ISAKOS CONGRESS 2023

Boston
Massachusetts
June 18–June 21

Using three-dimensional MRI of the intact knee to identify expected tunnel positions in anatomic single bundle ACL reconstruction

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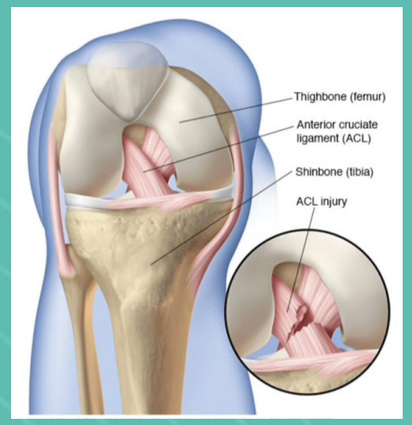
Disclosures:

- The authors declare that they have no conflict of interest
- No funding has been received for this study
- The study was approved by both:
  - ✓ Vinmec-VinUni ethics committee (approval no. 46/2022/CN-HĐĐĐ VMEC)
  - ✓ Ethics committee of Hanoi Medical University (approval no. 678/GCN-HĐĐĐNCYSH-ĐHYHN)

Introduction



Anterior cruciate ligament (ACL):

- One of 4 major ligaments of the knee
- ACL tear – most common ligamentous injury of the knee
- ACL reconstruction – standard & effective treatment for young, active patients, especially in athletes
- Anatomically optimal position of the ACL graft: controversial
- ACL footprints & anatomic centers vary from person to person
- In revision cases (failure): 70% due to technical errors[1]

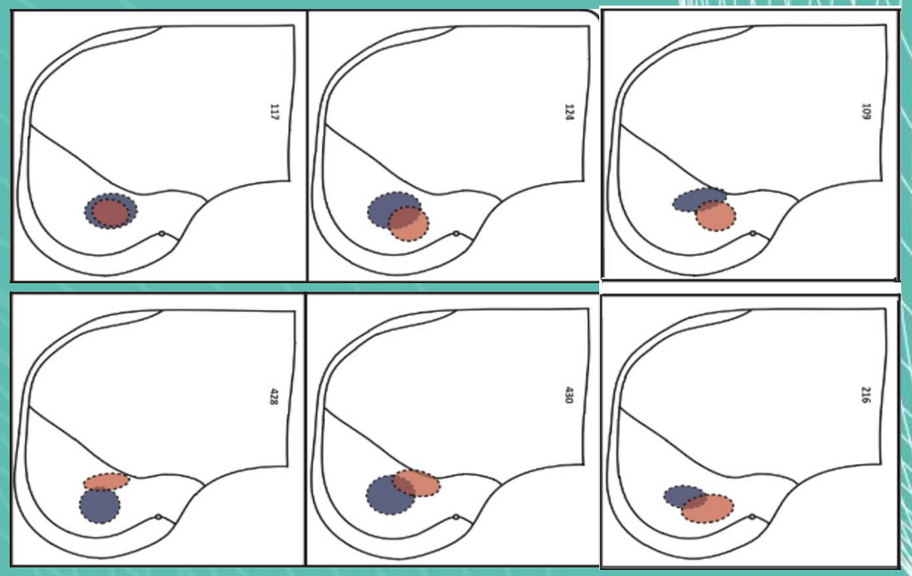
  80% of those related to tunnel positions (80% femur, 20% tibia)
- In recent years, three-dimensional (3D) magnetic resonance imaging (MRI) are used to identify the footprints & centers

