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A Technique of Lateral Process Blockade for Subtalar Joint Fusion: An Easy, Economical, and Effective Method to Prevent Rotation

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ABSTRACT

One of the most common debates in discussing the technique of isolated subtalar joint arthrodesis is whether a single point of fixation is adequate to achieve joint fusion. The single screw technique places a fixation device in line with the subtalar joint axis of motion. Regardless of whether the screw is run up from the plantar calcaneus or down from the talar neck, rotational movement can occur about this axis. This motion increases the risk of delayed union, misalignment, and nonunion of bone. Therefore, the use of a second point of fixation has been considered by many surgeons to be prudent, as a method to further stabilize the site of fusion by preventing rotary motion about the interfragmental compression screw. The following is a description of a lateral talar process blockade using a cut and bent Rush rod. This method is an easy, economical, and effective method of preventing rotary motion at the talocalcaneal interface when performing subtalar joint fusion.

Fusion of the subtalar joint (STJ) fusion can be performed in isolation or combined with other procedures for foot and ankle reconstruction. When a single screw is run from the neck of the talus into the lateral calcaneus, or, conversely, when it is directed from the calcaneus into the talar body, the screw rests within the axis of STJ motion. This leaves the interfragmental compression construct susceptible to rotational forces when weightbearing stress is resumed, or even when non-weightbearing range of motion exercises are initiated during the postoperative course. As such, a single point fixation technique is more susceptible to delayed or nonunion owing to the micromotion about this rotational axis. Over time, the concept of a single screw versus a 2-screw fixation construct has been discussed and debated. Recently, the use of 2 points of fixation for isolated subtalar fusion has seemed to be commonplace. In this fixation construct, 1 of the points of fixation is used to create interfragmental compression, and the other is used as an antirotation device, with or without additional interfragmental compression (1–6). A second point of fixation becomes especially important when bone graft materials are used, because it will further stabilize the bone-to-graft interface (7).

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Chuckpaiwong et al (8) measured the contact area in the STJ with a single screw fixation and noted that the mean contact area ranged from 119 to 197 mm^2. These values are, on average, only about 30% of the size of the entire posterior facet, which they measured at 582 ± 103 mm^2. Ultimately, the decision to use 2 points of fixation is made intraoperatively and varies with the stability of the final construct. If, for instance, an interpositional bone graft is used, a second point of fixation would be prudent. In that case, the first screw is driven principally to secure the bone graft and joint into the optimal position. When this construct is challenged intraoperatively, and residual rotation is available at the site, the addition of a second point of fixation could be prudent in an effort to definitively secure the construct (7). When arthrodesis is performed in cases of malunion or nonunion, the use of 2 points for fixation is recommended to enhance the stability (8–10). Although it can be argued that 2 screws provide a more stable subtalar fusion construct, some surgeons might question whether 2 points of fixation are necessary, given the natural morphology of the joint. The inherent shape of the STJ is that of a saddle (concavoconvex), which is naturally stable when the inherent contours are preserved, and the joint is aligned properly. In cases of severe degenerative change or STJ derangement secondary to trauma or when deformity correction requires wedge resection, the morphology of the arthrodesis interface becomes less stable, and fusion alignment and stability must be established and maintained by the fixation technique. In 1 large, retrospective study of isolated STJ fusion, both single-screw and 2-screw techniques were used, and no

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statistically significant differences were noted in the union rate between the 2 groups (11). A more recent study, however, was conducted to determine the comparative effectiveness of screw fixation techniques used in STJ fusion (8). The results revealed a greater average compressive force, torsional stiffness, and joint rotation resistance achieved with double screw fixation compared with the use of a single screw (8).

In consideration of the various STJ pathologic entities that lead to surgical reconstruction, the anatomy of STJ perfusion, and the effect that internal fixation techniques have on union rates, it is reasonable that stabilizing the talocalcaneal arthrodesis interface with dual points of fixation could have distinct advantages compared with a single point of fixation. Ultimately, the strategy to use 1 or 2 points of fixation is an intraoperative decision of the surgeon, depending on the stability of the construct when assessed during surgery (11–14). The technique described in our report illustrates a method of lateral process blockade that serves as an antirotation device for use in subtalar arthrodesis.

