

CALLOUS DISTRACTION TECHNIQUES FOR BRACHYMETATARSIA

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Callous distraction techniques have been employed for the treatment of congenital brachymetatarsia for a number of years. This technique has been quite helpful in alleviating symptoms as well as cosmetic concerns due to a short metatarsal. However, this technique can also be used for patients with iatrogenic brachymetatarsia. In fact, this may be a preferred technique in some individuals with post-operative complications. The author would like to describe his experiences with this treatment modality as well as some of the technical components of the procedure that may enhance the overall utilization of this approach.

GENERAL THOUGHTS

Callous distraction within the foot was initially described for the treatment of congenital brachymetatarsia. Prior to that time, this particular condition had been treated successfully with osteotomy of the metatarsal and the insertion of a bone graft. The greatest potential risk with this procedure was that the acute lengthening would place undue tension on the vascular structures, create vasospasm, and result in the loss of the digit. Fortunately, this was not a common complication, but in many instances difficulty could be encountered when a significant degree of lengthening was required. The soft tissue tension would tend to limit the degree of lengthening which could be achieved in an acute setting, possibly compromising the overall result even if vascular problems did not develop.

Therefore, the introduction of callous distraction techniques provided a significant improvement over the old bone grafting procedures. The gradual lengthening provided sufficient time for the soft tissues to adapt so that vascular insult was no longer a concern. Furthermore, callous distraction was a more forgiving procedure and the surgeon could control the amount of lengthening over time, as opposed to being restricted to the degree of correction that could be achieved at the time of surgery itself. Although complications can be noted

with callous distraction, generally speaking these can be managed reasonably well.

Callous distraction can also be used for the treatment of iatrogenic shortening of a metatarsal. There are a number of different approaches that could be used in patients with shortening of this nature. The specific procedure may vary based upon the anatomy and deformity which is evident, the degree of shortening, and other concomitant conditions such as previous infection.

SURGICAL OPTIONS

Bone Grafting

Bone grafting still provides a very effective means of correcting deformity following previous surgery, whether the problem is shortening or other angular deviations. In most instances good correction can be achieved. However, the disadvantages of bone grafting include additional surgical morbidity due to an iliac crest or calcaneal donor site, the potential for graft failure, and limitations relative to the ability to lengthen the bone in an abrupt manner. Thus, in case of iatrogenic shortening of a metatarsal, bone grafting can hold some of the same potential problems as seen in the use of this technique in congenital brachymetatarsia. However, in a patient who has previously undergone surgery, the surrounding fibrotic or scar tissue may also limit the degree of lengthening which can be achieved with bone grafting. Furthermore, as lengthening is performed one will place a greater degree of tension on the metatarsophalangeal joint, possibly leading to a joint limitus. This may be more of a problem in patients with periarticular fibrosis due to antecedent surgery.

In addition, if there has been a previous history of infection in the area, there may be a greater potential for subsequent infection with a secondary procedure. In this circumstance, if infection should develop following a bone graft, then the procedure may ultimately fail. Bone grafting procedures also require a significant interval

of nonweightbearing until graft incorporation has been achieved. In most instances where a bone graft is performed a plate and screw fixation will be required, probably necessitating a subsequent procedure to remove the hardware.

Sagittal Z Osteotomy

Sagittal Z osteotomy is another alternative that provides lengthening and some degree of correction in the sagittal plane. This procedure avoids the need for autogenous bone grafting, and because it is an osteotomy, there is a greatly reduced healing interval, although nonweightbearing will be required during the initial postoperative period. In addition, the same concerns relative to creating excessive tension at the metatarsophalangeal joint may be relevant with this procedure as well. Although the author has used this osteotomy in the lesser metatarsals with success, the rather narrow configuration of the bone makes the technique more difficult. In some patients, the osseous anatomy may prove inadequate for a sagittal Z procedure.

Callous Distraction

Callous distraction can obviate some of the concerns relative to joint tension because the lengthening is achieved over an interval of time, allowing the soft tissues to adapt more readily. In addition, a significant degree of lengthening can be achieved, and some degree of correction may also be provided in different planes as well. Plate fixation will not be required with this technique. However, callous distraction will also require a significant interval of nonweightbearing during the postoperative period. In fact, this interval of nonweightbearing in many instances may exceed that which would be required with a bone graft. However, this approach may allow for lengthening of a shortened metatarsal without the disruption of a previously infected surgical area.

Technical Issues

Callous distraction is a simple technique, although there are several technical points that should be mentioned. First, it is important to attempt to minimize the degree of soft tissue dissection that is performed around the metatarsal itself. In particular, the author attempts to minimize the degree of periosteal disruption. Generally speaking, once the osteotomy site is identified, a small linear

incision is made over the shaft of the metatarsal. A freer elevator is then introduced around the medial and lateral margins of the metatarsal to create a pocket that will allow free access for the osteotomy. No further disruption of the periosteal tissues is performed. Once the osteotomy is completed, this periosteal incision is then reapproximated with absorbable suture.

