Short-Term Outcomes of All-Inside Anterior Cruciate Ligament Reconstruction by The Trans-Femoral Approach

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COI　disclosure information

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Purpose

We created a drill guide for the trans-femoral approach and improved an all-inside anterior cruciate ligament (ACL) reconstruction technique that uses the drill guide to drill tibial and femoral tunnels after determining the femoral drilling position[1]. We reported outcomes at least 2 years after surgery using this technique.

Subjects

- **A total of 35 knees of 35 patients** (Men 21, Female14)

  (followed-up at least 2 years after the operation)
- The mean patient age : 36 years (13 ~61years old)
- The mean post op. follow-up period: 28.9 months

  (range: 24–48 months)

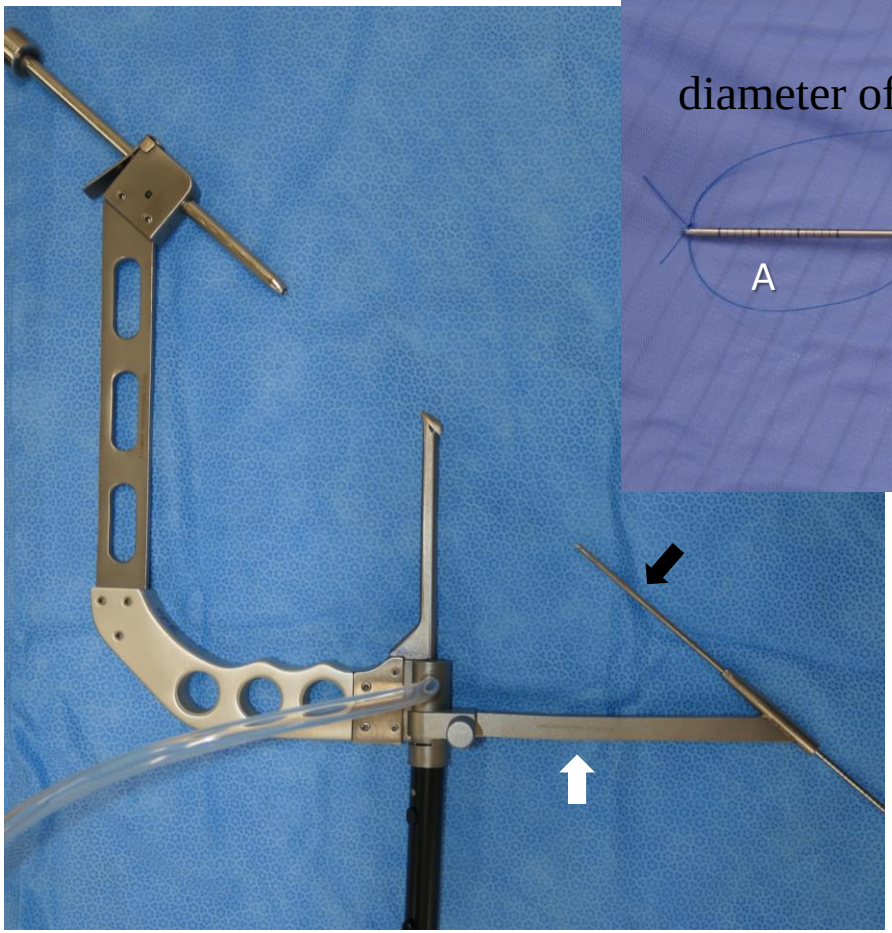
Evaluation

- Lysholm score (pre and post op)
- Side to side difference of KT-1000 (pre and post op)
- The position of the femoral and tibial tunnel measured by 3D-CT
- Comparison of the tibial tunnel positions between the knees without internal rotation of the lower limb (n=13) and those with (n=22)