Surgical Technique

The lateral process blockade technique begins after dissection, capsulotomy, and joint surface curettage for the STJ fusion has been completed. With the STJ and the calcaneus set in neutral position, a 3/32-in. Steinmann pin is run along the anterior border of the lateral process of the talus into the anterior calcaneus (Fig. 1). This will stabilize the joint in position while preparing the provisional fixation for the 7.3-mm cannulated screw. To achieve the proper angle to block the lateral process, the surgeon's hand must lay against the limb as shown in Fig. 2. It is also helpful to know that the required size of Rush rod can be predetermined using the lateral foot radiograph, if a good-quality, weightbearing film is available. Measuring from the floor of the sinus tarsi to the inner margin of the plantar calcaneal body, a typical lateral process block measures 30 to 35 mm in length, depending on the morphology of the calcaneus and the direction that the pin is run (Fig. 3*A* and *B*). We have found that this measure provides an accurate and reproducible assessment of the desired length, obviating the need for depth gauge use. If the morphology of the calcaneus has been distorted by trauma or congenital malformation, this measure could vary. Once the 3/32-in. Steinmann pin block has been applied, the joint should be fixed into position. To adequately apply the 7/64-in. Steinmann pin, the anatomy of the talar neck should be assessed to prevent impingement of the ankle by the screw head. It is usual to find a natural dell that exists on the superior surface of the talar neck just distal to the anterior border of the talar dome cartilage. This dell is readily palpable and is easily penetrated with blunt instrumentation. The countersink device for the 7.3-mm screw can be used to puncture a notch in this region to ensure proper pin placement and prevent slippage while seating the 7/64-in. Steinmann pin. With the joint in neutral position, the calcaneal tuberosity is then held within the palm of the hand. In the case depicted in the present report, the patient's left heel is held in the surgeon's right hand, and the pin is driven from the superior aspect of the talar neck into the plantar–lateral aspect of the calcaneal tuberosity. If the pin is aimed directly toward the palm of the hand, it will reside coaxial with the STJ axis of motion (Fig. 2). This leaves the joint subject to motion about the pin; hence, the need for the lateral process blockade. Once the STJ screw has been applied and its position confirmed using intraoperative fluoroscopy on multiple orthogonal planes, the 3/32-in. Steinmann pin can be replaced by a Rush rod of appropriate caliber and length (Fig. 3*C*). Application of the Rush rod can be done effectively by reproducing the alignment of the provisional Steinmann pin using manual instrumentation; a Kocher forceps or pliers works well for this purpose (Fig. 4). Once the Rush rod has been seated into the floor of the anterior STJ, the hooked end of the device is advanced further to engage the periosteum, much the same as when applying a Kirschner wire for fixation of an Austin first

Fig. 1. The 3/32-in. Steinmann pin lateral process block driven through floor of sinus tarsi and seated in inferior aspect of anterior body of calcaneus. Steinmann pin rests superior to 2 leads of internal bone stimulator device. The position and alignment of the subtalar joint and pin were confirmed using intraoperative fluoroscopy to ensure no major breech in device application. Throughout isolated subtalar joint fusion, a modicum of fluoroscopy is required to ensure that the subtalar joint screw aligns in bone to achieve compression of the parts, facilitating bone consolidation. It is important to ensure that the lateral process block and subtalar screws do not overpenetrate the bone, impinge on the soft tissues, or violate peripheral neurovascular elements. An unusual prominence of fixation, especially lateral, medial, or plantar protrusion of the fixation devices, increases the risk of postoperative complications.

Fig. 2. Intraoperative view of the placement of the 3/32-in. Steinmann pin for a lateral process block. Note, to achieve proper angle to block the lateral process, one's hand must lay against the limb. The 2-lead internal bone stimulator is placed across the anterior, middle, and posterior aspects of subtalar joint.

