Short communication

Living related donor allograft for revision anterior cruciate ligament reconstruction in a child: A case report ☆

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Received 22 November 2007; received in revised form 25 February 2008; accepted 29 March 2008

Abstract

Revision ACL reconstruction poses several challenges for the surgeon in terms of the timing of surgery and the limited graft choices. To our knowledge, there is currently no published data with regards to revision ACL reconstruction in a child. We describe the case of a 12-year-old girl who had a re-injury 4.5 months after her index primary ACL reconstruction at the age of 11 years. She sustained a repeat injury to the reconstructed knee following a road traffic accident and developed significant instability despite an intensive rehabilitation program. After careful consideration of the available graft materials – known all the advantages and disadvantages of the autografts, allografts and synthetic materials – we decided to use the patient’s mother’s hamstrings as a graft. The parents of our patient refused the use of allograft and synthetic materials. We discuss our management of this case, the reasons for our revision graft choice, and the theoretical disadvantages of some of the alternative graft choices available in this scenario. We believe in such cases, performing ACL revision with a donor graft of the patient’s mother could be a good alternative to allografts or synthetic grafts.

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Keywords: ACL; Revision; Child; Hamstring; Living related donor allograft

1. Introduction

The role for anterior cruciate ligament (ACL) reconstruction in children is much discussed and debated [36]. The main goal of ACL reconstruction in children is to restore knee stability without causing growth plate arrest, leg-length discrepancy, or angular deformity. The timing of surgery, graft selection, type of fixation device and surgical technique are areas of discussion [15,35]. Given the poor natural history with regard to progressive meniscal and chondral damage, the current consensus is to proceed with early reconstruction [25,36]. One of the main concerns is the violation of the growth plate with tunnel drilling in intra-articular reconstruction. However, studies have shown that drilling across the growth plate does not cause growth arrest [15,23]. The physis should not be crossed with either screw or bone block. Therefore soft tissue grafts, in particular the hamstring tendons are the graft of choice. Suspensory fixation devices are recommended for this group of patients. With the increasing number of primary ACL reconstructions in younger patients [6,8,28], one needs to anticipate the need for revision ACL reconstruction in these patients [4,27]. Revision ACL reconstruction poses several challenges for the surgeon in terms of the timing of surgery and the limited graft choices. Based on knowledge, there is currently no published data with regards to revision ACL reconstruction in a child.

We describe the case of a 12-year-old school girl who had a re-injury 4.5 months after her index primary ACL reconstruction at the age of 11 years. She sustained a repeat injury to the reconstructed knee following a road traffic accident and developed significant instability despite an intensive rehabilitation program. Our goals of her revision ACL surgery were to stabilize the knee so as to prevent secondary damage to the...
articular cartilage and menisci, and minimize the functional morbidity. Based on our knowledge, currently there is no published study on the use of a living related donor allograft for revision ACL reconstruction. The considerations of the various graft options will be presented and discussed.

2. Case report

A 12 year-old girl who sustained a repeat ACL injury of a previously reconstructed knee and underwent revision ACL reconstruction using living related donor hamstring allograft. The index primary ACL reconstruction was performed at 11 years of age. Arthroscopic intra-articular reconstruction was performed with an ipsilateral 6 mm diameter quadrupled hamstring autograft. Graft fixation was achieved by a continuous loop Endobutton ® (Smith and Nephew Endoscopy, Andover, MA) over the femoral end and bone staple over the tibial end. Post-operative recovery and rehabilitation were uneventful.

Four months after the index operation, the patient represented following a motorbike injury with knee pain and swelling. Clinical examination revealed grade 2 Lachman’s, grade 2 anterior drawer and grade 3 pivot shift consistent with an acute ACL graft disruption. Her Tanner staging at the time of the revision surgery remained unchanged at Stage 1. Arthroscopic examination revealed an acute disruption of the index ACL graft and a displaced bucket handle tear of the posterior horn of the lateral meniscus, which was repaired with two oblique pediosutures. The knee was placed in a brace.

On subsequent follow-ups, the patient complained of increasing instability affecting her activities despite intensive physiotherapy. At 9 months after her repeat injury, she was found to have significant quadriceps atrophy and knee instability (3+ Lachman’s and anterior drawer, 2+ pivot shift test) results.

Further treatment options were discussed with the patient and her parents. In view of the debilitating instability with non operative management of bracing, physiotherapy and decreased activity level, surgical reconstruction was recommended. The choice of graft was discussed. These include the following:

1) Contra lateral hamstring autograft. Her initial hamstring graft was a relatively small (6 mm) diameter and given her severe instability it was felt to be inadequate.

2) Bone patellar tendon bone graft was not appropriate given the presence of open epiphyses and the potential of growth arrest with the use of bone blocks.

3) Allograft or synthetic graft. The parents decided not to take the risks of disease transmission or foreign body synovitis.