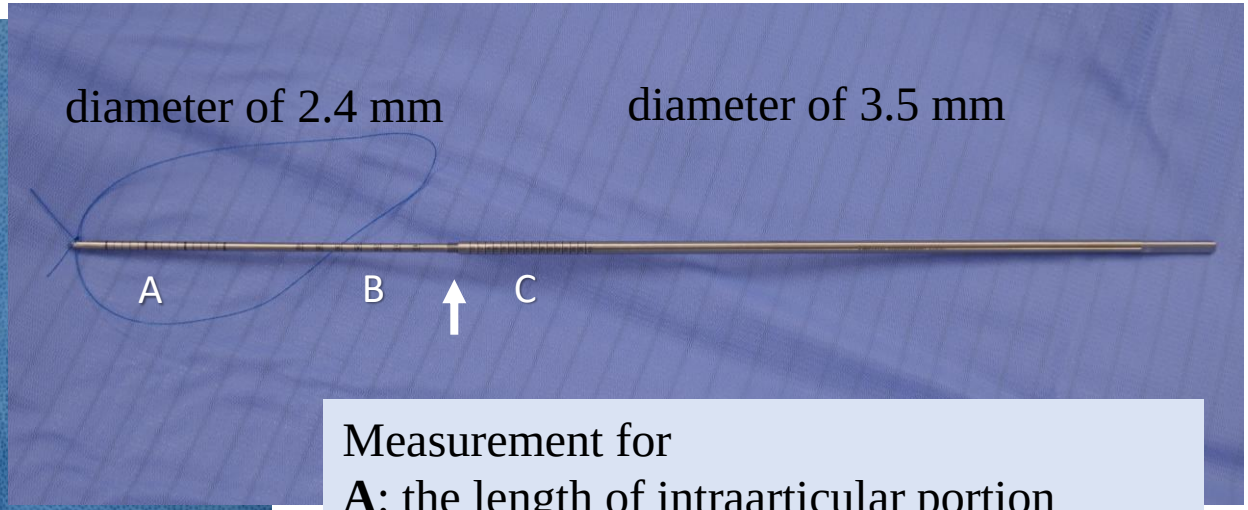
  (statistical analysis: paired t-test)

Instruments

Trans-femoral drill guide + Tibial tunnel guide (Hole-in-one guide)



Drill guide pin with an apertured tip with a 2-0 nylon loop

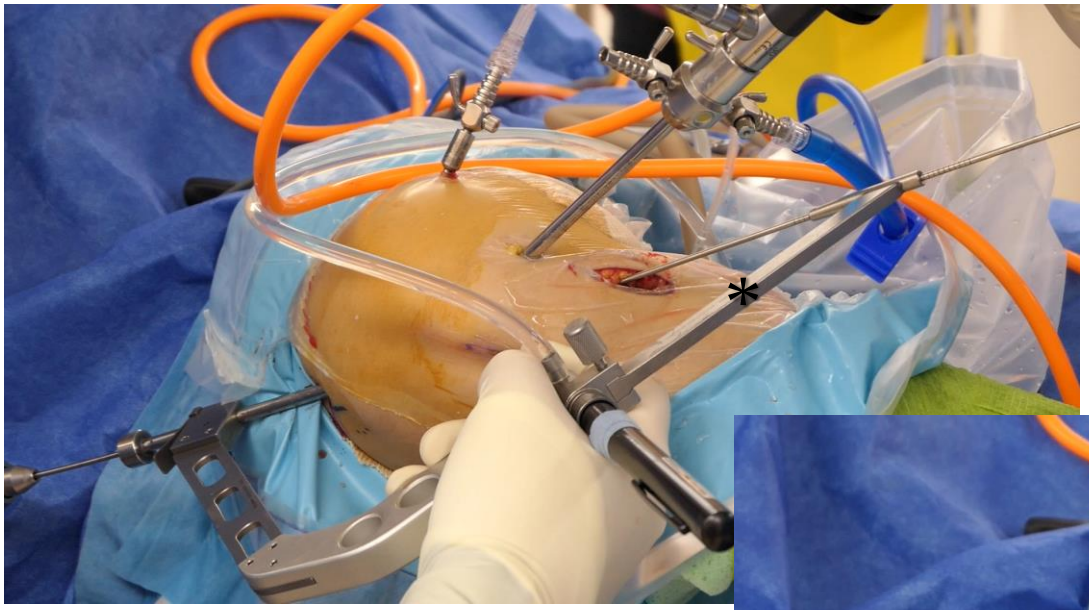


Measurement for
A: the length of intraarticular portion
B: the length of femoral socket tunnel
C: the length of tibial socket tunnel
White arrow: threading

