Lateral Column of the Foot Arthroplasty With Interpositional Fascia Lata Graft: A New Technique

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Abstract: Tarsometatarsal reconstruction is common after a traumatic event as joint pain develops and progresses to chronic arthritis. Often, the surgeon elects to reconstruct the foot, performing arthrodesis of the medial, middle, and lateral columns. However, debate exists regarding whether lateral column reconstruction should consist of arthrodesis or arthroplasty at this joint level. This is attributed to the greater amount of motion present to the lateral versus the medial and middle columns. Although many sources advocate joint salvage through arthroplasty, few techniques are described in the literature as to how to accomplish this. We present a review of the literature pertaining to lateral column arthroplasty as well as a technique performed by the authors utilizing a tensor fascia lata allograft as an interpositional spacer after joint resection. The senior author has used this technique with great success for many years.

Level of Evidence: Diagnostic Level 4. See Instructions for Authors for a complete description of levels of evidence.

Key Words: arthrodesis, arthroplasty, fascia lata, lateral column, tarsometatarsal joint

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HISTORICAL PERSPECTIVE

Reconstruction of the lateral column [lateral tarsometatarsal joint (TMTJ) or fourth/fifth metatarsal-cuboid joint] is not a topic that is widely published on. In the literature, debate exists regarding arthrodesis versus arthroplasty. Often performed secondary to end-stage arthritis and pain, arthrodesis offers relief of pain through joint obliteration, absolute stability, and has shown success in the past. However, biomechanical studies have shed light on the triplanar motion available to the lateral column of the foot, almost 2 to 3 times that of the medial and middle columns in the sagittal and frontal planes. Preservation of motion should be a goal for the surgeon. By preserving this motion, the foot may avoid stiffness and continue to perform as a mobile adaptor as it encounters various terrains. Komenda et al. stated that "the motion of the lateral column is important for optimum function" and recommend "the lateral column not be included in the arthrodesis" of the TMTJ. This sentiment has been echoed by various other foot and ankle surgeons. With this in mind, we describe a technique for lateral column arthroplasty with placement of an interpositional tensor fascia lata allograft to maintain space and motion of the joint. The procedure was implemented by the senior author (J.M.M.) after experiencing an unacceptable rate of nonunion when lateral column arthrodesis was attempted along with patients subjectively complaining of lateral column foot stiffness postoperatively.

Midfoot arthritis often results in chronic pain and functional impairment. Of the many causes, post-traumatic degeneration is the most common. Although TMTJ injuries account for <1% of all fractures, it has been reported that upwards of 20% are either missed or misdiagnosed and up to 50% of these injuries progress to degenerative arthritis. Specifically, lateral column arthritis is associated with Lisfranc complex injuries, isolated lateral midfoot trauma (cuboid fracture), fifth metatarsal base fractures (zone 1), inflammatory arthritis, and primary degenerative arthritis. Because of this, the surgeon should have an understanding of this joint complex and how to treat it appropriately.

The TMTJ is divided into 3 columns: medial, middle, and lateral. The medial column is the articulation between the first metatarsal and medial cuneiform; middle column between the second/third metatarsals and the intermediate/lateral cuneiforms; lateral column between the fourth/fifth metatarsals and the cuboid. The motion at these joints is variable with the lateral column significantly more mobile than the medial and middle columns. The lateral column joints are able to achieve 20 degrees of flexion-extension and supination/pronation while the medial and central columns have significantly less motion with second metatarsal-intermediate cuneiform joint motion the least at a reported range of 0.6 to 4 degrees of flexion-extension. In addition, the bases of the fourth and fifth metatarsal are not fixed to the cuboid as tightly when compared with the medial 3 TMTJ articulations due to their anatomic structure. Studies have demonstrated the greater ability of the lateral column to accommodate to stresses and loading when compared with the medial and middle columns and arthrodesis of all 3 columns results in greater forefoot and calcaneocuboid pressures when loaded. Because of this difference in joint motion, surgeons may be more hesitant to fuse the lateral column in the presence of painful TMTJ arthritis. Further, because of this motion, the joint may be more forgiving to arthritis compared with its medial counterparts and arthrodesis may not be necessary.

