Multiple Needle Puncturing: Balancing the Varus Knee

JOHAN BELLEMANS, MD, PhD

Abstract

The so-called “pie crusting” technique using multiple stab incisions is a well-established procedure for correcting tightness of the iliotibial band in the valgus knee. It is, however, not applicable for balancing the medial side in varus knees because of the risk for iatrogenic transsection of the medial collateral ligament (MCL). This article presents our experience with a safer alternative and minimally invasive technique for medial soft tissue balancing, where we make multiple punctures in the MCL using a 19-gauge needle to progressively stretch the MCL until a correct ligament balance is achieved. Our technique requires minimal to no additional soft tissue dissection and can even be performed percutaneously when necessary. This technique, therefore, does not impact the length of the skin or soft tissue incisions. We analyzed 61 cases with varus deformity that were intraoperatively treated using this technique. In 4 other cases, the technique was used as a percutaneous procedure to correct postoperative medial tightness that caused persistent pain on the medial side. The procedure was considered successful when a 2- to 4-mm mediolateral joint line opening was obtained in extension and 2 to 6 mm in flexion. In 62 cases (95%), a progressive correction of medial tightness was achieved according to the above-described criteria. Three cases were overreleased and required compensatory release of the lateral structures and use of a thicker insert. Based on these results, we consider needle puncturing an effective and safe technique for progressive correction of MCL tightness during minimally invasive total knee arthroplasty.

Figure: Surgical technique for releasing medial tightness using multiple needle punctures. With the trial implants in situ, the medial soft tissue sleeve is progressively stretched using multiple needle punctures into the tense fibers, while applying a continuous valgus stress.
In the varus knee, progressive shortening or contraction of the soft tissue structures on the medial side occurs, whereas the lateral structures become stretched. The opposite occurs in the valgus knee.1-4

Performing a total knee arthroplasty (TKA) in these situations may, therefore, require some type of mediolateral soft tissue balancing to provide a stable soft tissue envelope with symmetric laxity both on the medial and lateral side.1,2,4-9

This is usually achieved by releasing one or more of the contracted structures until the soft tissue tension is equalized on both the medial and lateral sides of the knee joint.

In the valgus knee, the so-called “pie crusting” technique using multiple stab incisions is a well-established procedure for correcting tightness of the iliotibial band.1,2

It is, however, not applicable for balancing the medial side in varus knees, because of the risk for iatrogenic transsection of the medial collateral ligament (MCL). In varus knees, most surgeons therefore prefer to release or elevate the soft tissues off the tibial insertion site, using either sharp or blunt techniques. This frequently requires extensive soft tissue dissection, and frequently also an extension of the incision more distally.

This article presents our experience with a less invasive alternative, where we make multiple punctures in the MCL using a 19-gauge needle to progressively stretch the MCL until a correct ligament balance is achieved. As such, this technique can even be used as a postoperative procedure in cases with persistent medial tightness after the index TKA.

Our initial results with this procedure have been examined in a prospective study using computer navigation, and were recently published by our group in The Journal of Arthroplasty.10 The patients from that study are included in this current paper together with 30 other cases that we have treated since.

In total, 65 patients requiring medial soft tissue balancing were included in our retrospective analysis. In 61 cases, the procedure was performed during TKA. In 4 cases, it was performed at a later stage. The study group consisted of 39 women and 26 men with an average age of 67 years (range, 39-81 years).

The preoperative mechanical axis on full leg standing radiographs was 12° varus (range; 8°-25°) for the knees that underwent the procedure during the index TKA.

Once all osteophytes on the femoral condyles, intercondylar notch, and tibia were removed, the bone cuts were made and both cruciates were excised. Next, the femoral and tibial trial components were inserted, and ligament balance was performed using the needle puncturing technique.

Mediolateral balance was checked every 5 to 10 needle punctures and was assessed using maximal manual varus-valgus stress with the knee in extension and 90° flexion. The assessment was performed by the author (J.B.) of this paper who was also the senior surgeon in all of these cases.

In total, 65 patients requiring medial soft tissue balancing were included in our retrospective analysis. In 61 cases, the procedure was performed during TKA. In 4 cases, it was performed at a later stage. The study group consisted of 39 women and 26 men with an average age of 67 years (range, 39-81 years).

The preoperative mechanical axis on full leg standing radiographs was 12° varus (range; 8°-25°) for the knees that underwent the procedure during the index TKA.

Once all osteophytes on the femoral condyles, intercondylar notch, and tibia were removed, the bone cuts were made and both cruciates were excised. Next, the femoral and tibial trial components were inserted, and ligament balance was performed using the needle puncturing technique.

Mediolateral balance was checked every 5 to 10 needle punctures and was assessed using maximal manual varus-valgus stress with the knee in extension and 90° flexion. The assessment was performed by the author (J.B.) of this paper who was also the senior surgeon in all of these cases.

The procedure was considered successful when a 2- to 4-mm maximal mediolateral joint line opening was obtained in extension and a 2 to 6 mm opening was obtained in flexion.

In the 4 patients that underwent the procedure after a prior index TKA, the procedure was performed for persistent tightness with an absent medial joint line opening during valgus stress, and in each case this was confirmed with stress radiographs.

**SURGICAL TECHNIQUE**

The technique requires the medial soft tissue sleeve to be tensioned, which is achieved by holding the knee under valgus stress. As such, it is easy to identify the most tense fibers by digital palpation or even while inserting the needle. A standard 19-gauge aspiration needle is used to pierce the tensest fibers by puncturing in a perpendicular or slightly oblique fashion, while the knee is continuously stressed in valgus (Figure). A standard aspiration needle can be used, or even better, a 19-gauge spinal needle, since these are somewhat longer and easier to use for this purpose. Punctures are performed every 3 to 5 mm apart, in a similar fashion as the stab incisions are made in the “pie crusting” technique used for releasing the iliotibial band in the valgus knee.

Every 5 to 10 punctures, mediolateral balance is reassessed using manual varus-
valgus stress with the knee in extension and 90° flexion, until the appropriate medial joint line opening is achieved. Usually, this occurs progressively after 5 to 35 punctures, depending on the severity of the tightness. If the tightness is observed in extension or flexion only, the punctures are carried out respectively in extension or flexion only, thereby puncturing only the tight soft tissue fibers. Tightness in flexion indicates that the anterior fibers require release. Tightness in extension indicates that the posterior fibers are shortened and required correction of medial tightness that was present both in flexion and extension, 21 knees in extension only, and 10 in flexion only.

Three cases were considered as failures (over-released) according to the previously described criteria. One case was considered over-released in extension (>4 mm), and required compensatory iliotibial band release and the use of a thicker insert. Two cases were considered over-released in flexion and required the use of a constrained condylar knee (CCK) insert to provide sufficient stability in flexion.

During follow-up, no signs of clinical instability were noted in any patient. Two patients required manipulation of the knee under anesthesia at 2 weeks postoperative because of insufficient flexion.

**DISCUSSION**

This article presents our experience with a minimally invasive technique for medial collateral ligament balancing in the varus knee. The technique requires no additional soft tissue dissection and can be performed relatively easily while using a standard minimally invasive approach. Using multiple needle punctures, the shortened medial soft tissue sleeve is progressively stretched while applying a constant valgus stress during the puncturing maneuver. Once the appropriate release is obtained, the procedure is finished and does not require any specific postoperative protective measures different than those for a standard TKA. Our data suggests that the technique is safe and does not compromise mediolateral stability of the knee.

**REFERENCES**