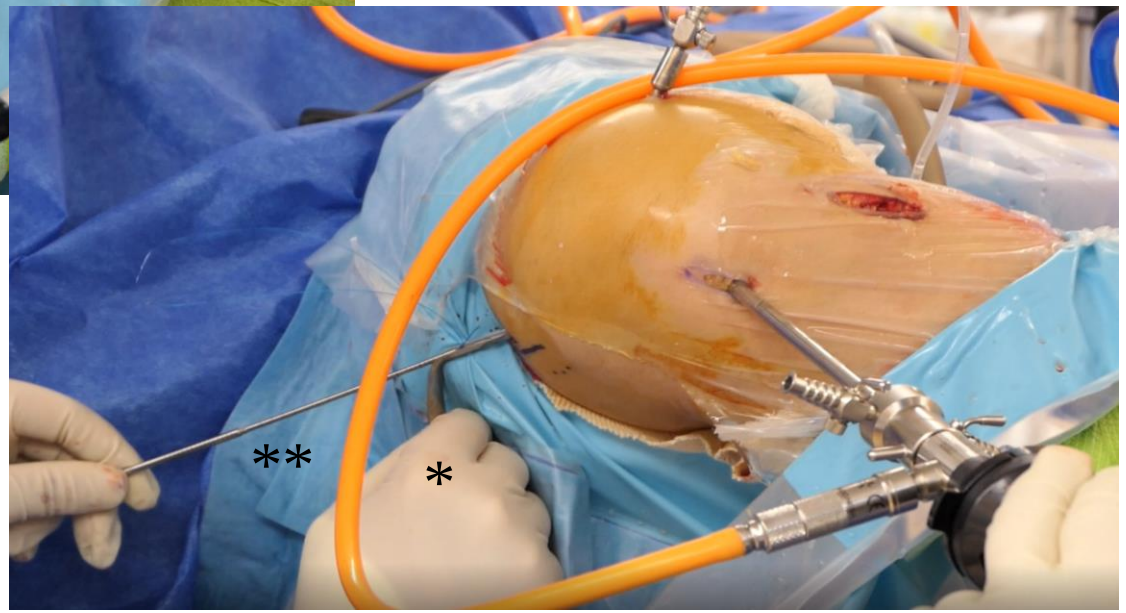
White arrow: Tibial tunnel guide can be integrated with the trans-femoral drilling guide.
Black arrow: The kirschner wire that indicate the location of the tibial tunnel exit on the anterior aspect of the tibia.

Methods (1)

The drilling guide set installed during operation.
Asterisk (*) indicates the tibial tunnel guide.

