hallux valgus were identified during the study time frame. There were 2 males and 18 females and the average age was 59.1 (range 23 to 79). The average preop HAA was 29.2 degrees (range 21-42). The average 10 week postop HAA was 11.9 (range 7-16) and correction to a normal HAA was achieved in all cases. This was found to be statistically significant ($p < 0.00001$). The average 12 month postop HAA was 13.8 degrees (range 8-28). No statistically significant change was seen in HAA at 10 weeks postop to 12 months postop ($p = 0.176578$). Overall, the preop to 12 month postop HAA improved an average of 15.3 degrees, a change that was significant ($p < 0.00001$). 5/20 had loss of correction of the HAA from 10 weeks postop to 12 months postop. However 3/5 with loss of correction were still within normal range of HAA and remained improved from their pre-operative value. 2/5 who had recurrence outside of normal limits of HAA were still improved from their preoperative value with an average improvement of 13 degrees from preop to 12 months postop. Overall, there was a mean loss of HAA correction of 1.9 +/- 2.3 degrees.

The mean VAS score preop was 4.4 (range 0 to 8). The average VAS scrore reported at 12 months postop was 0.45 (range 0-2). The VAS score improved by 4.04 points on a scale of 0-10 , which was statistically significant ($p < 0.001$). At 12 months postop, 75% of patients reported they were very satisfied with their outcome, 25% reported they were somewhat satisfied, and none of the patients reported dissatisfaction with their outcome. 95% reported they would recommend the procedure to a friend.
The mean ACFAS first ray score at 12 months postop was 83.6 (range 60-100). Clinical exam at 12 months postop identified 6/20 with greater than 60 degrees of 1st MPJ dorsiflexion, 4/20 with between 45-59 degrees of dorsiflexion, 8/20 with 36-45 degrees dorsiflexion, and 2/20 with less than 36 degrees dorsiflexion. 18/20 patients had greater than 0 degrees of plantarflexion at 12 months postop.
Assessment for complications identified 3/20 who reported minor neuritis/numbness at 12 months postop that did not require treatment. None of the patients developed hallux varus. One patient developed a nonunion of the Lapidus fusion site that was treated with local bone grafting without further treatment at the 1st MPJ surgical site. No other patient required further surgical intervention.

ANALYSIS AND DISCUSSION

The reported postoperative recurrence rate of hallux valgus varies widely with reports ranging from 3-73% and few studies differentiate between symptomatic and asymptomatic recurrence [5]. Bock et al. reported a recurrence rate of 30% at an average follow up of 10.3 years with 93.5% of those patients being asymptomatic in their recurrence. Chong et al. reported a recurrence rate of 9.9% in 199 patients at an average follow up of 5.2 years and stated that 25.9% of the patients reported dissatisfaction with their outcome. A Cochrane review of hallux valgus surgery reported that 25-33% of patients expressed dissatisfaction after bunion surgery [12].
Recurrence of deformity makes the assumption that the operation corrected the deformity in the first place. Surgeons are hesitant to fully correct hallux valgus deformity for fear of over correction which in combination with insufficient soft tissue reconstruction leads to under correction. Regardless of persistence or recurrence of deformity being asymptomatic, patient satisfaction is certainly influenced by the appearance of toe alignment. We were able to achieve normalization of HAA with MCLR in all patients at 10 weeks postoperative and had a recurrence rate of 10% (2/20) at 1 year follow up when assessing HAA alone. While we did have 5 cases involving loss of HAA correction from 10 weeks postoperative to 12 months postoperative, 3/5 were still within normal limits of HAA and our study shows a sustained improvement in HAA for all patients. Furthermore, patients reported high satisfaction with none of the patients reporting dissatisfaction at 12 months following hallux valgus surgery and 95% stated that they would recommend the procedure to a friend. We feel that patients undergoing hallux valgus surgery are most satisfied when their foot both feels better and looks normal.
In regard to the 12 month postoperative ROM, it is well know that some degree of associated stiffness is to be expected following hallux valgus surgery. It is commonplace for surgeons to avoid dorsal incision, medial capsulotomy, and dorsal dissection of periosteum in an effort to avoid joint stiffness. The approach to MCLR described here goes against these trends based on incisional approach and joint exposure. It is our routine to resect the dorsal aspect of the 1st metatarsal head using a combined McBride / cheilectomy approach in Lapidus fusion which we feel leads to a better pain relief and cosmetic result. This approach seems to be supported by a high level of satisfaction, statistically significant pain relief, and demonstrated preservation of 1st MPJ ROM.
Limitations of this study include the relatively small number of patients in the study, although all were consecutive which decreases exclusion bias. Also, all procedures were performed by a single surgeon, which could also be seen as a benefit, as this removes the inter-surgeon variability with patient selection and procedure technique. We also had a relatively short follow-up period, with the average follow up being 12 months. Another limitation is that we did not have a preoperative ACFAS score available for review since this was a retrospective study. In conclusion, the present study of consecutive patients demonstrates that medial collateral ligament reconstruction performed in conjunction with Lapidus fusion reliably assists in correction of hallux valgus deformity, has a low complication rate, maintains correction for one year, and contributes to both high patient satisfaction and pain relief.

REFERENCES

1.Goldfarb, WL, Melillo ,TB, Levinson FN, Newman LM, Battey M. The Tear-Drop Capsulectomy and Capsulorrhaphy: A New Approach in Aiding the Soft Tissue Repair of Hallux Abducto Valgus. The Journal of Foot Surgery: Winter; 19(4): 199-201. 1980.
2. Wenig JA, McCArthy DJ. Modified V-Y Capsulorrhaphy in Hallux Abducto Valgus Surgery. J Am Podiatr Med Assoc: Mar;79(3):132-8. 1989.
3. Harold B. Kitaoka, M.D., Mark G.Franco, M.D., Amy L. Weaver, M.S., Duane M. Ilstrup, M.S.Simple Bunionectomy with Medial Capsulorrhaphy. Foot & Ankle International.12(2):86 – 91. 1991.
4. Gould, J. S., Sheriff, A., Fowler, R., & Fleisig, G. S. Anchor Enhanced Capsulorraphy in Bunionectomies Using an L-shaped Capsulotomy. Foot & Ankle International: 61-66. 2003.
5. Bock, P., Kluger, R., Karl-Heinz, K., Mittlbock, M., Schuh, R., & Trnka, H.J. The Scarf Osteotomy with Minimally Invasive Lateral Release for Treatment of Hallux Valgus Deformity . The Journal of Bone and Joint Surgery: 1238-1245. 2015.
6. Chong, A., Nazarian, N., Ji, C., Tracey, M., & Shepherd, D. T. Surgery for the correction of hallux valgus: minimum five-year results with a validated patient-reported outcome tool and regression analysis. The Bone & Joint Journal: 208–214. 2015.
7. Ferrari J, Higgins JPT, Prior TD. Interventions for treating hallux valgus (abductovalgus) and bunions. Cochrane Database of Systematic Reviews 2009, Issue 2.