Introduction

Studies using 3D MRI of the uninjured/contralateral knee

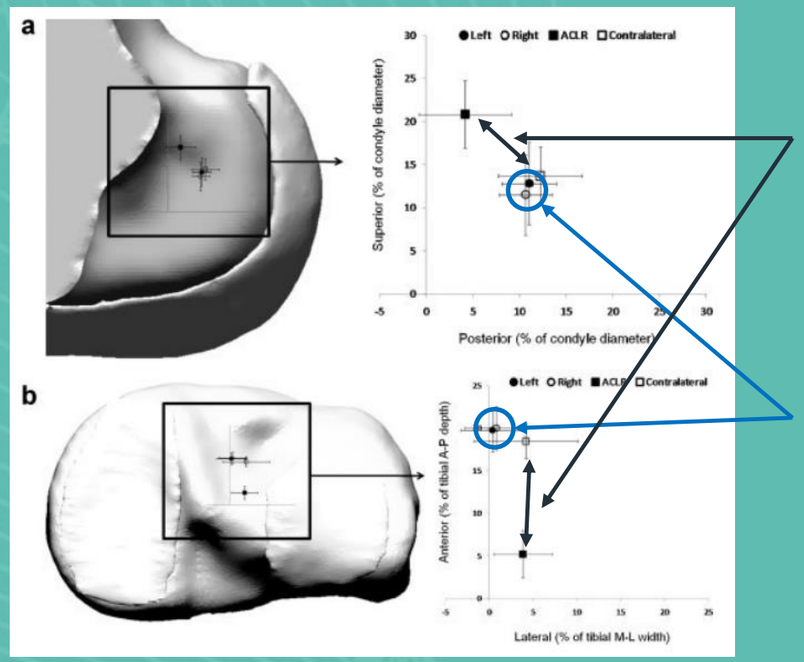
- Hart et al using 3D MRI of the intact knee to evaluate and compare to the surgical knee

- Scanlan et al using 3D MRI of the knee to compare the footprint centers between both side and between the intact & the surgical knee



Footprint of the intact knee

Tunnel Aperture



Difference between the intact and the surgical knee

Similarity of both sides

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Objects & Methods

Objects:

- 31 patients, unilateral ACL tear
- ACL reconstruction at Center for Orthopaedics & Sports Medicine – Vinmec Healthcare System, from 04-08.2022

Criteria:

- Inclusion: Age of 18 – 45; unilateral ACL tear; the contralateral knee is intact; agreement of surgical consent form and taking 3D MRI of the uninjured knee; full capacity for civil acts
- Exclusion: Deformity in one or both knee/leg; asymmetry in both lower limbs (alignment, size, …); refuse participating in the study

Study method:

- Cross-sectional description study, using convenience sampling

Objects & Methods

Take 3D MRI of the intact knee:

- MRI Machine: G.E SIGNA™ Pioneer AIR™ 3.0 Tesla silent (GE Healthcare – United State)

MRI Protocol:

- Follow Han's Protocol (2012)
- Position: Supine, Knee in flexion position of 0-10 degrees
- Sequence: proton density (PD) 3D
- Time: 15 minutes

Comparative Study > Knee Surg Sports Traumatol Arthrosc. 2012 May;20(5):986-95.
doi: 10.1007/s00167-011-1690-y. Epub 2011 Oct 11.

Measuring the anterior cruciate ligament's footprints by three-dimensional magnetic resonance imaging

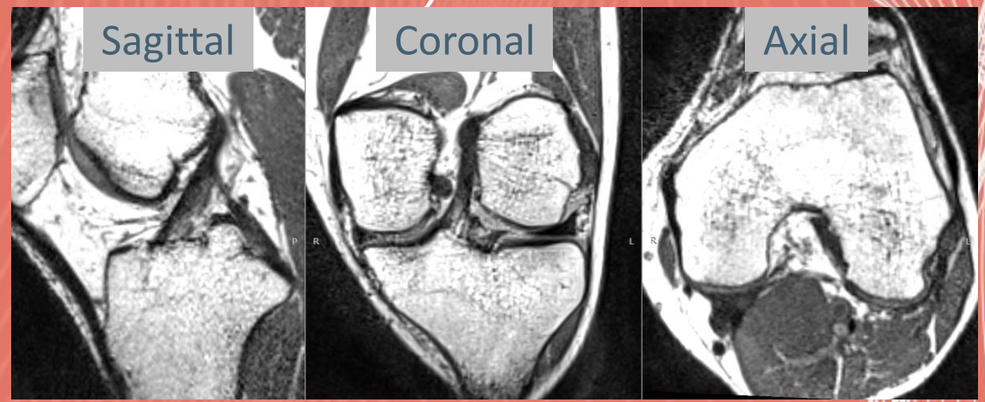
Yung Han [1], David Kurzencwyg, Adam Hart, Tom Powell, Paul A Martineau

