Survivorship of allograft ACL reconstruction in adolescent patients

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ABSTRACT

Purpose: The overall benefits of ACL reconstructive surgery in young athletes has been previously established. Graft selection for ACL reconstruction, specifically in this population however, remains controversial. The literature is limited and long-term survival rate of allograft ACL reconstruction in the adolescent population remains poorly defined. Current evidence, none level I, appears to demonstrate increased failure and subsequent revision rates in allograft reconstruction of complete ACL tears compared to autograft; 7–35% compared to 3–13% respectively. The purpose of the present study was to evaluate revision rate and functional outcomes of allograft ACL reconstruction in the adolescent population at extended follow-up.

Methods: A retrospective chart review was performed. Forty patients who underwent transphyseal ACL reconstruction with either bone patellar tendon bone (BTB) or Achilles tendon bone (ATB) allograft performed by a single surgeon over a 12-year period were identified. Demographic and surgical details were analyzed. Enrolled patients completed a Lysholm Knee Scoring Scale and a Tegner Activity Level Scale during phone interviews. All secondary surgeries performed on the ipsilateral knee were recorded.

Results: Twenty-five patients were enrolled; fifteen were lost to follow-up. There were ten male and fifteen female patients included for analysis. Average age at index surgery was 16 years (range 13–18 years). BTB allograft was used for seven patients, and ATB allograft was used for the remaining eighteen patients. Average follow-up was 54 months (range 13–136 months). The average Lysholm score at follow-up was 87 (range 57–100). The average Tegner score at follow-up was 6.8 (range 3–10). Three patients underwent revision ACL surgery (12% study group, 7.5% all) for traumatic re-rupture. Re-rupture occurred 12, 13 and 38 months after index surgery.

Conclusions: Autograft remains the standard for ACL reconstruction in the general pediatric population. In the adolescent population, however, the use of BTB or ATB allograft is a reasonable alternative with satisfactory outcomes, decreased harvest site morbidity, decreased post-operative pain and faster rehabilitation. The traumatic re-rupture rate in this series was similar to previously published traumatic failure rates in young adult athletes after reconstruction with autologous tissue (11–13%). Further prospective studies are needed to determine any true difference in the use of either allograft or autograft in the adolescent population.

1. Introduction

There has been a recent increase in the number of adolescent sports-related injuries coincident with the rise in year-round competition as well as generalized participation in organized sports. Specific injuries vary with the athlete and sport. Intra-substance ACL tears, which had previously been described as a largely adult athlete injury, are increasingly being detected in adolescents. Female soccer players have been found to have the highest rate of ACL injury, followed by male football players.[1] This is attributed to the cutting and pivoting actions found in these sports. Females are believed to be at higher risk for these injuries due to several physiologic characteristics such as, increased

femoral anteversion, increased quadriceps angle, decreased intercondylar notch width and quadriceps-dominant activation during running and jumping activities.[2]

In the pediatric population, management of these injuries is largely driven by a concern for physeal preservation. If the traditional reconstruction methods applied in adults were applied in children, the graft material would cross the physis in the skeletally immature patient.[3,4] This may lead to premature physeal closure causing potential leg length discrepancy and angular deformity.[4,5] In the adolescent patient, physeal preservation decreases in significance as there is less growth remaining. ACL reconstruction using transphyseal techniques are accepted practice in these patients. For the active adolescent

athlete, surgical reconstruction is recommended as nonsurgical management has been demonstrated to result in recurrent instability as well as secondary injuries to the menisci and articular cartilage.[6,7]

Special considerations need to be taken into account when managing adolescent ACL tears. Notably, adolescents have increased re-rupture rates following reconstruction compared to their adult counterparts. This may be attributed to increased activity levels placing stress on the repair as well as possible decreased post-operative compliance. The increased failure rate is further amplified when these ACL reconstructions are performed with allograft. Proposed benefits of allograft use include decreased harvest site morbidity and potential for faster rehabilitation. Previous studies have demonstrated increased re-rupture rate by up to four times in the adolescent population.[8] This study aims to further define the long-term survivorship of allograft ACL reconstruction in the adolescent patient population for comparison with previously published data.

2. Materials and methods

A retrospective chart review was performed which identified ACL reconstructions performed by the senior author between January 2002 and December 2012. These were identified using the surgical diagnosis of cruciate ligament reconstruction within the query criteria of the electronic health records at the practicing surgeon's institution. Procedures performed by other surgeons were excluded for uniformity of data. Documentation, including operating room dictations, was collected for each patient as well as both pre- and post-operative clinical visits when available.

Contact information was obtained from the health records and the patients were called. Verbal consent for participation in the study was obtained from the patient or the guardian if the patient was a minor. Research assistants who had not previously participated in the care of these patients performed the phone surveys. The patients were asked to complete Lysholm Knee Scoring Scale and Tegner Activity Level. Any additional procedures performed on the ipsilateral knee were also recorded. The patients were mailed a hardcopy of the consent and scoring system surveys with a return envelope. The hardcopy surveys included a section for additional comments that had not been captured during the phone survey.

3. Results

During the defined time period, forty ACL reconstructions were identified, which had been performed by the senior author. All of them were performed using allogeneic tissue. Based on the demographic information available in the medical charts, twenty-five patients were contacted. Fourteen of these were female and eleven were male. For each patient the operative report was available for review. The females were on average 16 years old at the time of surgery (range 13–17 years) and the males were also on average 16 years old (range 14–18 years).