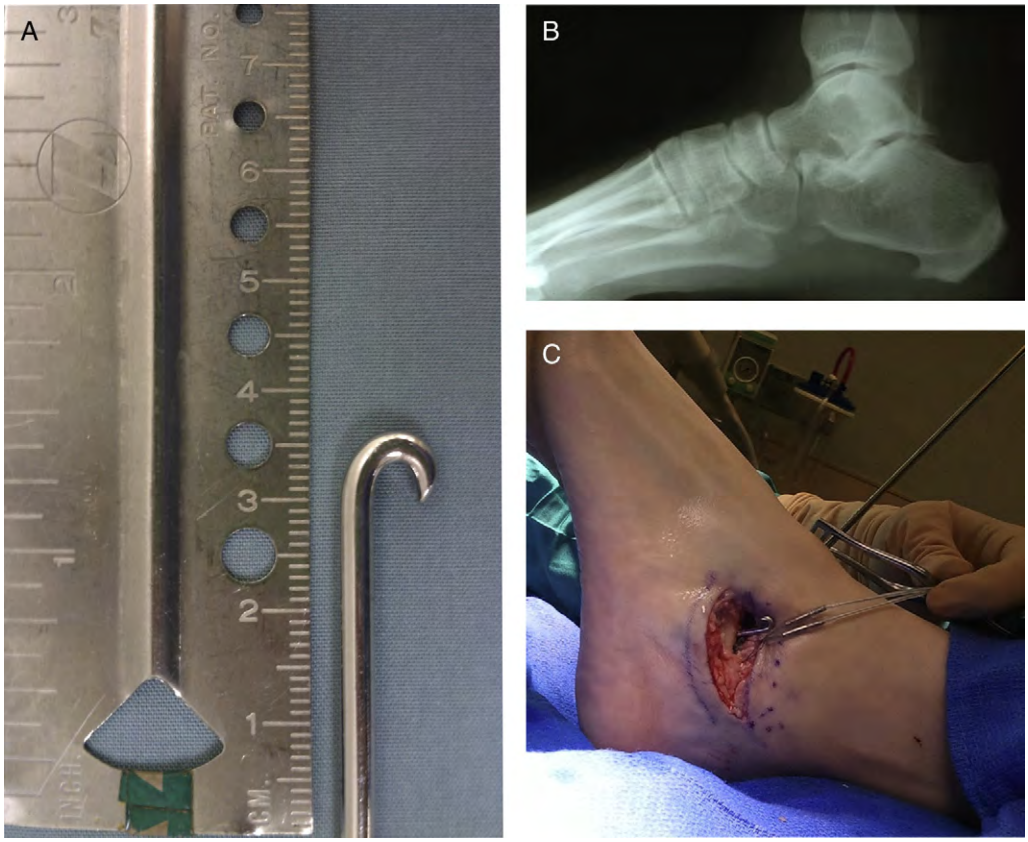

Fig. 3. (*A*) Rush rod can be premeasured and cut in preparation for subtalar joint fusion, improving the efficiency of this technique. (*B*) The length of Rush rod can be measured from the preoperative radiographs and often measures 30 to 35 mm in length, commensurate with the height of the anterior third of the calcaneal body. (*C*) The 3/32-in. Rush rod replaces the Steinmann pin. The prebent "candy cane" shape facilitates seating of the device within the floor of the sinus tarsi, very similar to how a cut and bent Kirschner wire is used to capture the periosteum when fixating an Austin osteotomy. The traditional technique, which measured, cut, and bent the 3/32-in. pin, was identical to that described for prebending of a Kirschner wire for buried fixation of an Austin osteotomy of the first metatarsal metaphysis. Use of the prefabricated (i.e., prebent) Rush rod avoids the need for cutting and bending this very heavy gauge pin. This technique modification saves time in preparation and reduces the tourniquet and anesthesia time to some degree.

Fig. 4. Rush rod seated into floor of sinus tarsi using a Kocher clamp. The "candy cane" end of the rod is advanced until the free end of the device captures bone. The prominence of the rounded end serves to block the lateral process of the talus. This provides a second point of fixation of the subtalar joint, preventing rotary motion at the joint level. In this technique, the subtalar joint screw is placed in the same direction as the axis of motion of the subtalar joint; thus, rotation about this axis is possible. Therefore, it is prudent that a second point of fixation is used to supplement stabilization of the parts.

metatarsal distal metaphyseal osteotomy. Once complete, this provides a "doorstop" effect at the anterior margin of the lateral process of the talus, thereby inhibiting rotational motion about the arthrodesis. Intraoperative fluoroscopy is used to confirm the alignment and length of the fixation devices to ensure that a breach has not

Fig. 5. Rush rod seated anterior to lateral process of talus. The bent end of the rod is rotated medially and advanced to engage the bone on the floor of the sinus tarsi, similar to the seating of an osteotomy Kirschner wire to capture periosteum.

Fig. 6. Lateral radiograph revealing lateral process block seated in floor of sinus tarsi anterior to lateral process of talus.