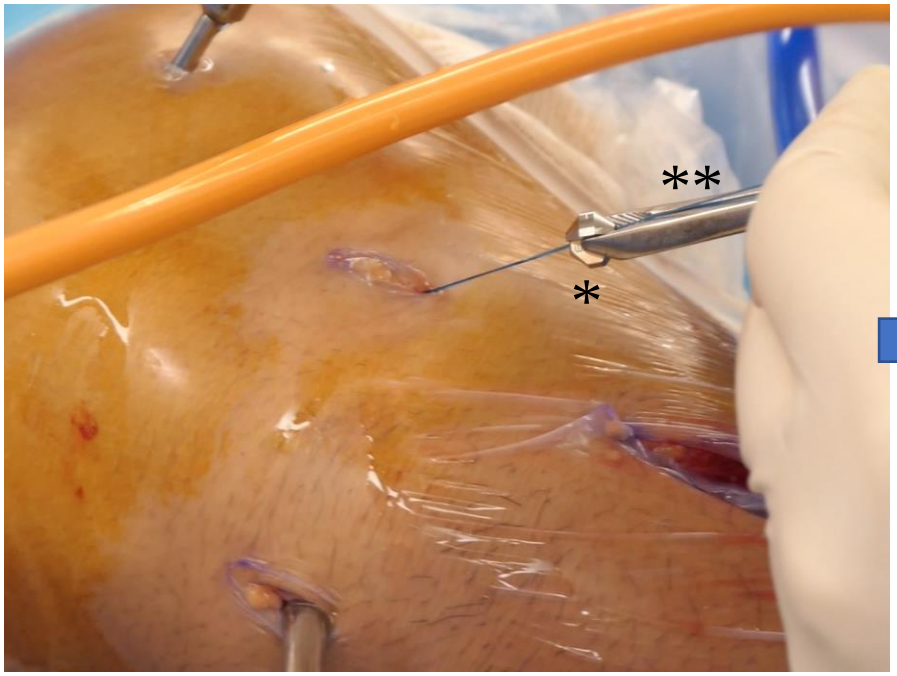


Knee flexion of 90°

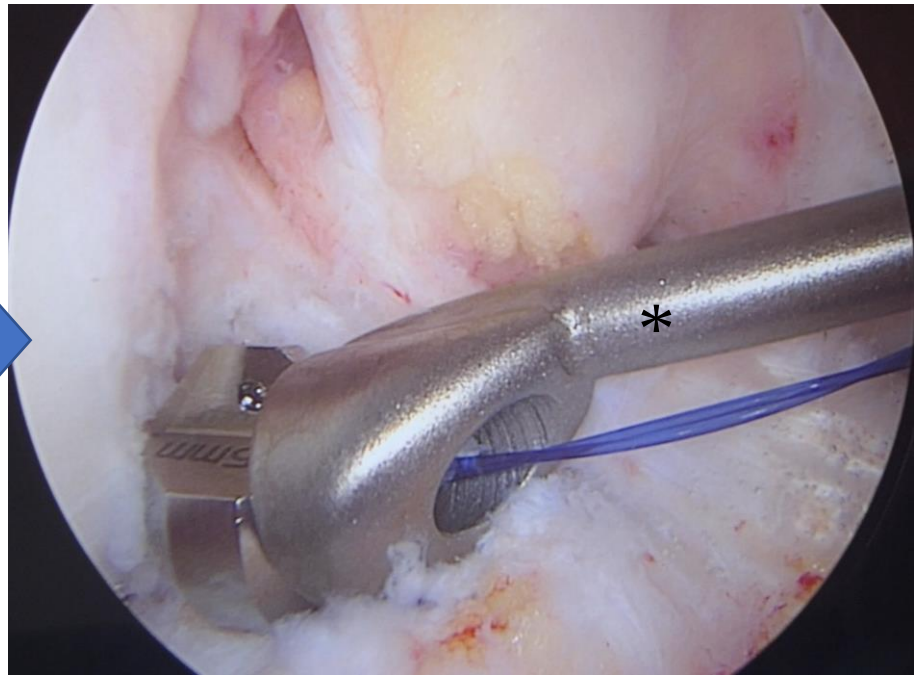


After inserting an L-shaped guide sheath **Asterisk** (*) along the steel wire from the lateral aspect of the femur, the drill guide pin carrying the No. 2-0 nylon loop **Asterisk** (**) is advanced along the L-shaped guide sheath until it engages the tibial plateau.

Methods (2)



A guiding nylon thread is passed through the reamer bit **Asterisk** (*) opening using grasping forceps **Asterisk** (**).



Attaching a reamer bit onto the drill guide pin in the intraarticular space. A reamer pusher **Asterisk** (*) is used to tie two No. 2-0 suture threads onto the nylon loop, and these threads are used to deliver a reamer bit into the intraarticular space.

Results

The mean side-to-side difference in KT-1000

pre op: 4.4±1.1 mm post op: 0.30±0.8 mm

The mean Lysholm score

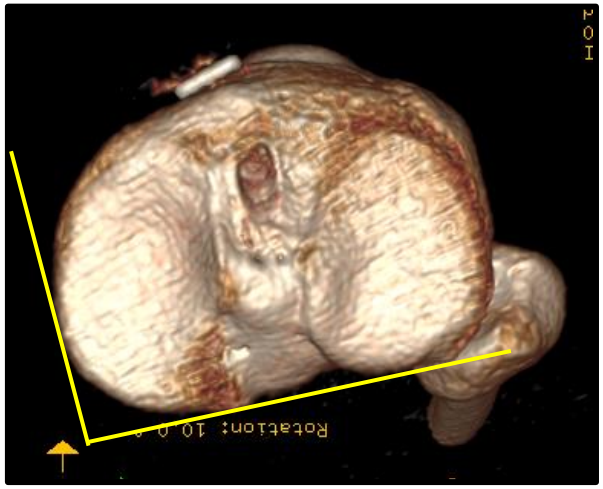
pre op: 62.1±12.7 post op: 96.6±4.5

- The semitendinosus tendon was used as a graft material in 34 patients.
- The mean length of grafts: 55.1±0.8 mm
- The mean diameter of graft: 8.7±0.5 mm
- The mean length of the intra-articular part of the graft: 25.6±2.2 mm
- The mean length of the femoral route: 39.6±4.5 mm.
- The mean length of the tibial tunnels: 19.7±2.1 mm.

