Septic Arthritis after Anterior Cruciate Ligament Reconstruction in Pediatric & Young Adult Patients: The 20-Year Experience at a Regional Referral Center

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INTRODUCTION: Septic arthritis following anterior cruciate ligament reconstruction (ACLR) represents a potentially devastating complication, necessitating treatment with one or more additional operations, extended antibiotic therapy, and potentially revision ACLR. There is limited research available on the incidence, treatment, and clinical outcomes associated with this condition in pediatric and adolescent patients. The present study therefore seeks to address this dearth of existing evidence by evaluating 20 years of ACLRs at a large pediatric referral center at which 8 different fellowship-trained sports medicine surgeons treated a high volume of patients in pediatric and adolescent age groups. The information needed for this study is deeply embedded in patients' clinical notes, signifying the need for a Natural Language Processing (NLP) approach, especially since the size of this data makes approaches like manual reviewing completely impractical.

METHODS: A database, consisting of clinical notes of all patients who underwent ACLR at the study institution from 2000-2020 was retrospectively queried to identify cases of septic arthritis following ACLR using an NLP approach. Patients were included who: (1) underwent primary or revision ACLR at the study institution and (2) subsequently were diagnosed with septic arthritis of the ipsilateral knee, based on arthrocentesis with synovial fluid white blood cell (WBC) counts >50,000 or positive bacterial cultures. Surgical data from the ACLR, irrigation and debridement(s) (I&D), and any subsequent ipsilateral knee surgeries, as well as bacterial culture results and clinical outcomes were collected. Age-based cohorts included 'pediatric' (<13 years-old), 'adolescent' (13-19 years-old), and 'young adult' (20-35 years-old). Chi-squared tests were performed to test for associations between graft source (allograft vs autograft), graft type (HS: hamstring autograft; Allo: allograft, HS+Allo: hamstring autograft with allograft supplementation; BTB: patellar tendon autograft; Q: quad tendon autograft; ITB: physeal-sparing iliotibial band autograft), and age, with incidence of septic arthritis.

RESULTS: 5,638 ACLRs (4123 adolescent, 73.1%; 909 young adult, 16.1%; 606 pediatric, 10.7%) were performed during the study period. 13 cases (0.23%) of post-ACLR septic arthritis (Table 1) were identified at a median of 12 days (range 8-630) after ACLR, with all cases arising in primary ACLRs and with varying graft-based incidences (Allo: 0%; HS: 0.33%; HS+Allo: 0; BTB: 0.10%; Q: 0.53%; ITB: 0%). All patients were diagnosed by knee arthrocentesis. 3 patients were diagnosed with septic arthritis at a mean of 12 months following ACLR, but all 3 had undergone additional ipsilateral knee arthroscopy and partial meniscectomy within 18 days preceding the diagnosis. Amongst the remaining 10 patients, diagnosis occurred at a mean of 13.3 days (range 6-36) following ACLR. All patients underwent at least one arthroscopic I&D, with a mean of 2.1 occurrences (range 1-4), and were able to retain their ACL grafts, with subsequent revision ACLR performed only in 1 of the 13 patients 6 years following the index procedure. Two patients required subsequent arthroscopic lysis of adhesions with manipulation under anesthesia for arthrofibrosis associated with decreased range of motion associated with the infections. The mean clinical follow-up following the infection diagnosis was 3.5 years (range, 7 months - 9.2 years). Seven other subsequent ipsilateral knee procedures were performed, including 4 cases of arthroscopic partial meniscectomy in 3 patients and 3 patellofemoral procedures in 1 patient. All patients had grown positive bacterial cultures (Table 1), the most common of which was staphylococcus aureus (n=3, 23.1%), followed by one of a variety of other staphylococcus species (n=9, 69.2%), c. acnes (n=1; 7.7%) and streptococcus (n=1; 7.7%). While 9 (69.2%) patients were treated with prolonged intravenous antibiotics delivered through peripherally inserted central catheters (PICC) upon discharge, 4 patients (30.8%) were able to be discharged on oral antibiotics. No statistically significant associations were identified by chi-squared testing by graft source (p=0.28), graft type (p=0.38), or age (p=0.27). There were no cases in the pediatric cohort, while the adolescent cohort incidence (0.30%) was similar to that of the young adult cohort (0.18%).

DISCUSSION: Septic arthritis incidence following ACLR was similarly low between adolescents, 13-19 years old and young adults, 20-25 years-old (p=0.27), but no cases were identified in over 600 cases of ACLR in children <13 years-old. Neither graft source nor graft type were associated with risk of infection. Most cases were caused by Staphylococcus species. Aggressive treatment, most commonly with multiple arthroscopic I&Ds and extended antibiotic therapy, was associated with graft retention in all cases, with no suggestion of disproportionate subsequent risk of graft rupture. This study was made possible by leveraging novel NLP pipelines which allowed us to identify all ACLR patients, cases of septic arthritis, and the detailes of these procedures such as graft type from more than 5000 operations.

SIGNIFICANCE: Using a robust NLP pipline, we were able to extract detailed information from a siginificant, but rare event indicating no association between patient age, graft source, and graft type, on risk of subsequent septic arthritis after ACL reconstruction.

Table 1: Septic Arthritis post-ACLR Cases (n=13)

Mean age (range)	17.3 (14-27)
Sex	Male: 7 (53.8%), Female: 6 (46.2%)
Median time, ACLR to I&D (range)	12 days (8-630)
Mean number of I&Ds (range)	2.1 (1-4)
Mean number of total subsequent ipsilateral knee operations (range)	0.8 (0-3)
Antibiotic treatment	IV: 9 (69.2%), PO: 4 (30.7%)
Mean follow-up (range)	3.5y (7m – 9.2y)
Bacterial Culture Results	S. aureus: 3 (23.1%), other staphylococcus: 9 (69.2%), Streptococcus: 1 (7.7%), C. acnes: 1 (7.7%)

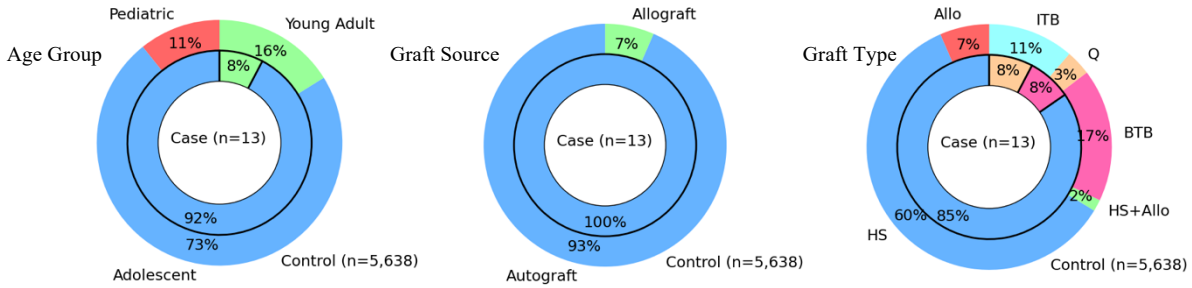

Figure 1: Distribution of age, graft source, and graft type for case (inner circle) and control groups (outer circle)