Smaller Diameter Femoral Tunnel Biocomposite Interference Screws Provide Adequate Fixation Strength in Anterior Cruciate Ligament Reconstruction: A Cadaveric Study

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Background

- Anterior Cruciate Ligament Reconstruction (ACLR) is commonly performed with bone patellar tendon bone (BTB) autograft[1]
- Fixation of the graft in the femoral tunnel is typically achieved with either suspensory fixation (i.e., suture button) or aperture fixation (i.e., interference screw)[1]
- Femoral sided interference screw fixation with metallic screws has been previously studied[2] and factors found to influence fixation strength include:
    - Screw geometry
    - Insertional torque
    - Bone quality
- Limited studies exist evaluating the influence of screw diameter on fixation strength in the setting of modern biocomposite interference screw fixation
- Utilization of smaller diameter interference screws can be advantageous as they allow for:
    - Less native femoral bone loss
    - Decrease risk of graft damage during insertion
    - Optimization of biologic healing
    - Preservation of potential bone loss in setting of revision surgery

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Objectives

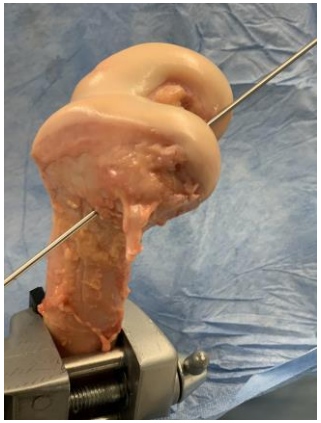
- **To evaluate the effect of bioabsorbable screw diameter on the time-zero pull-out strength and failure mode of femoral tunnel fixation utilizing BTB autograft in a cadaveric model**

Materials and Methods

- 24 en-block cadaveric knee specimens from 17 donors
    - Mean age 61.3 ± 8.42 years
    - range 48-74 years
- Allocated to one of three groups based on screw diameter (n=8/group)
    - 6mm
    - 7mm
    - 8mm
- Allocation based on bone mineral density (g/cm2) as determined by dual x-ray energy absorptiometry (DEXA) to ensure no difference among groups
- A priori power analysis = 6 specimens per group to obtain 90% power
- One Way ANOVA performed to determine difference in pull-out force
- Chi-Squared test to determine difference in failure mode

Surgical Technique

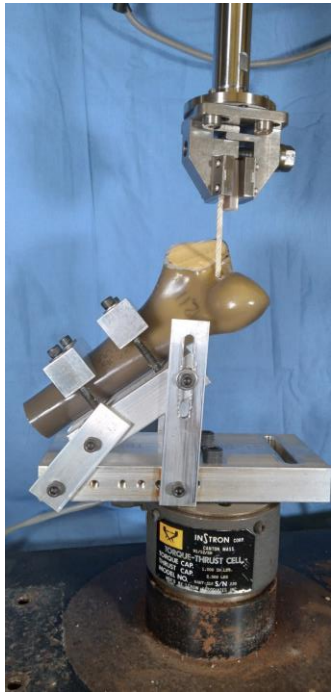
- Harvested standard BTB bone block 10mm x 25mm on tibial and patellar side
- 10mm flexible reamer over guide pin placed at remnant femoral ACL origin to establish femoral tunnel
- Tapped and secured with respective 6mm, 7mm, or 8mm screw based on allocation


Testing Scheme

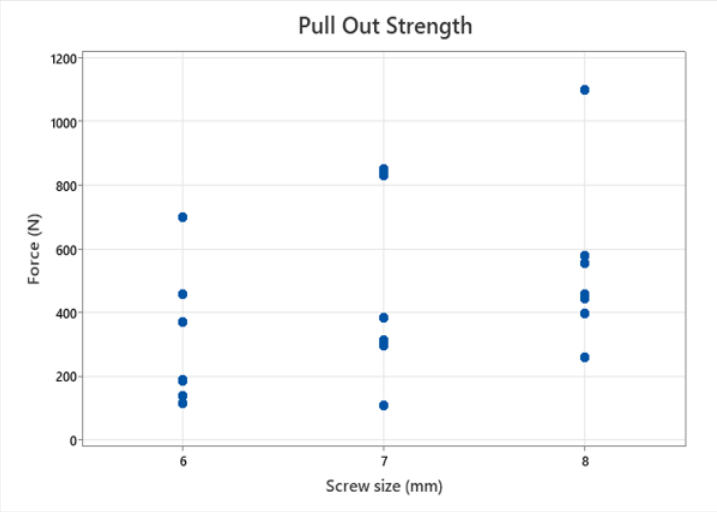
- Femoral shaft mounted using custom clamp and free tibial bone block mounted to load cell
- Graft pulled in line with femoral tunnel
- Preloaded to 10N, then tested monotonically in tension at 1mm/sec to failure
- Recorded
  - Load to failure (N)
  - Failure Mode

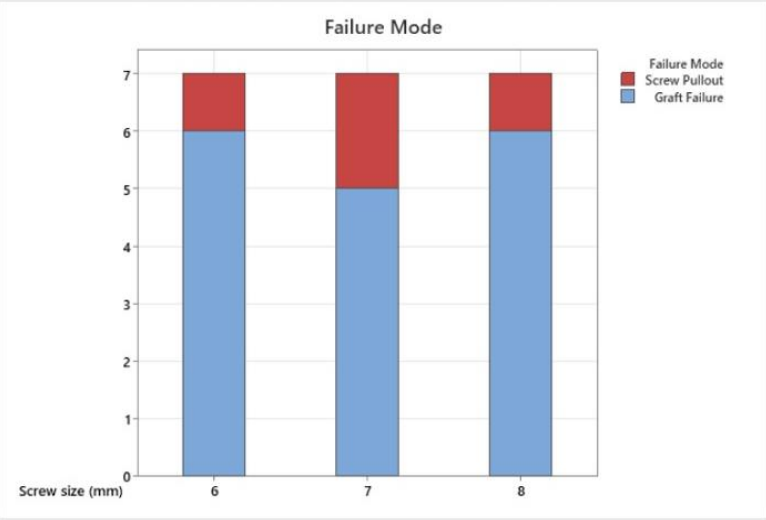
Testing Apparatus



Results

- No difference in load to failure (N) among 6mm, 7mm, and 8mm diameter screws (p=0.23)
- No difference in failure mode among 6mm, 7mm, and 8mm diameter screws (p=0.73)





Discussion

- Pull out strength did not differ based on interference screw diameter
  - Time-zero fixation load to failure in cadaveric model was higher than force on ACL during active ROM for all screw diameters[3]
- Failure Mode did not differ based on interference screw diameter
  - Most common failure mode was graft failure with no evidence of screw back out

Limitations

- Elderly cadaveric bone loaded in non-physiologic modality results in lower reported load to failure than would be expected in vivo[4]

- Can only assess time-zero fixation and does address additional fixation with biologic incorporation of graft over time

Conclusions

- Pull out force to failure and failure mode of femoral tunnel fixation for ACLR with BTB autografts at time zero does not differ among 6mm, 7mm, or 8mm biocomposite interference screw diameter

- Smaller 6mm interference screws can allow for preservation of native bone stock, potential for improved biologic healing, and decreased risk of damage to the graft during insertion without significantly compromising fixation strength

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