

Arthroscopic Techniques

Figure-of-nine position: A convenience trick for standard technique of ACL reconstruction

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ABSTRACT

While position of leg during arthroscopy may not affect clinical outcome of a well-done ACL reconstruction, better view during reconstruction, more efficient fluid ingress in position of hyperflexion during femoral tunnel drilling, decreased crowding of instrumentation, and convenient disposition during surgery for surgeon and assistant with need for reduced logistics are some advantages of figure of nine position. Adoption of this alternative position in arthroscopic ACL reconstruction is easy because it does not require alteration to standard technique of ACL reconstruction. There are even greater merits for considering this position for three portal medial viewing medial drilling techniques.

Keywords: ACL reconstruction, Figure-of-nine position, Figure-of-four position, Three-portal technique, Tips and Tricks in ACL reconstruction

INTRODUCTION AND REVIEW OF LITERATURE

The figure-of-four position is the classic arthroscopic position for exploration of the lateral compartment of the knee.^[1] Figure-of-nine position differs from figure of four position [reverse figure of four for the left knee: Figure 1] in that the sole of affected side is placed against the medial aspect of contralateral thigh [Figure 2] instead of placing the ankle over the front of thigh.

The use of figure-of-four position produces a tibial varus torque and internal rotation stress which tightens the PL bundle and makes its visualization better.^[2] Literature duly recognizes that figure-of-four position provides increased exposure to the posterolateral aspect of the intercondylar notch and is optimal position for visualization of the posterolateral bundle.^[1,3] Furumatsu *et al.*,^[1] however, found figure-of-four position unsuitable for ACL reconstruction because operation table interferes with free access to the lateral aspect of the knee. He described figure-of-nine position to place the lateral aspect of knee beyond the edge of operation table [Figure 3]. He pointed out that figure-of-nine position provides a similar arthroscopic view with the freedom of access [Figure 3] from lateral aspect avoiding interference or contamination from the operation table.

Furumatsu *et al.*,^[1] however, used figure-of-nine position for outside-in reaming of femoral tunnels in DBACL reconstruction. We describe our experience of using figure-of-nine position for conventional inside out reaming for standard transportal single-bundle (SB) reconstruction. We find that figure-of-nine position has several advantages of convenience over a standard “knee flexed-leg vertical” position for SB ACL reconstruction.

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Figure 1: Figure-of-four position.



Figure 2: Figure-of-nine position: Please note the restraint improvised from a simple roller bandage.

TECHNIQUE

The contralateral leg is secured to operation table with a restraint, improvised from a roller bandage [Figure 2] to prevent it from being pushed off the table. The operated limb is scrubbed, draped as per the routine. Diagnostic arthroscopy, partial meniscectomy/meniscus repairs, or other associated pathologies are addressed as necessary in knee flexed-leg vertical position by the side of the table as per the standard practice of the surgeon. Authors of this study do not use any leg holder and option of figure-of-nine position for femoral tunnel drilling would not be available for a surgeon who uses a leg holder.

Figure-of-nine position is used for femoral tunnel drilling only. Authors of this technical note always follow “femoral tunnel first” technique. Sole is placed against medial aspect of opposite knee/thigh allowing the leg to lie flat on the table while the lateral aspect of the proximal tibia and distal femur

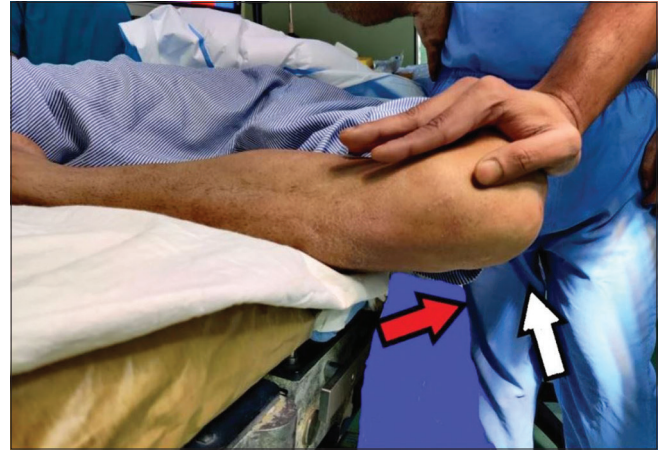


Figure 3: Demonstrating how the knee and lateral aspect of distal thigh protrudes beyond the edge of table (red arrow) and affords free access to lateral aspect (white arrow).

protrudes beyond the edge of operation table providing free access to lateral aspect of distal femur for later suture management and flipping of button [Figure 4]. Viewing is done through standard AL portal and guide wire placement and reaming is done in through the AM portal albeit in figure-of-nine position. Femoral tunnel length obtained with this technique was adequate and between 32 and 35 mm and socket was reamed to depth between 25 and 28 mm. Fixed length loop of 15 mm with button was used in most cases, however, the technique is easily adaptable to adjustable loop with button as well.

Tibial tunnel drilling is done in the knee flexed leg vertical position as per the standard practice of the surgeon. Tibial fixation is done with biocomposite interference screw in majority of case in 15–20° flexion as routine.