The diagnosis of TMTJ arthritis requires the surgeon to specifically pinpoint the affected joint(s). It may be difficult to confirm a symptomatic lateral column with referred pain from the medial or middle columns a possibility. To add to the challenge, the presence of radiographic osteoarthritis does not always match the clinical symptom of lateral column pain. It has been reported that arthrodesis for lateral column symptoms is only necessary in 6% to 25% undergoing complete TMTJ fusions. Many authors recommend diagnostic injection, specifically under fluoroscopic guidance, which has both prognostic and therapeutic value.

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a 20% leak rate of local anesthetic into adjacent midfoot joints due to the anatomy with small joints in close proximity, and therefore this technique is preferred.

Various surgical treatments have been described for lateral column arthritis. Although arthrodesis of the medial and central columns is the standard of care, the debate in treatment of the lateral column hinges between 2 philosophies: arthrodesis versus arthroplasty. Some may argue that in arthrodesis one achieves the pain relief desired as the main surgical (goal) outcome, whereas others argue that fusion results in compensation with complications arising elsewhere as a result. These complications may include chronic lateral foot pain, increased forefoot and lateral column pressures, increased rate of delayed or nonunion at the lateral column arthrodesis site, fourth and fifth metatarsal stress fracture, metatarsalgia, midfoot stiffness, lateral foot prominence, and prominent or broken hardware. The lead surgeon of this paper encountered 6 complications of patient dissatisfaction in a rigid lateral column along with a high nonunion rate, leading to his implementation of the technique described here.

Several papers favor arthrodesis of the lateral column. A retrospective study by Ralff and Schon of patients who underwent complete TMTJ fusion demonstrated a 74.5% decrease in pain, 73.8% increase in functional capacity and an 120% increase in American Orthopaedic Foot and Ankle Society (AOFAS) midfoot scores. Of note, 13 patients reported subjective stiffness, 4 complained of lateral prominence (2 of these requiring surgical correction through osteotomy), 1 developed fourth metatarsal stress fracture, 9 experienced broken hardware (3 requiring removal), 1 developed an infected pseudoarthrosis, and 1 progressed to nonunion. Sangeorzan and Hansen in another retrospective study found, although not statistically significant, no difference in outcomes between those that underwent arthrodesis of the lateral column and those that underwent total arthroplasty. Other authors who have performed complete TMTJ fusion have commented on how it may be more favorable to avoid arthrodesing the lateral column. Coetzee et al. has suggested that, in the instances where lateral column arthrodesis is undertaken, one should perform a fourth and fifth metatarsal arthrodesis to the cuboid with no fusion between the cuboid and lateral cuneiform to maintain some residual intracuneiform motion.

The first documented cases of a motion-preserving procedure were described in 2002. Berlet et al., in a series of 12 patients, used the peroneus tertius tendon rolled into an "anchovy," placed into a 1 cm space created across the resected articular surface, and temporarily held in place with a K-wire. Their method resulted in 6/8 patients satisfied with a 35% reduction in pain postoperatively and 10% decrease in disability. Mauro and Hembree described 3 cases reports with good results, detaching peroneus brevis or peroneus tertius from their insertion and inserting the tendon into the resected joint space (2 mm in size).

Other arthroplasty procedures maintain joint space through use of percutaneous wires and biocompatible spheres (carbon, ceramic). This maintains normal ligamentous anatomy, forgoing the need to use an adjacent tendon which could result in deformity or complication elsewhere. A technique by Chiang describes resecting 1/4 cm of each metatarsal base's articular surface, maintaining the distal cuboid articular surface, and placement of a pyrolytic carbon sphere into each of the resected joint spaces. Shawen et al. describes a similar technique using a spherical ceramic device. These spherical ceramic devices were originally used in hand arthroplasty with eventual Federal Drug Administration-approval for the lateral column of the midfoot. Their technique involves using a burr to create a hole in the center of each opposing TMTJ surface, both metatarsal and cuboid, just to the cortical rim for sphere placement. AOFAS scores improved 87% and visual analog scale pain improved 62% in their 11 patients who all stated they would undergo the surgery again.