Center of tunnel position measured by 3D-CT

- The position of the femoral tunnel (Quadrant method)
  - mean of 34.8±6.1% of the distance from the posterior femoral condyle (AP)
  - mean of 35.6±8.6% of the height from Blumensaat's line (Height)

- The position of the tibial tunnel
  - mean of 39.8±7.2% of the distance from the anterior edge of the tibia (AP)
  - mean of 48.1±3.6% of the distance from the medial edge of the tibia (ML)



Comparison of the tibial tunnel positions between the knees without internal rotation (IR) of the lower limb (n=13) and those with (n=22)

	Without IR		With IR		Post op. without vs with
	pre op	post op	pre op	post op	
• Lysholm score (points)	56.5±6.3	96.2±4.5	65.1±14.3	96.9±4.6	P=0.69
• Side to side difference by KT-1000 (mm)	4.85±1.28	0.45±0.93	4.09±0.92	0.23±0.69	P=0.48

		Without IR	With IR	
The femoral tunnel	AP	35.7±6.6%	34.3±5.8%	P=0.54
	Height	33.6±8.0%	36.8±8.7%	P=0.30
The tibial tunnel	AP	37.5±6.1%	41.1±7.8%	P=0.16
	ML	46.5±3.1%	49.1±3.7%	P=0.046

Discussion (1)

- All-inside ACL reconstruction is gaining popularity because it can minimize damage to the trabecular bone integrity and synovial membrane function, thereby causing less postoperative pain compared with conventional techniques[2].
- All-inside ACL reconstruction using quadruped semitendinosus improves functional outcomes similarly to previous studies. Our ACL reconstruction using all-inside transfemoral approach showed good clinical results and anatomic placement of the femoral and tibial tunnel.

Independent vs. Dependent Approach

- In the independent approach, retrograde drills are commonly employed to create femoral and tibial sockets. This procedure allows for accurate socket placement, although surgeons need to separately determine the position and orientation of femoral and tibial tunnels.
- However, the bone tunnel diameter should be large enough to allow for the passage of a 3.5-mm–diameter drill pin. Our customized reamer bit-guide pin system can help resolve the issues of retrograde drilling, and provides tibial tunnels with a small diameter of 2.4 mm.

Discussion (2)

Transtibial or Anteromedial vs. Trans-femoral Approach

- Recent studies reported that modified transtibial approach is able to place the femoral tunnel near the anatomic center of the ACL footprint with varus and internal rotation of the tibia as well as outside-in technique[3].
- Our transfemoral approach is minimally invasive, with a tibial tunnel diameter of only 2.4 mm. This small diameter minimizes bone loss, damage to the trabecular bone integrity, and postoperative risks of bleeding and infections. With many versions of the transfemoral approach, the distal tibial tunnel exit tends to be near the tibial plateau. To prevent this risk, our technique employed a tibial tunnel guide to ensure that the tunnel exit is located in an anatomically acceptable position.

Without vs. With Internal Rotation of the lower leg

- Our version of the dependent approach enables anatomic placement of the femoral tunnel since this tunnel is positioned first. Furthermore, our approach makes it possible to create tibial tunnels at anatomically appropriate locations by securing the injured lower leg in an internally rotated position.

Conclusions

This is the first report on a bone drilling method using a single drill guide in an all-inside ACL reconstruction procedure with the trans-femoral approach. This method is considered to make femoral tunnel drilling relatively easy, and to reduce the incidence of tibial damage. The tibial tunnel position was more favorable in the knees with internal rotation of the lower limb than those without.

References

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2. Nuelle CW, et al. (2022) All-inside anterior cruciate ligament reconstruction. Arthroscopy.
3. Youm YS, et al. (2013) 3D CT analysis of femoral and tibial tunnel positions after modified transtibial single bundle ACL reconstruction with varus and internal rotation of the tibia. Knee.