Software:

- Radiant DICOM Viewer 2021.2 (MEDIXANT MACIEJ FRANKIEWICZ)

Planar Setting:

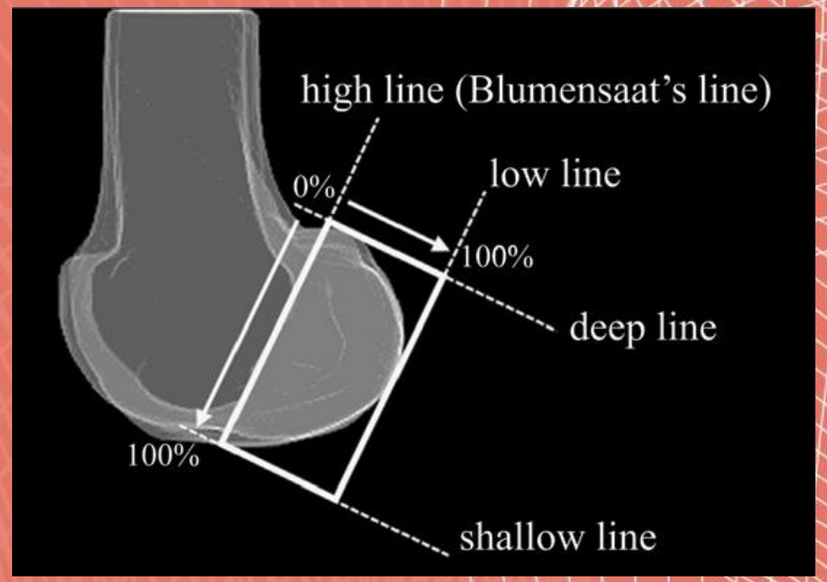
- Using Multiplanar Reconstruction (MPR) Mode