To the best of the authors' knowledge, no update in the literature on lateral column arthroplasty has been presented in over 8 years since the work of Shawen and colleagues. The technique demonstrated in this paper takes into consideration the work previously reported and expands upon it. We resect the entire arthritic joint space medially to lateral so no residual interaction between the metatarsal bases and cuboid persists. In addition, fascia lata allograft is used, sparing the need for tendon harvest and additional incisions. Tensor fascia lata, the deep fascia of the thigh, can either be in autograft or allograft form, as used in this technique. It is an ideal graft due to it being strong, pliable, durable, and showing minimal compression which allows it to maintain the space created through joint resection. Studies have demonstrated fascia lata use as an interpositional graft for arthroplasty of the jaw, elbow, subtalar joint, knee, thumb, and first metatarsophalangeal joint with good results.

An important factor when considering an isolated lateral column arthroplasty is the ability to return patients back to weightbearing (WB) faster. Reported cases have kept patients off their feet for only 2 to 3 weeks to allow for soft tissue healing to occur. In contrast, lateral column arthrodesis requires a greater period of non-weightbearing (NWB) immobilization and has also shown complications of hardware failure and delayed or nonunion, suspected to be attributed to the extra motion in lateral column versus the medial 2.

In the post-traumatic or chronic osteoarthritis setting, arthroplasty of the lateral column provides a viable reconstruction alternative through motion preservation while keeping the option open for arthrodesis later if need be. It can also be performed to convert a complete TMTJ fusion to an arthroplasty if the patient has subjective complaints of stiffness, history of recurrent stress fractures, or metatarsalgia. However, it may not be appropriate for all cases of TMTJ arthritis and pain, such as those cases of complicated Charcot neuroarthropathy reconstruction. Recommendations have been made to avoid lateral column resection and fuse only the medial and middle column.

INDICATIONS AND CONTRAINDICATIONS
The technique has only been used as a primary procedure for chronic midfoot (TMTJ) arthritis whether in a clinical picture of osteoarthritis or post-traumatic arthritis by the senior author (J.M.M.). Examples of post-traumatic arthritis can be a result of TMTJ fracture-dislocation, intra-articular fifth metatarsal base avulsion fracture, or history of failed lateral column fusion. Examples of osteoarthritis can be a result of wear-tear or transfer load secondary to calcaneo-cuboid arthrosis.

This has not been used in the acute primary management of midfoot traumatic scenarios. In addition, there is no reported literature of a lateral column arthroplasty used when midfoot fusion is necessary in Charcot foot reconstruction.

PREOPERATIVE PLANNING
Often lateral column surgery is not done in isolation but is part of a global midfoot pathology. Therefore, preoperative planning should assess the entire TMTJ to determine if fusion...
of the medial and central columns is require in combination with a lateral column arthroplasty.

The first step in operative planning is the patient interview and physical examination. An important history point to ascertain is whether the deformity is degenerative (osteoarthritis) versus post-traumatic for planning in situ or realignment arthrodesis, respectively. Observation and palpation may reveal subcutaneous exostoses the patient states have been enlarging over a period of time and/or are painful in certain shoe gear. Passive range of motion of the midfoot (simultaneous forefoot pronation and abduction) may elicit pain to 1 of the 3 columns, however it has been found that the lateral column is often asymptomatic. Diagnostic injection blocks may aid in determining an osseous arthritic pathology versus soft tissue. True intra-articular injection can be difficult to perform as stated earlier, and therefore patient subjective recollection of relief may not be fully accurate as a tool to determine surgery or not. However, this technique along with other modalities (subjective complaints, advanced imaging) can aid in diagnosis and treatment plans.

Imaging studies can be performed to assess the joint. Radiographs may demonstrate dorsal spurring or obliteration of the joint spaces. In the post-traumatic situation, certain key angles and alignment relationships should be assessed to plan reconstruction with deformity correction. These include: talo-first metatarsal angle on anteroposterior (AP) and lateral, calcaneal-fifth metatarsal angle on AP, medial cuneiform to ground distance on lateral, aligned medial aspects of the base of the first metatarsal and medial cuneiform on AP, aligned medial aspects of the second metatarsal base and intermediate cuneiform on AP, aligned medial aspect of the fourth metatarsal and cuboid on oblique view. Results can all be assessed against reported norms or an uninjured contralateral foot. Realignment arthrodesis has been suggested when there is none of the following: >2 mm of displacement, >15 degrees of malalignment in the transverse and/or sagittal plane.