DISCUSSION

Figure of four is preferred position for diagnostic round and meniscectomy in lateral compartment because it is loosely packed position of the knee compared to “90°-knee flexed-leg vertical” position. In the standard vertical knee position, the articular surfaces of lateral compartment are much more closely articulating [Figure 5] compared to varus stressed position of figure-of-nine position [Figure 6].

Besides varus stress opening, figure-of-nine position in addition causes internal rotation of tibia and makes lateral collateral ligament and PLC lax. Lax collateral ligaments and PLC make space in posterolateral joint [Figures 7a and b] even more loose which affords easier viewing, instrumentation, triangulation, and drilling, particularly during the critical step of femoral socket preparation.

In “leg-vertical” position, closely congruent tibial and femoral condyles on either side, roof of the notch above, and patella and



Figure 4: Please note the placement of loop for shuttling of graft.

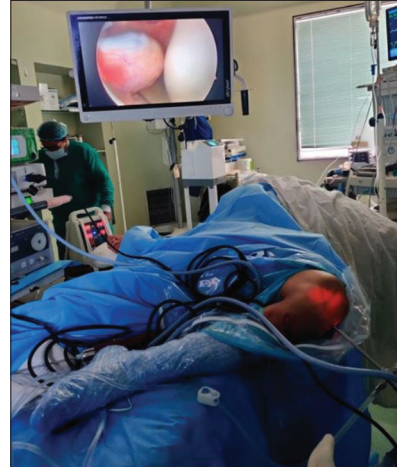


Figure 6: Please note opened up posterolateral joint space in figure-of-nine position.



Figure 5: Notch view shown on monitor with knee-flexed-leg-vertical position; note closely articulating tibial and femoral articular surfaces.

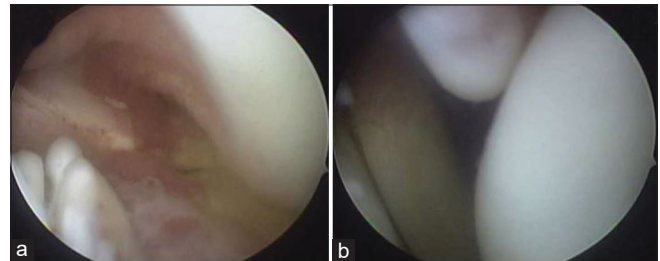


Figure 7: Arthroscopic view of working space for ACL reconstruction in posterolateral joint area (a). Knee-flexed-leg-vertical position (b). Figure-of-nine position.

synovial fat pad in front limit the space in notch, particularly in hyperflexion position [Figure 8], required for optimum femoral socket creation^[4] in transportal technique. We understand that internal rotation of tibia moves tibial tuberosity medial wards so that patella tracks with greater medial orientation than standard “leg-vertical position” and frees greater space in notch area, particularly along its lateral wall [Figure 9]. This additional space is of particular value in hyperflexed position to allow placement of both the scope and instrumentation in notch with increased maneuverability, less crowding and clashing of instrumentation, and better visualization.

Furumatsu *et al.*^[1] published excellent pictures to illustrate the superior visualization of ACL remnant tissue, lateral meniscus posterior root (LPMR) as well as supplemental fibers of LPMR to ACL, and medial tibial eminence with figure-of-nine position

vis-a-vis standard knee-flexed position. Authors remarked that arthroscopic removal of torn scar tissue at the ACL femoral footprint in “90°-flexed knee-leg vertical” position may damage the LPMR and its supplemental fibers. With patella and fat pad pushing down on the scope and reamer in the reduced notch space in knee hyperflexion, these structures suffer damage from shaft of flower reamer: Particularly because the angle of scope is turned superior to view ACL socket site and these structures escape field of view [Figure 8].

Reduction of notch space in hyperflexed knee position has another undesirable effect. In patients with narrow notch, hyperflexed position forces partial withdrawal of scope, because either of offset zig or the reamer is occupying much space in the notch already. With this partial withdrawal, over-the-top view either becomes “distant” or “lost altogether” [Figure 8]. Correct offset zig application requires a good over-the-top view. Authors of this article sometime had to give up use of offset zig and use “free hand guide wire insertion technique” to avoid losing the over-the-top view, particularly in patient with narrow notch. This free hand guide wire insertion technique has an added risk of inadvertent posterior blow outs.



Figure 8: Hyperflexed-Knee-leg-vertical position: Notch space is much reduced, over the top view is lost. Assistant is in inconvenient disposition. To bring the knee to table level for fluid ingress equivalent to Figure-of-nine position, assistant must bend on his knees/back and will be even more inconvenienced.

Loosely packed position of lateral compartment coupled with opening of lateral compartment due to varus and internal rotation induced by figure-of-nine position with patella tracking with medial orientation with more efficient gravity-assisted ingress of irrigation fluid permits enough space in the notch to maintain the scope much deeper in the posterolateral notch, even while offset zig or reamer is already inserted, helping maintain over-the-top view throughout the femoral tunnel preparation procedure. Ability to directly observe the reaming in hyperflexed position while maintaining over-the-top view may be of value to “avoid by early detection” possibility of posterior blow out, particularly in patients where “free hand guide wire insertion technique” was used.