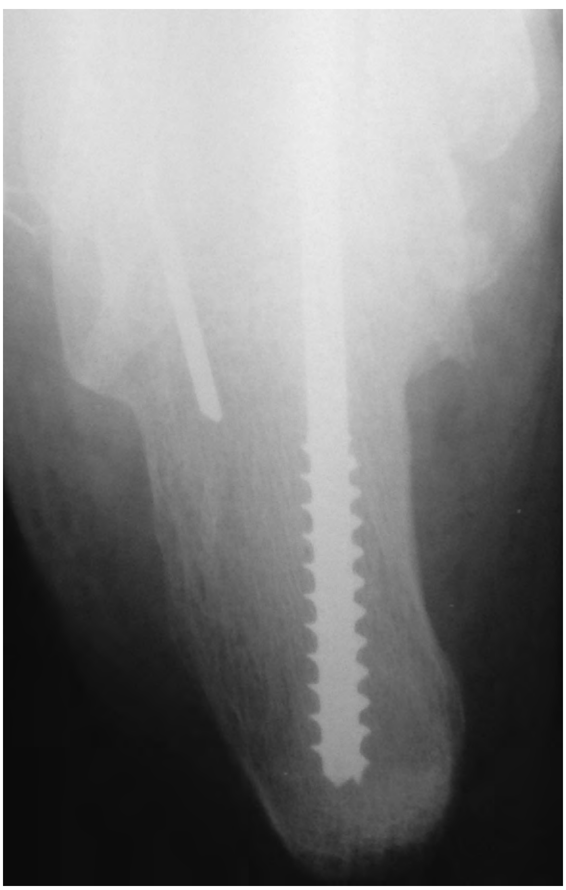

Fig. 7. Calcaneal axial view revealing alignment of lateral process block compared with alignment of subtalar joint screw. This view is important because it reveals a number of important properties of the structure and alignment of the parts. First, the long leg axial view confirms the adequate position and alignment of the rear foot with the leg because the subtalar joint screw appears to bisect both the tibia and the calcaneus. Second, the region of the subtalar joint (STJ) facets is clearly visible, requiring middle facet tarsal coalition resection and STJ arthrodesis. Third, this view confirms that the position and length of the fixation devices is appropriate. In the event that the STJ screw is less than optimal (i.e., overpenetrating the lateral wall, plantar aspect of the tuber), the device should be redirected. This will ensure the most appropriate fixation technique to avoid the untoward complication of soft tissue impingement or peripheral nerve injury.

Fig. 8. Anteroposterior left ankle radiograph revealing lateral process blockade of talus and 7.3-mm subtalar joint screw without evidence of unusual prominence or impingement of ankle. The “candy cane” end of the Rush rod can be seen as it abuts the anterior border of the lateral talar process in this magnified view.

occurred of the cortical margins of the calcaneus that could result in soft tissue or neurovascular irritation or impingement (Fig. 5). Once the proper position and alignment of fixation has been confirmed using fluoroscopy on multiple orthogonal planes (Figs. 6, 7, and 8), the joint can be challenged by manipulation a final time, ensuring rigid and stable fixation of the arthrodesis before closure.

Discussion

The use of a Rush rod has been described and used in orthopedic surgery for a myriad of procedures for a long period. This device was named after a surgeon who popularized a variation of Kuntscher’s nail for use in dynamic intramedullary fracture fixation of the femur (15). This device is economical, relatively easy to use, and has a prebent end that can be manipulated to engage the floor of the sinus tarsi. In 2012, in the northwest Ohio region, a 3/32-in. Rush rod cost approximately $120 compared with $310 for a 7.3-mm cannulated screw (80-mm length). Although it can be argued that a Steinmann pin is a simple and low-cost (approximately $40) device, accurate bending and cutting of such a thick-gauge device can be arduous. Hence, in a crude sense, and without considering patient quality of life, complications, and other factors that constitute a detailed cost-effectiveness analysis, it seems that the use of a Rush rod, as described in our report, is likely to be less expensive than the use of other fixation devices. The technique we have described is practical, because Rush rods are readily available in a spectrum of gauges, and their application requires a minimum of commonly available instrumentation (i.e., trauma drill, heavy pin cutter, and Kocher forceps or needle nose pliers). Given that STJ arthrodesis is often a relatively straightforward procedure, the application of a second point of fixation need not be taxing in time or expense. The senior author (M.S.J.) has been using a lateral process blockade as a supplement in STJ arthrodesis for nearly 2 decades without complications or the need for removal. The lateral process blockade, specifically using the Rush rod, appears to be easy to apply, economical, and effective in eliminating rotary motion between the talus and calcaneus when arthrodesis is desired.

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