Advanced imaging such as magnetic resonance imaging or computed tomography can aid in further intra-articular evaluation, demonstrating loss of cartilage, subchondral cysts, or bone marrow edema lesions located adjacent to the joint space. Technetium bone scan may also be ordered but studies have found increased uptake in non-painful joints, specifically the lateral column.

FIGURE 1. Incision placement. Lateral most incision for lateral column arthroplasty. Additional middle and medial incision were created for middle and medial column arthrodesis and distal bunionectomy procedures.

FIGURE 2. Left foot intraoperative clinical picture of bone exposure demonstrating the (1) fifth metatarsal base, (2) fourth metatarsal base, (3) cuboid. Left side of photo is distal toward toes. Secondary incision for tailor's bunion procedure performed.

**TECHNIQUE**

The technique described here is for an isolated lateral column arthroplasty. On the basis of preoperative planning, medial and central column arthrodesis can be performed at the same time. Preoperative planning points to determine whether this is required or not has been defined above.

The patient is placed supine on the operative table. An ipsilateral hip bump may be utilized to internally rotate the operative limb for improved positioning for the procedure. The incision is placed on the dorsal to dorsal-lateral aspect of the fifth metatarsal diaphysis, centered over the intersection of the fourth and the fifth metatarsals and the cuboid (Fig. 1). It should extend 1 to 2 cm proximally and distally from the TMTJ to obtain adequate visualization of the arthroplasty site. Dissection is carried through the subcutaneous and deep fascial layers to bone (fourth and fifth metatarsal bases; cuboid) (Fig. 2). Care must be taken during dissection to avoid any neurovascular structures (intermediate dorsal cutaneous or superficial peroneal nerve medially and sural...
nerve laterally; lateral marginal vein) which should be retracted if encountered.

Once the osseous structures are visualized, a capsular incision is made into the fourth-fifth metatarsal-cuboid joint and this space is dissected. These joints can be better identified by attempting to manually mobilize each respective joint (fourth TMTJ and fifth TMTJ) in the sagittal plane and visualizing opening of the joint space. Additionally, removing any osseous overgrowth of joints with a sagittal saw or rongeur will also aid in joint visualization. Periosteum should be reflected several centimeters on each side of the joint line in preparation for the osteotomies. A ¼ or ½-inch osteotome is then used to mobilize each joint segment. Joint resection is performed either with a sagittal saw or osteotome from a dorsal to plantar orientation in a planal resection fashion. The fourth metatarsal base is resected 0.5 cm, fifth metatarsal resected 0.5 cm, and distal cuboid resected 0.5 cm (Fig. 3). A small bone joint compressor/distractor can be used to distract the joint. Care should be taken to protect the fifth metatarsal styloid process and peroneus brevis insertion as well as the plantar ligaments at the joint during the osteotomy to preserve function and some inherent stability.

To maintain space between the newly-resected joint spaces, a tensor fascia lata allograft is used. The graft should be trimmed to the size of the joint, usually around 0.6 to 1.0 cm in total thickness after being folded onto itself 2 times, creating a 4-layered sandwich (Fig. 4). Before preparing the graft for permanent placement, it is temporarily placed into the site of bone resection to determine if an appropriate fit has been achieved (Fig. 5). If not, the graft can be trimmed to size or one of its 4 layers can be excised. Once satisfied, the graft is prepared for insertion.

An absorbable suture is used to place a simple stitch into the plantar apex of the folded graft to pass the needle through the plantar foot once placed in the resected area. Both strands of suture should remain on the external surface. An absorbable simple-interrupted suture is placed in each corner to keep the

![Figure 3](image_url)

**FIGURE 3.** Intraoperative fluoroscopic image of the fixation construct. Fusion of the first-third tarsometatarsal joint with arthroplasty of the lateral column. Note the space created between the bases of metatarsals four/five and the cuboid for placement of the graft.

![Figure 4](image_url)

**FIGURE 4.** Preparation of the fascia lata graft. Note how the square graft is folded over onto itself twice yielding 4 layers of thickness. The suture placed through the graft folds is to be used to pass through the plantar foot.