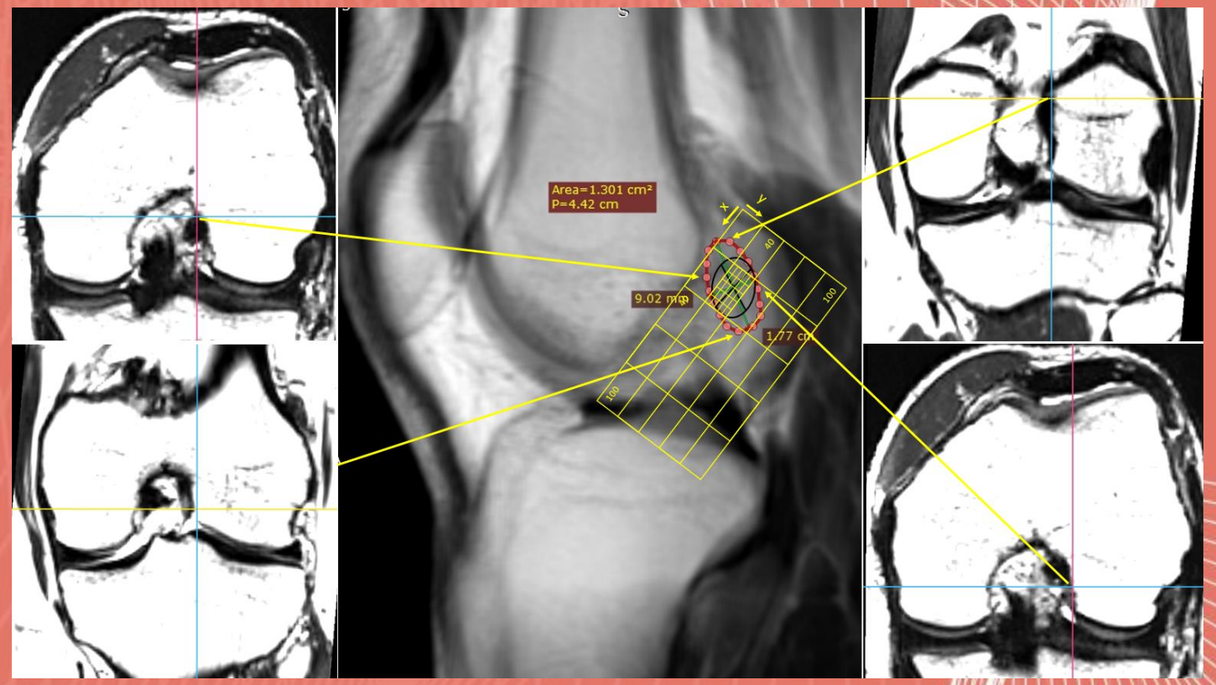


Objects & Methods

Identify femoral center:

- Step 1: Input DICOM data
- Step 2: Set up standard planes, use pseudo-2D radiograph follow Morita's report
- Step 3: Identify the border of femoral footprint
- Step 4: Identify the expected position of tunnel (Using concept of I.D.E.A.L position)
- Step 5: Measure and determine position of the center using quadrant grid (Bernard-Hertel's method) on sagittal plane