It was proposed that one of the parents would consider donating the hamstring tendons for reconstruction. The patient’s mother having a low demand lifestyle agreed to donate her hamstring tendons. Before taking the final decision for using living related donor allograft, we reviewed the literature carefully, counseled the mother about the possible risks, morbidity, rehabilitation, expectations. We performed preopera-

![Fig. 1. Endoscopic picture of the tibial tunnel. The physeal plate is visible as a separate area in epiphysis.](image-url)
knee so as to prevent secondary damage to the articular cartilage
spurt, recent change in foot size and growth charts [16, 28, 35].
Tanner stage, onset of menses, family member height, growth
graft selection. The clinical markers include skeletal age,
of skeletal maturity is critical in determining the timing of surgery
to be considered in a patient with persistent instability. Assessment
apart from non surgical management, surgical reconstruction has
management [34]. Some authors recommend diagnostic arthro-
results associated with conservative treatment [1, 2, 24, 36]. The
operative management are superior to non operative management [34]. Some authors recommend diagnostic arthro-
scope and evaluation under anesthesia to take a decision for ACL
reconstruction in children [22]. For a skeletally immature patient,
from non surgical management, surgical reconstruction has
to be considered in a patient with persistent instability. Assessment
of skeletal maturity is critical in determining the timing of surgery
and graft selection. The clinical markers include skeletal age,
Tanner stage, onset of menses, family member height, growth
spurt, recent change in foot size and growth charts [16, 28, 35].
Our goals of her revision ACL surgery were to stabilize the
knee so as to prevent secondary damage to the articular cartilage
and menisci, and minimize the functional morbidity. The case
management and the considerations for the graft choice for this
young patient requiring a revision ACL reconstruction will be
discussed. This case report illustrates a problem that arises when
a young patient cannot provide good quality autograft for her
ACL revision.
For our patient, non surgical management with bracing and
lifestyle modification was not successful due to persistent
instability limiting her daily lifestyle. Extra-articular ACL recon-
struction has been described and performed for skeletally im-
mature patients with the aim of restoring knee stability and
averting the risks of growth disturbances due to violation of the
growth plate in intra-articular reconstruction technique. This tech-
nique is not preferred due to the poor results, reported in various
studies [7, 9, 12, 21]. Intra-articular ACL reconstruction is currently
the recommended technique with good clinical results [14, 15, 23].
The concern of growth disturbances due to growth plate violation
had been addressed by various authors [4, 18, 19]. Current evi-
dence has demonstrated that tunnel drilling does not result in
significant growth disturbances [32]. Keeping in mind the
patient’s age, persistent knee instability and limitation of activities,
the recommended treatment was a revision ACL reconstruction
using soft tissue graft. The types of graft in revision ACL recon-
struction are varied. The options available are as follows:

a. Contralateral hamstring tendon autograft. From the index
reconstruction, the patient had a relatively small diameter
graft of 6 mm. In addition, the patient is also noted to have
increased objective ligamentous laxity; therefore, the use of
the autograft was excluded. Furthermore the patient and her
parents declined the use of contralateral autograft.
b. Bone patellar tendon bone graft. For revision ACL surgeries,
bony tendon grafts are widely used with acceptable results [13].
However, this graft is contraindicated in skeletally immature
patient due to the potential of the bone block causing premature
physeal fusion and resulting in growth disturbances [11].
c. Cadaveric allograft. The use of cadaveric allograft has been
recommended for revision surgery and in multi-ligament
reconstructions [3, 30]. It minimizes donor site morbidity and
avoids further weakening of the knee joint [17, 29]. However;
an allograft does have potential problems of disease trans-
mission [10]. It has also been shown to have physiological
differences from the autografts in terms of slower revascular-
ization, recollagenization and suboptimal healing as suggested
by immunogenic studies. This would have been the graft of
choice for this patient. However, the patient and parents
declined this option in view of the potential disadvantages.
d. Synthetic graft. Synthetic graft has been used in selected
patients for ACL reconstruction. To enhance the repopular-
isation of the graft by native soft tissue, it is essential that the
graft is inserted within the native ACL stump to serve as strut
augmentation. In our patient, there was minimal soft tissue
stump remaining, therefore the use of synthetic graft was
excluded. The patient and her parents were also not agreeable
for this option due to risk of foreign body synovitis.
e. Living related donor allograft. The living related donation of
solid organs such as liver and kidney has been practiced in
transplantation surgery with good success [5,26,31]. To our knowledge, the use of living related allograft has not been previously published for ACL revision surgery. The main advantages are bigger graft size and a fresh allograft. As well documented in the literature, tendons are not immunogenic; there is no need for special immune compatibility tests [33]. The fresh allograft biomechanical properties will not be degraded as a result of irradiation and freezing in the process of cadaveric allograft preparation. This new and radical option was explored with the patient and parents. After much deliberation, the patient’s mother’s hamstring tendon was selected as the graft for the revision ACL reconstruction. There was no need for our patient of a two staged revision [20], because of the small diameter primary tunnels.

Because of her early re-injury after the primary reconstruction, we were not able to evaluate her post-operative IKDC and Tegner scores.

With the increasing number of primary ACL reconstructions in younger patients [6,8,28], one needs to anticipate the need for revision ACL reconstruction in these patients. Unique problems are presented in the child that include open epiphyses, graft selection and fixation techniques. We have presented the case of a skeletally immature who presents with the need for revision ACL reconstruction, the considerations in graft selection and the use of a living related donor allograft for ACL reconstruction.

References