![Figure 5](image_url)

**FIGURE 5.** Joint distraction and placement of the fascia lata graft within the resected joint space. Notice complete resection of the joint across the distal cuboid and fourth-fifth metatarsal bases.
FIGURE 6. A, Placement of the fascia lata graft into the arthroplasty site. Note straight needle in surgeon’s hand extending through the plantar foot. B, After both arms of the suture are passed through the foot, it is loosely knotted. This is done to keep the graft in place and prevent dorsal displacement.

graft in the folded position as well. With the resection site being maintained in an open position with use of a distraction device, a straight Keith needle is attached to each of the two strands of suture exiting the folded graft. Both are passed into the resection site and through the plantar aspect of the foot. As the suture is passed through the plantar foot, the graft is pulled with it evenly into the resection site. The 2 strands of suture exiting the plantar foot are then tied down either on a suture button, 4 × 4, or directly to the skin (Fig. 6). Layered closure is performed making sure that the deep fascia is well approximated to maintain the grafts position in the space and to prevent dorsal subluxation.

RESULTS

Currently there are no scores validated (AOFAS, American College of Foot and Ankle Surgeons) results to report for this procedure. The case demonstrated here represents a 65-year-old woman who underwent a left foot medial and middle column arthrodesis with lateral column arthroplasty. She underwent the same procedure on the right foot 3 years prior and was asymptomatic to this extremity at the time of surgery. Left foot pain level was a constant 10/10 on a daily basis. Conservative measures such as anti-inflammatory medication, shoe gear modifications, and local injections were attempted and ultimately failed before surgery. The patient ultimately underwent medial and middle column fusion, lateral column arthroplasty, naviculocuneiform fusion, and talor's bunion correction (Fig. 7). The postoperative course was uneventful. At 14 months follow-up, she rates her discomfort a maximum 3/10 and continues to make progress toward pain resolution (Figs 8, 9). She has transitioned back to normal sneaker shoe gear and states she is pleased with the operation results and would undergo it again if given the choice.

FIGURE 7. Preoperative (A) and postoperative (B) lateral radiograph of the left foot. Notice the increased space (radiolucency) in the 4 to 5 metatarsal-cuboid joint region from pre to post. Fifth metatarsal tuberosity preserved to not disturb the peroneus brevis insertion.

COMPLICATIONS

Possible complications include too little or too great of resection to the arthroplasty site. This can result in either continued stiffness or instability experienced on weightbearing to the lateral column, respectively. In addition, another cause of stiffness could result in over-stuffing the joint with the graft.
Other complications include graft subluxation from the arthroplasty site, graft-host reaction, etc. Peroneal brevis insufficiency or insertional rupture is a possibility if too much fifth metatarsal base is resected. Sural nerve injuries/irritation are a possibility due to the location of the arthroplasty.

The patient will WB in a controlled ankle motion until week 6 at which point they are transitioned into a sneaker as tolerated.

POSSIBLE CONCERNS, FUTURE OF THE TECHNIQUE

Other types of grafts can be used for interposition. One such example is GraftJacket (Wright Medical, Arlington, TN) due to its thickness and durability during incorporation. One should pick a graft with these qualities. As always, clear graft choice uses with your patient a head of time in case of any allergy, personal, or religious concerns using graft of donated (allograft), porcine, bovine, or equine origin.

CONCLUSIONS

According to the existing literature, there is no consensus for performing arthrodesis over arthroplasty or vice versa. In addition, there is no strict contraindication to lateral column arthrodesis.8 That being said, preservation of joint motion should always be a goal in reconstructive surgery, especially when the option is visible and within the best interest of the patient. Surgeons should not feel that arthrodesis of the lateral column is a foregone conclusion in the presence of concomitant
medial and middle column arthritis, especially considering that it is difficult to isolate medial/middle versus lateral column pain and the presence of lateral column radiographic arthritis does not correlate to the presence of discomfort.

Lateral column arthroplasty appears to perform well in the post-traumatic or primary osteoarthritic patient. As demonstrated, various techniques exist to preserve motion such as the one described here. Complete joint resection with allogenic tensor fascia lata graft allows for one surgical incision, maintenance of the joint space, and motion through pseudoarthrosis. However, the literature is scarce regarding this topic. More research is needed concerning long term results of arthroplasty versus arthrodesis, functional outcomes, and satisfaction rates.

REFERENCES