ACL lesions surgical treatment in pediatric patients. Our all-epiphyseal experience

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Abstract

The prevalence of traumatic knee disease in children and young athletes has steadily increased over the past few years. The subjects who have engaged in intense sporting activities since a young age were especially vulnerable to developing an anterior cruciate injury. With the development of new imaging and clinical examination methods, diagnosis has also improved. The need to ensure joint growth without complications and the rising demands for a return to competitive sport are driving the search for an appropriate surgical technique. Today, only a few cases should receive conservative treatment. The main flaw of the extra-articular technique is that it doesn't respect the anatomy and results in excessive rigidity. Even precocious subjects can use the all-epyphiseal technique, which allows for the respect of the growth plates. It does not present a particularly high complication rate and permits a full return to sports activities prior to the trauma with an adequate learning curve on the part of the surgeon. However, in more mature subjects with still open physis, the traditional transepiphyseal arthroscopic technique is possible as long as the tunnel is not too large. In any case, it is crucial to provide a thorough and ongoing follow-up until the end of growth as well as individualized rehabilitation.

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Introduction

The injury of the anterior cruciate ligament is one of the most frequent sports injuries.[1] The literature described a very low frequency of this traumatic pathology in adolescence and in pediatric age until 1980. However, we had a rapidly and consistently increasing trend in recent years. Its reasons can be schematically divided into sports activity and a more precise diagnosis of the injury in subjects at a young age. This increased incidence is estimated at about 50.9/100,000 in New York State and 76/100,000 for females and 47/100,000 for males in the Scandinavian Registry between 10 and 19 years of age.[1] Statistical series report a variable percentage of cruciate ligament injuries in the presence of acute traumatic hemarthrosis in pediatric age ranging from 10 to 65%. Shea reports that in the United States ACL injuries account for 30.8% of all knee injuries and 6.7% of all injuries in competitive soccer players between the ages of 5 and 18.[2] Advanced and descriptive imaging systems (MRI) allowed an accurate diagnosis of the lesion. A more widespread and standardized clinical evaluation capacity by a larger number of clinicians is a further recent acquisition. A better awareness of the type and modalities of the trauma by coaches, trainers, masseurs should also be added. The rate of insertional lesions of the ACL and in particular the detachment of the intercondylar spines is higher in the pediatric age, then becoming less frequent compared to intralegamentous lesions in puberty. The conservative treatment of ACL lesions in pediatric and juvenile age has long represented the therapy of choice and the therapeutic gold standard. Today, however, this indication is subject to increasing criticism.[1-3]

Materials and Methods

The progressive damage caused by chronic instability removes about 50% of traumatized subjects from activity.[3-5] In a variable percentage between 21% and 100% in the different series, a significant meniscal and/or capsular lesion coexists with a trau-

matic lesion of the ACL. Therefore, conservative treatment should be chosen in subjects presenting isolated ACL lesions and significant residual skeletal growth. In these cases, personalized rehabilitation will be arranged and sport activity will be remodeled.[6] It is necessary to codify an ACL reconstruction surgical treatment capable of neutralizing the joint risk of chronic instability while minimizing the damage of the physis.[4-6] The primitive trauma itself is able to produce, both experimentally and clinically, significant damage to the physis. Scientific and technical effort was therefore oriented towards the development of "physeal sparing" surgical techniques.[4-6] These techniques are divided into three types: i) extraepiphyseal stabilizations, ii) transepiphyseal stabilizations and iii) intraepiphyseal stabilizations (all-epiphyseal).