In “leg-vertical-hyperflexed position” and standard two portal arthroscopic ACL reconstruction, bone debris of drilling collects in the inefficiently irrigated reduced notch space obstructing the reading of calibration mark on reamer. It is often necessary to aspirate the debris with shaver immediately either through an additional third portal or enlarge the AM portal itself so that the shaver can also be inserted thru the AM portal while the reamer is already placed through AM portal. This maneuver to clean of the debris to have a



Figure 9: Figure-of-nine position: Nice view of guide wire is obtained with good view of over-the-top position as well as articular margin. Assistant maintains hyperflexion position with one hand. Knee is placed at table level for efficient gravity-assisted fluid irrigation without inconvenience.

clearer view of the calibration of the reamer is small but a common irritant in an otherwise very elegant arthroscopic ACL reconstruction. Arthropump “flush” option is elegant solution but involves an additional logistic. In figure-of-nine position, socket is created in dependent position and that prevents debris collecting around the calibrations in the notch as most of it gravitates down into lateral compartment rather than accumulating around [Video 1] mouth of socket; in fact, much less debris comes out and most stays within tunnel [Video 1] again because mouth of socket is facing antigravity in figure-of-nine position.

Most remarkable convenience in figure-of-nine position is ability to maintain hyperflexion without an assistant [Figure 9]. Assistant is awkwardly disposed during holding of flexion [Figure 8], especially with leg on the side of table. In fact, for obtaining the same efficiency of gravity-assisted fluid irrigation and joint cavity dilatation, assistant must bend his back going down to almost his knees, straining his back much awkwardly. In fact, the assistant shown in figure, is junior consultant who is a diagnosed case of PIVD and

will not bend his back. In this situation, figure of four is a big help.

And then, the assistant must maintain the hyperflexion position for fairly long period starting with guide wire insertion to depth gauging to reaming to Ethibond loop placement. There had been occasions, though rare if one works with same operating team members, of bent wires because some movement of knee occurred. In institutions like ours where residents are your assistants who keep changing due to rotation in various units or end of the tenure, a few occasions did occur. In figure-of-nine position, assistant is just holding the foot and supervising the position which the surgeon placed the knee in, at the beginning of guide wire insertion and even if assistant loosens his hold knee movement does not occur. This removal of element of human error by the assistant has been one of the most attractive of advantages of figure-of-nine position, at least for us.

Three-portal technique^[5] has been described in literature for simultaneous medial viewing and medial drilling of femoral socket using two portals placed with “90°-knee flexed-foot resting on the table position” and the surgeon accessing the medial aspect from contralateral side. Despite the advantage of a frontal view of ACL remnant site, the procedure has not become much popular possibly because of procedural difficulties of access from contralateral side and impeded fluid irrigation with knee upright on table. We have used “medial viewing and medial drilling” philosophy with leg in figure-of-nine position and find this position to afford equally convenient access for viewing and reaming [Figure 10] as it is for lateral viewing and medial reaming. Gravity-assisted fluid irrigation is also equally efficient as in “knee by the side of table” as knee lies flat on table.

Authors of this article have been using figure-of-nine position for nearly 6 years and have used this technique in more than 150 cases and believe that figure-of-nine position as described above has several advantages of convenience

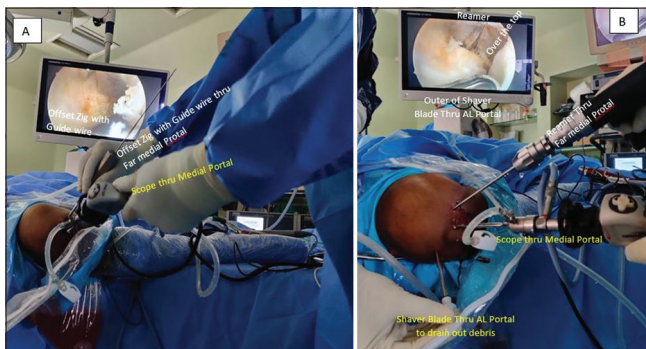


Figure 10: Three portal medial-viewing-medial-drilling technique: Note that medial access is obtained from ipsilateral side. irrigation is efficient without arthropump as the knee is placed flat on table. Outer of shaver blade can be used to drain out debris from AL Portal.

compared to standard knee flexed-leg vertical position: Better view, more efficient fluid ingress in hyperflexed position, decreased crowding of instrumentation, and convenient disposition during surgery for surgeon and assistant with need for reduced logistics. It is easy to adopt in one's arthroscopic practice as it does not require any alteration to standard technique of ACL reconstruction. There are even greater merits for considering this position for three-portal medial viewing medial drilling technique.

CONCLUSION

Figure-of-9 position for femoral socket/tunnel drilling in an arthroscopic ACL reconstruction may be a good addition to the armamentarium of an arthroscopic surgeon for its several added advantages. Adoption of this position requires only minor modification to ACL reconstruction methods without altering the standard techniques. It is more beneficial in three-portal technique.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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