Physeal Disruption During ACL Reconstruction in Skeletally Immature Patients: Does Independent Femoral Tunnel Drilling Place the Physis at Greater Risk?

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ABSTRACT

PURPOSE: The purpose of this study was to radiographically assess differences in physeal disruption between transtibial and independent tunnel drilling techniques following ACL reconstruction in skeletally immature patients.

METHODS: A retrospective, matched comparative cohort study was performed, including skeletally immature patients who underwent transphyseal ACL reconstruction between January 1, 2008 and March 31, 2011.

RESULTS: There were significant differences in the estimated area of physeal disruption (1.84 cm² vs. 0.74 cm², P<0.001), femoral tunnel drill angle (32.1º vs. 72.8º, P<0.001), medial / lateral location of the femoral tunnel (24.2 mm vs. 36.1 mm from lateral cortex, P<0.001), and distance from the lateral aspect of the distal femoral physis and the femoral tunnel exit (4.7 mm vs. 26.7 mm from lateral cortex, P<0.001). There were no statistically significant differences in: (A) femoral tunnel location (transplant and independent groups using Euclidean distance vs. 50.1º, P=0.003) drill angles. There were statistically significant differences in the femoral tunnel (72.8º vs. 32.1º, p=0.001) and tibial tunnel (60.5º vs. 50.1º, P=0.003) drill angles.

CONCLUSIONS: Surgeons should be aware that if an independent femoral tunnel drilling technique is utilized during transphyseal ACL reconstruction, the physis is at greater risk when drilling at more oblique angles.

INTRODUCTION

Pediatric ACL reconstruction is complicated by the presence of open physes in skeletally immature patients.

Drilling through the physis may be associated with growth arrest, limb deformity, and limb shortening.

Transphyseal ACLR can be performed either with:

1) Transtibial femoral tunnel drilling

2) Independent femoral tunnel drilling

There is more recent interest in independent femoral tunnel drilling to allow more oblique femoral tunnels for “anatomic” placement of ACL graft

Studies that assess the safety of transphyseal ACLR utilize Transtibial drilling

There are no clinical studies have evaluated the differences between Transtibial and Independent femoral tunnel drilling during Transphyseal ACLR

MATERIALS AND METHODS

All patients between 10 and 15 years of age who underwent ACL reconstruction between January 2008 and March 2011 were identified

Pre-operative MRI was utilized to determine the estimated total cross-sectional area of the femoral physis for each patient

Post-operative plain films were used to collect the:

- Width (AP films) and length (lateral films) of the portion of physis that was drilled
- Angle of the femoral and tibial tunnels (in relation to the femoral condyles), location of the femoral tunnel across the physis, and the distance of the exiting femoral tunnel from the physis (Figure 1)
- Measurements were compared between independent and independent tunnel groups using the independent samples Student’s t-test

RESULTS

There were also statistically significant differences in:

- The percentage of physeal area removed by transtibial and independent femoral tunnel drilling (2.11% vs. 4.93%, respectively; P<0.001)
- Medial / lateral location (measure of tunnel eccentricity) of the femoral tunnel across the physeal area (26.1 mm vs. 23.2 mm from lateral cortex, P<0.001)
- Distance from the lateral aspect of the distal femoral physis and the femoral tunnel exit (26.7 vs. 4.7 mm, P<0.001)

There were no statistically significant differences (p>0.05) in:

- Initial estimated physeal area
- Average diameter of the femoral tunnels based on documented reamer size

DISCUSSION

- Independent femoral tunnel drilling is associated with more obliquely oriented femoral tunnels that are located more eccentrically within the distal femoral physis

- The estimated percentage of distal femoral physeal area drilled inversely correlates (r = 0.8565, Pearson correlation coefficient) with the femoral tunnel drill angle

- Potential risks of obliquely drilled femoral tunnels are further demonstrated by the proximity of the lateral tunnel exit to the perichondral ring, a structure accepted to be fundamental to circumferential expansion of the growth plate.

CONCLUSIONS

- The safety of transphyseal ACL reconstruction as it relates to the distal femoral physis cannot be presumed based on prior studies

- Surgeons must exercise caution when creating eccentric, obliquely oriented transphyseal femoral tunnels in skeletally immature pediatric patients no matter what type of femoral tunnel drilling technique is chosen

REFERENCES