In most instances the skin incision is long enough to provide adequate exposure and visualization of the osteotomy itself. The pins may be inserted percutaneously in most instances, thereby avoiding further soft tissue disruption.

The author's preference is to insert the distal pin for the apparatus first. In most instances, there is little if any limitation of space or osseous tissues for insertion of pins proximally within the foot. However, this is not the case as one moves further distally, and it would be preferable to avoid insertion of a pin into a digit. Therefore, the author will first insert the pin into the distal aspect of the metatarsal and use this as the basis for subsequent pin location. Fluoroscopy is very helpful in assessing pin placement and location before proceeding.

Once the distal pin has been inserted and the location judged to be suitable, the most proximal pin is then usually inserted. This will provide for a more certain location of the proximal pin, and generally provides a more linear relationship with all of these devices. In many patients this may necessitate that the two proximal pins span the metatarsal cuboid or the metatarsal cuneiform joint. One should carefully assess the actual distraction device itself when aligning the pins to ensure that the pins are not so far from the osteotomy that adequate distraction cannot be achieved. Remember that the frame must fit onto the pins and only a finite amount of lengthening is provided by the device. If the distance between the proximal and distal segments is too great then there will be little space left on the frame for additional separation, (i.e. distraction), between the segments.

Once the pins have been inserted and the position is deemed suitable the osteotomy is then performed. If the osteotomy is performed prior to this stage then the distal metatarsal segment will be freely movable and insertion of the pins will be much more difficult. In addition, achieving a linear relationship with the pins will be more difficult once the osteotomy has already been performed. The external frame is then placed over the pins and the osteotomy site is compressed. The wound is closed with absorbable sutures and in most

instances the author uses a Jones compression dressing. This type of cast is used during the initial postoperative phase as it provides a measure of protection for the external frame. Although this is not a necessity, it does generally provide a certain level of comfort and security for the patient until they can become adjusted to the presence of the frame. The cast is usually discontinued within the first week or so after the surgery.

In some patients the distraction process will result in deviation of the toe due to the tension that is placed on the flexor or extensor tendons. A number of authors have described inserting a Kirschner-wire into the associated digit, and at times across the metatarsophalangeal joint as it is believed by some that the use of the wire will tend to mediate this effect. The author has not found that this is a problem, and a pin is not used routinely in the associated toe. However, there have been some patients where the toe required some additional splintage with tape during the lengthening process to overcome this type of problem.

Postoperative Care

As noted above, the patient is usually placed into a Jones compression cast initially. The patient is maintained nonweightbearing until it is deemed that sufficient lengthening and healing have occurred. At two weeks after surgery the patient will begin the distraction process, turning the apparatus one-quarter turn every six hours. Radiographs are then made periodically to assess the amount of lengthening which has been achieved, and once this is felt to be sufficient, the patient is instructed to discontinue the distraction process. Should the metatarsal be overlengthened, the reverse process can be employed, that being shortening of the metatarsal until a sufficient length has been achieved.

Afterwards, the patient is evaluated periodically with radiographs to determine when there has been sufficient healing for initial weightbearing. Once this interval has been achieved, the author will allow the patient to begin initial weightbearing with the pins and frame in place. It is felt that this provides some measure of protection against excessive weight-bearing forces on the newly lengthened area of bone. The author has seen some patients where sagittal plane deformity has developed in the metatarsal once weightbearing was instituted. In those circumstances, it was usually due to the fact that the frame was removed prior to the institution of weightbearing.

The patient is then re-evaluated two weeks later, at which time the distal and proximal pins are removed from the external fixator. Weightbearing continues for an additional two weeks with only two of the remaining pins in place. At that time, the remaining pins and external fixator are removed. This allows the osseous tissues to adapt to weight-bearing stress over time, reducing the likelihood of plastic deformation of the more immature bone substance.

The greatest drawback to this type of procedure is the lengthy period of nonweightbearing that may be required in some patients. On average, it takes about three months before patients are ready to begin full weight-bearing without the external fixator when a lesser metatarsal has been addressed. However, patients undergoing surgery on the first metatarsal generally require a much more lengthy interval of nonweightbearing, sometimes extending up to six months.

Complications

Potential complications with this approach are generally minor and usually will consist of some type of digital deformity due to the altered tension on the tendons. Mild cases of dorsal nerve entrapment have also been encountered, but these have responded well to local injections of corticosteroid. Furthermore, in some patients the degree of scarring in the skin can be objectionable. This is due to the fact that linear tension is being applied to the scar during the initial healing interval. Therefore, the author attempts to warn all patients prior to undergoing the procedure that this may be a factor after surgery. This may be particularly important when patients are undergoing the procedure primarily for cosmetic reasons. However, the scar can certainly be excised and primarily closed at a later time, rendering a more appealing scar for the foot.

Conclusion

Overall callous distraction is a viable alternative in a select patient group to address shortening of a metatarsal. However, the author's preference in most situations is to employ a sagittal Z osteotomy, if feasible. This approach is simple, effective, and involves less recovery time than if callous distraction or bone grafting is required. Nonetheless, callous distraction is effective, and may be preferable in most situations where previous infection has been a problem.