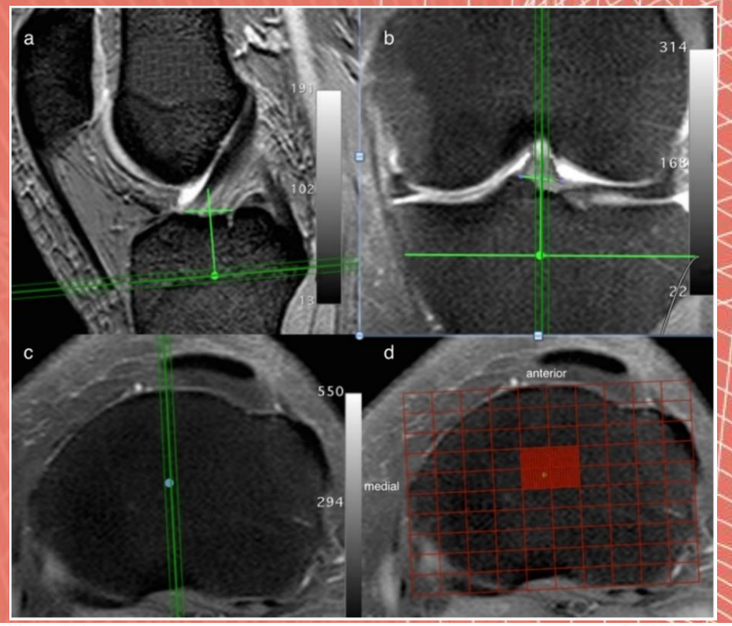


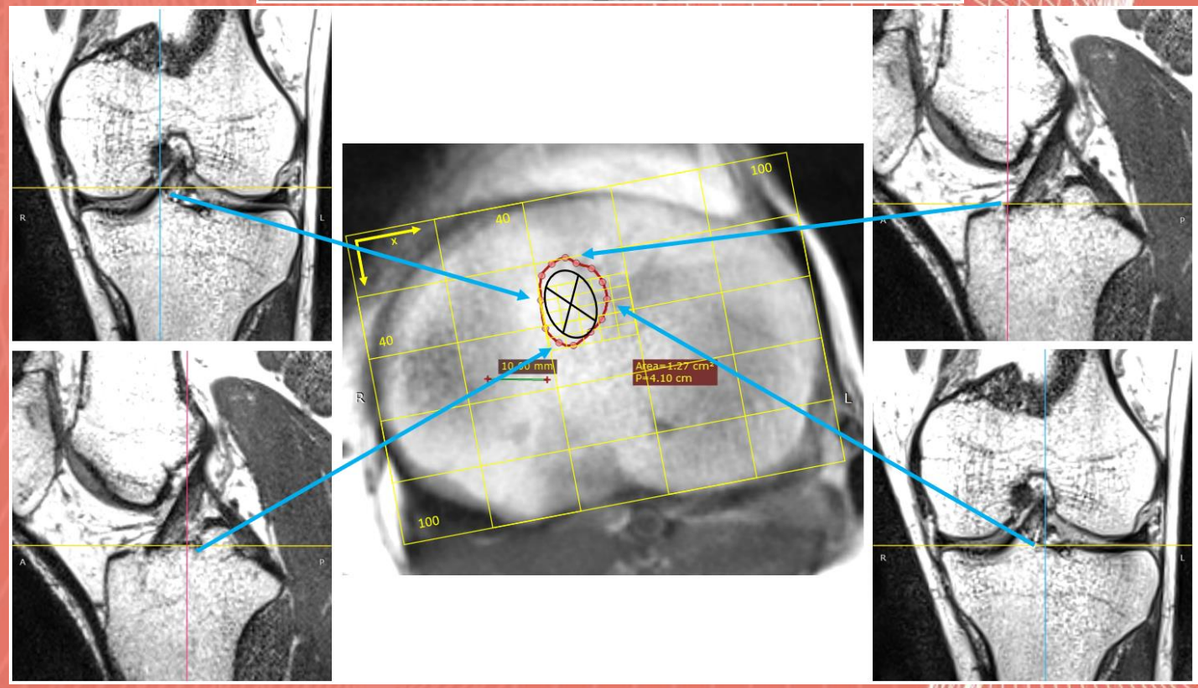


Objects & Methods

Identify tibial center:

- Step 1: Input DICOM data
- Step 2: Set up standard planes, follow Parkinson's report
- Step 3: Identify the border of tibial footprint
- Step 4: Identify the expected position of tunnel, at the anatomic center of tibial attachment
- Step 5: Measure and determine position of the center using quadrant grid (Parkinson's report) on axial plane