Each patient underwent a diagnostic arthroscopy with meniscal pathology repaired or debrided as deemed appropriate. Seven males and five females had meniscal pathology, which required debridement. The ACL tear was then confirmed arthroscopically. An Achilles tendon-bone (ATB) graft was used for nineteen patients and a bone patellar tendon bone (BTB) graft was used for the remaining six patients. A titanium interference screw fixed the ATB graft in the femoral tunnel and a biocomposite interference screw and staple affixed the graft to the tibial tunnel. For the BTB grafts titanium interference screws fixed the bone blocks in both the femoral and tibial tunnels. Following fixation, an intraoperative clinical exam was performed to confirm stability.

From the point of contact for the survey, the average time since surgery was 54 months (range 12–147 months). For males this was 61 months (range 18–147 months) and for females this was 48 months (12–96 months). The average Lysholm Knee Score Scale value was 87 (range 57–100). For males this was 92 (range 64–100) and for females

83 (range 57–100). The average Tegner Activity Score was 6.8 (range 3–9). For males this was 7.0 (range 6–9) and for females this was 6.6 (range 3–9). Two patients required revision ACL reconstruction. Both of these patients were female and the re-rupture and revision occurred 12 and 13 months after the index procedure. For both of these patients the re-rupture occurred participating in the same non-contact sport as the original injury occurred (basketball and soccer respectively). No additional patients required another procedure on the ipsilateral knee.

4. Discussion

As the rate of participation in organized sports continues to climb among adolescents, so too will the rate of sports-related injuries. ACL injuries in this population remain a management challenge as adolescents typically place a higher demand on the repair than their adult counterparts. They require a reconstruction that returns stability and prevents further injury while at the same time allowing them to return to their pre-injury activity level. It is this high demand that contributes to the increased failure rate of ACL reconstructions in this population. The Multicenter Orthopaedic Outcomes Network (MOON) consortium cohort evaluating ACL reconstructions demonstrated that patients between the ages of 10–19 were over two times more likely than patients between the age of 20–29 to have a re-rupture following a reconstruction.[9] These rates were demonstrated to be 8.2 and 4% respectively.[9] This study also demonstrated an increased rate of failure in allograft versus autograft reconstruction. For all ages the failure rate of autograft reconstruction was 3.5 and for allograft 8.9% within two year follow-up.[9] A logistic regression model was made using this data that predicted up to a 22% failure rate of allograft reconstruction in the adolescent group.[9]

Other studies have similarly demonstrated elevated failure rates in adolescents who underwent ACL reconstruction with allograft. In one study by Singhal et al. evaluating outcomes of ACL reconstruction with anterior tibialis allograft, a failure rate of 23.1% was reported.[10] When comparing patients younger and older than 25, failure rates of 35 and 13% were reported respectively.[10] The authors recommended against the use of tibialis anterior allograft in ACL reconstruction for patients under 25 years of age. Another study by Engelman et al. compared groups of adolescents, with the average age of 15 years, who underwent ACL reconstruction with allograft or autograft.[11] The failure rate in the allograft group was significantly higher than autograft (28.95 versus 11.43%, p = 0.352).[11] Our study demonstrated failure rates in adolescent allograft ACL reconstruction of 8% (2/25); comparable to the autograft cohorts of previous studies.

Our study also reported on long-term follow-up of the procedure as indicated by the Lysholm and Tegner scores. The average score for the Lysholm Scale was 87, 92 for males and 83 for females. This score range indicates a good outcome of knee ligament surgery with fewer symptoms in the patients. The average score for the Tegner Score was 6.8, 7.0 for males and 6.6 for females. This score range indicates the ability to participate in recreational or competitive sport. The main aim for adolescent athletes would be > 6 to 10, this range indicates the ability to play recreational to competitive to national and international elite competitive sports. This is ideally where most adolescent athletes would fall in order to continue competitive play post-ACL reconstruction surgery and this study shows this result is possible via allograft reconstruction.

Limitations of this study included a small sample size and absence of a control group. A comparison group of autograft reconstruction patients would have evaluated the true difference between autograft and allograft by controlling for variables such as surgical technique and rehabilitation protocol. Rather the outcome of re-rupture was compared to previously published values in the literature. Our study also had a relatively small sample size and incomplete follow up, 25 of 40 patients (62.5%) responded. The adolescent population commonly presents this challenge, as there is increased mobility when they transition out of the

home to higher education or employment.

5. Conclusions

Previous literature has demonstrated increased failure rates of allograft ACL reconstruction in the adolescent population. The gold standard for ACL reconstruction for these patients remains autograft. However, the use of BTB or ATB allograft is a reasonable alternative with satisfactory outcomes, decreased harvest site morbidity, decreased post-operative pain and faster rehabilitation.[12] This study demonstrates that the allograft failure rate may not be as high as otherwise published. A discussion is necessary with the patient to outline the management options with the relative risks and benefits of each treatment strategy. Also further prospective studies are needed to determine any true difference in the use of either allograft or autograft in the adolescent population since other studies have found that clinical outcomes are similar between the two.[13]

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