The extraepiphyseal technique can have a role in very young patients however, it is the only one not to ensure isometry. The most common is represented by the use of a mobilized ileotibial band pedicle according to McIntosh and subsequent modifications with an extra and intra-articular hybrid technique starting from its starting point at the Gerdy's tubercle, passed into the throat in the over position the top and then passed under the intermeniscal ligament to be fixed through a thin hole in the tibial plateau to the anterior periosteum of the tibia distal to the physis. It is disadvantaged by the impossibility of recreating the anatomy of the ACL and its intra-articular function and by the sensitive risk of post-surgical joint stiffness. The all-epiphyseal technique, of which we have a 28 cases experience, allows treating even young subjects (Tanner1-2) with very significant instability and minimal radiological evidence of physiological closure (Figure 1). The technique consists in the diagnostic arthroscopic phase and in the repair of any concomitant joint injuries then proceed with the preparation of the docking site for the neoligament. With a specific guide introduced with an angle of 70°-80° a femoral guide wire is placed from anterior and distal to the epicondyle running intraepiphyseally until it reaches the footprint of the native ligament. Preparation of the tunnel with out-in technique. The tibial guide wire is positioned totally intraepiphyseal with a 35 ° sagittal angled guide and the tibial tunnel is prepared with the out-in technique (Figure 2 and 3).[4,5] The most commonly used graft is a hamstrings autograft, although quadriceps tendon or allogeneic bone bank grafts can also be used. The neoligament is then usually fixed with a resorbable interference screw in the femoral site and with a button fixation system in the tibial site. Alternatively, it is possible to prepare the tunnels with an all inside system (retrodrill) and fixing with suspension systems. The procedure is controlled both arthroscopically and with an image device (C-arm). Active and passive physiokinesitherapy began in the first postoperative day. In the presence of a type of patients with a slightly older age (14-16 years) in which the closure of the physis is advanced and a more advanced bone age (Tanner 3) it is possible to proceed with ACL reconstruction with transepifphyseal technique since, from experimental and clinical studies: a lesion that affects up to about 7% of the physis does not generate a significant disturbance of its growth.[6] It is important not to exceed the measurement of 9 mm in the diameter of the tunnel itself. In this case, after having prepared a slightly more vertical tibial tunnel (50°-55°), it is possible implant the graft (patellar tendon or hamstrings) and fixation with resorbable pins or suspension system at the femur and interference screw the tibial, minimizing the risk of epiphysiodesis generated by the neoligament, as the physis will in effect be crossed only by soft tissues.[7,8] Although this last technique seems intuitively the one, among the three, capable of providing the most anatomical ACL reconstruction, should be reserved only for older patients with a limited residual growth.

It is important the post-surgical follow-up of patients to be

Figure 1. X-ray to evaluate bone age of the patient.

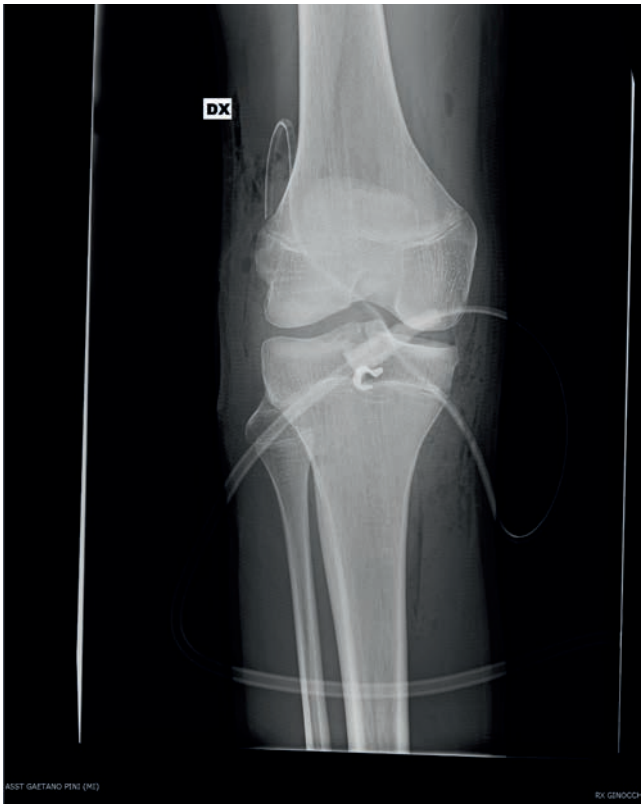

Figure 2. All-epiphyseal post-op 12 years old, front.

Figure 3. All-epiphyseal post-op 12 years old, lateral.

Figure 4. MRI follow up at 9 months from the surgery, 13 years old.

close (Figure 4) and continue until the complete closure of the physiques to monitor their evolution and any sequelae. The rehabilitation protocol must then be designed on the individual patient through a continuous interaction between the surgeon, the rehabilitator and the caregivers.

Discussion

In arthroscopic ACL reconstruction surgery among pediatric population, the most frequent complications are represented in order of frequency by the rupture of the graft, rigidity, growth disorders, infections, persistent instability.[1,2,7] The risk of rupture of the neoligament is reported in the literature as more frequent in subjects treated with the all-epiphyseal technique than in the adult population treated with the classic arthroscopic technique, while there are no different outcomes between the latter and the cases treated with the trans-epiphyseal technique.

Conclusions

Today it is increasingly important to predict and validate a surgical treatment to reconstruct the anterior cruciate ligament in prepuberal and pubescent subjects. The surgical technique must have the primary objective of minimizing the impact on the physis providing a result that is as long lasting and stable as possible over time and at the end of the growth. Conservative treatment, although its field of application has been restricted in recent times, still makes sense in selected cases. Intuitively, the transepiphyseal technique, which can however only be reserved for patients with Tanner 3 and with a limited residual growth potential, seems able to provide a more anatomical reconstruction at the price of a simpler and less complicated surgical technique. However, the all-epiphyseal arthroscopic reconstruction guarantees a possibility of effective reconstruction, with a high level of functional anatomy, even in younger patients, completely sparing the physis.

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