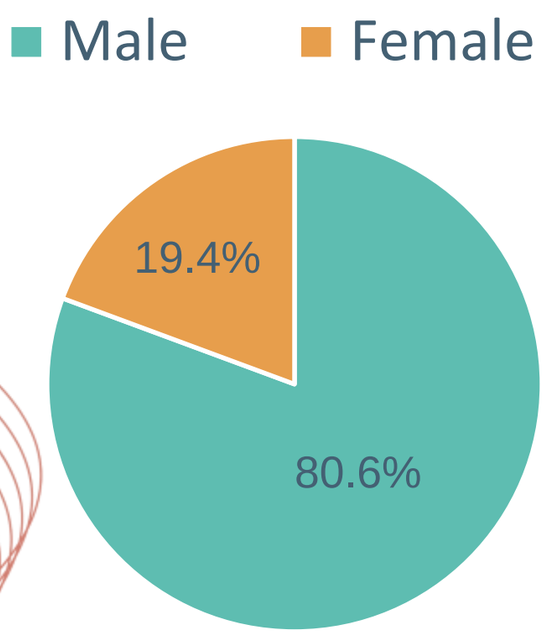




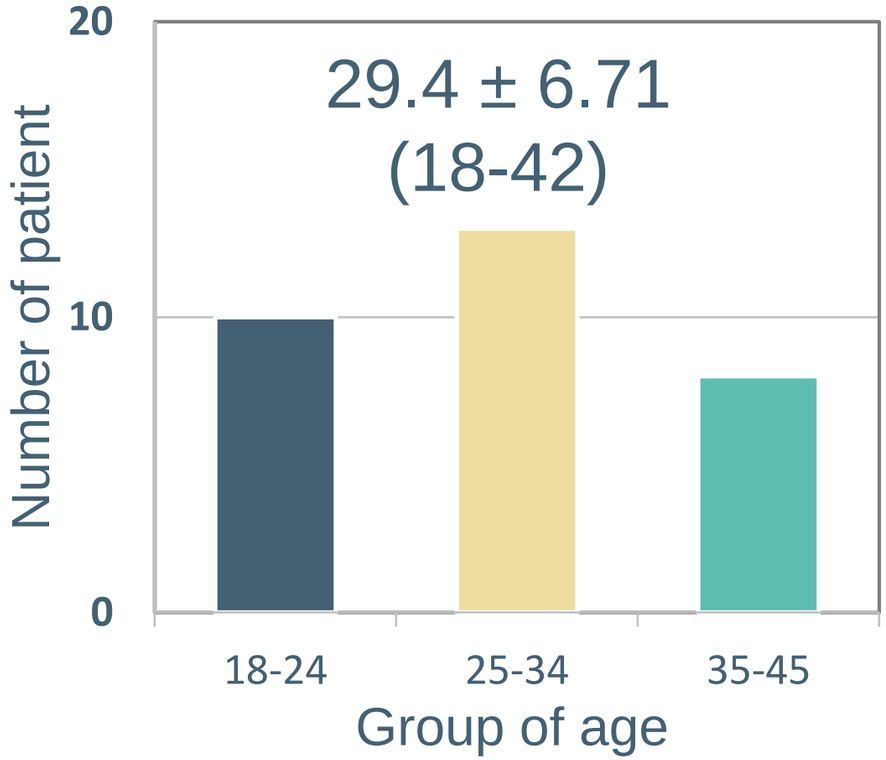
Results

GENERAL CHARACTERS

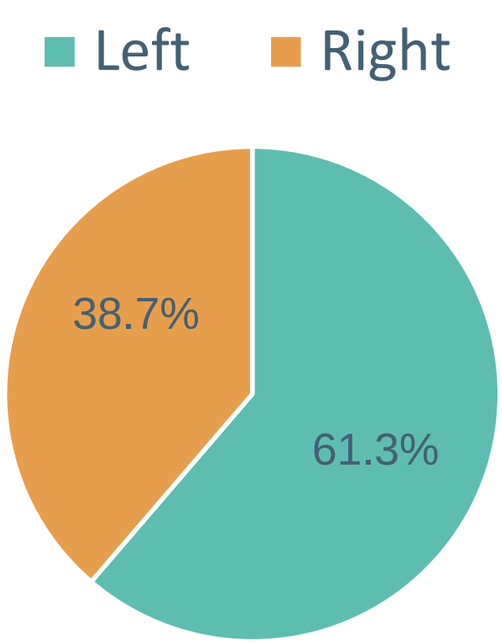
GENDER



AGE



INJURIED SIDE

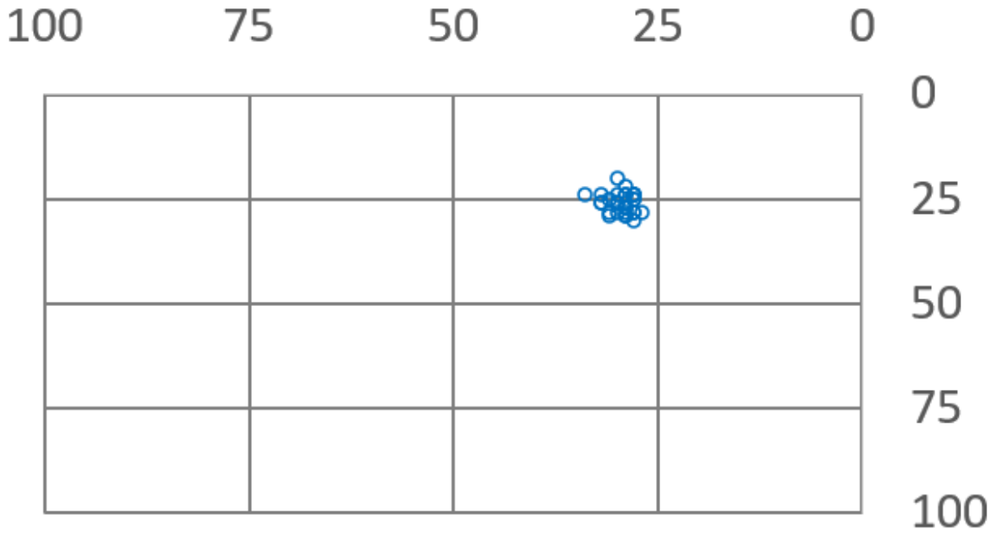


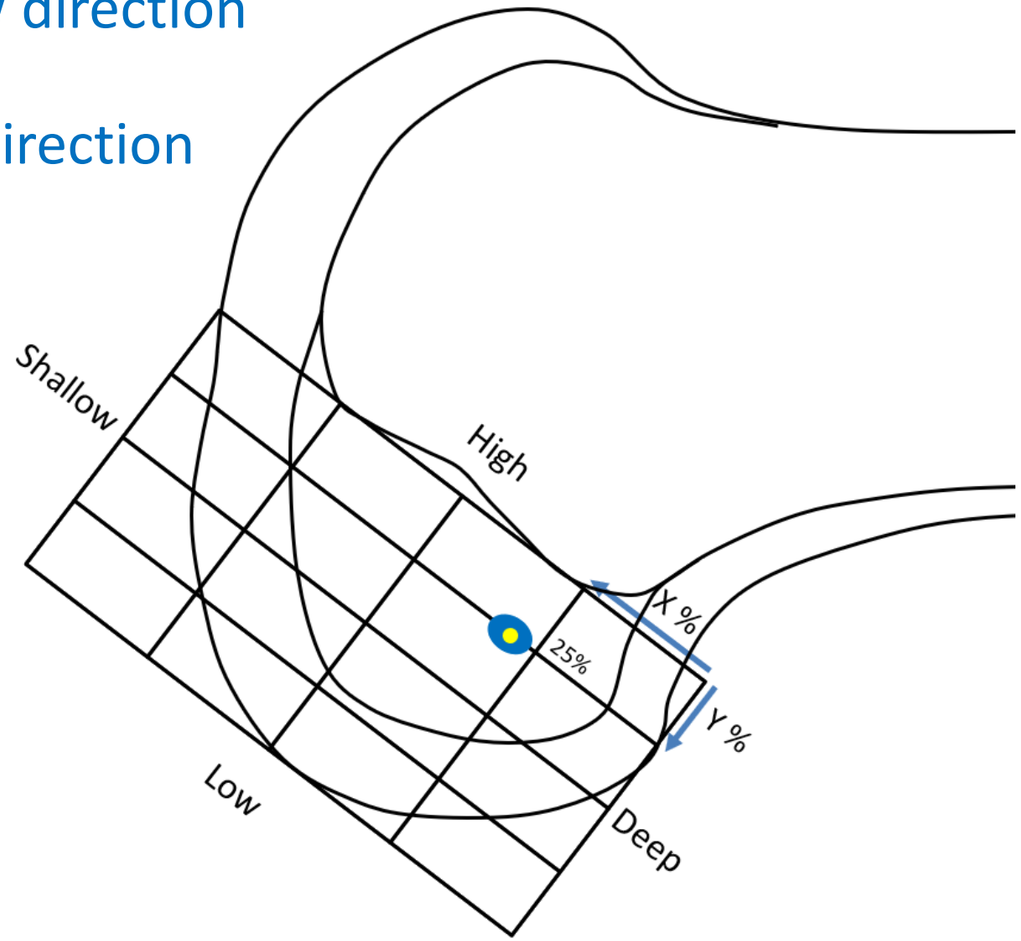
Results

POSITION OF EXPECTED FEMORAL TUNNEL

29.5 ± 1.6 % (27-34%) in deep-shallow direction

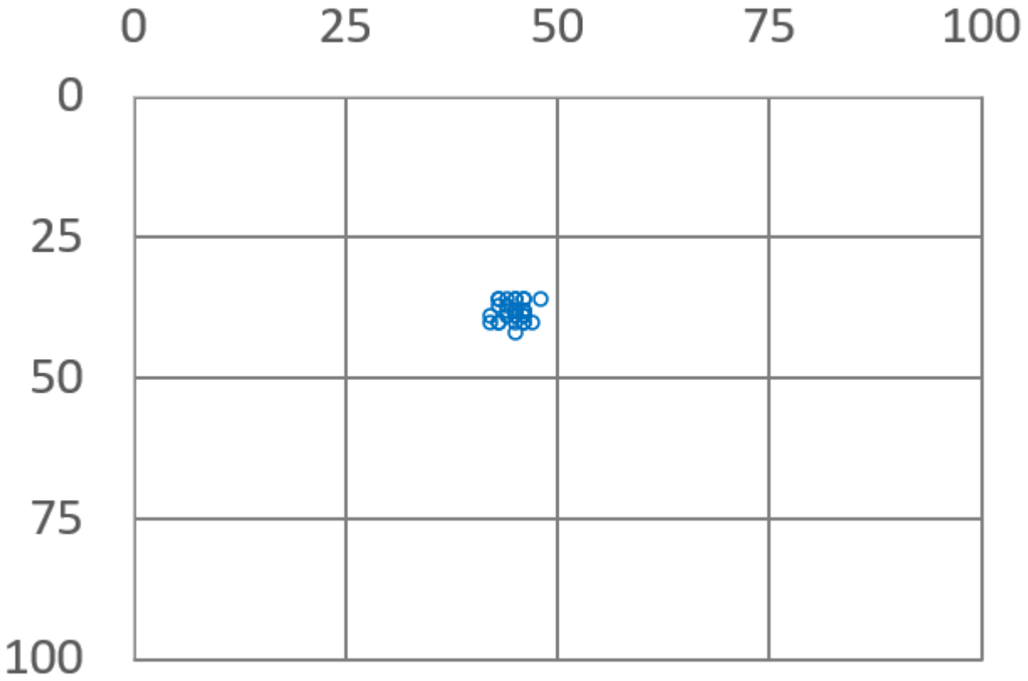
25.9 ± 2.3 % (20-30%) in high-low direction

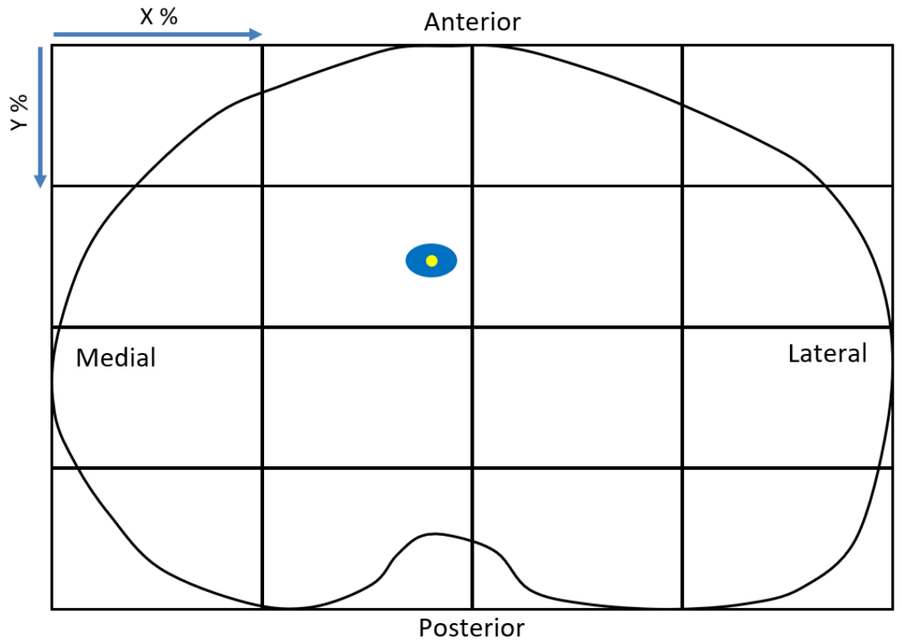




Results

POSITION OF EXPECTED TIBIAL TUNNEL





44.8 ± 1.4 % (42-48%) in medial-lateral direction

38.2 ± 1.7 % (36-42%) in anterior-posterior direction

Conclusion

- Identifying the center of ACL footprint using 3D MRI can be:
  - Applied in pre-op planning
  - Useful in evaluating post-op results
  - Supplied valuable information in studying of ACL anatomy
- Reliable in identifying & measuring the center of ACL footprints
- Our study has some limitations, need to study carefully in better designed researches

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