Complex Knee Injuries in Young Patients

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Knee dislocation is an infrequent pathology, but its prevalence is believed to be underestimated owing to the absence of a diagnosis and also to the fact that in many cases they reduce spontaneously [1]. This prevalence has been increasing in later years due to a better understanding of the lesion and the advance in imaging diagnostic techniques [2]. Most of them are high-energy lesions which occur most frequently in traffic accidents and sports trauma. They might cause important articular damage with sequelae such as stiffness and multidirectional instability, but the associated neurovascular lesions are the most serious ones as they can end up in limb amputation.

In the case of dislocations that get to the shock room with no reduction, the diagnosis is evident. But in those cases in which there is a spontaneous reduction, there should be a high level of suspicion so as not to misdiagnose it.

The delay in the recognition of this lesion brings about a delay in diagnosing the most serious complication, which happens to be an arterial lesion with devastating consequences.

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15.1 Conduct

These patients generally present a polytraumatic picture. Once the dislocation is reduced, a thorough neurovascular examination should be carried out. In those patients with no signs of vascular involvement, it is important to perform an evolution control with a regulated neurovascular examination, since very subtle damages to the popliteal artery may occur at later stages. In these cases the ankle/arm index might be very useful to control vascular status. If the patient requires CT studies, an angio CT of the popliteal artery can be performed. If there should be absence of pulse or if the latter diminishes along the studies, we indicate an arteriography.

When there is an imminent arterial lesion, a prompt surgical exploration is indicated with a multidisciplinary team [3].

Other possible lesions associated to knee dislocation are neurological lesions. It has been estimated that they are found in 10 and in 40% of cases, and the common peroneal nerve and popliteal sciatic nerve are the most commonly affected [4].

The neurological damage may be of variable seriousness, with partial or total functional recovery with rehabilitation, or it might be a complete

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lesion which will require the transfer of the posterior tibial tendon to improve ankle functionality and hence walking ability.

Once the most serious complications are ruled out, and the patient is clinically stabilized, we focus on the knee. We carry out a thorough soft tissue, morbidity range, varus-valgus deformities and articular stability physical examination. Certainly, by this moment, we already have X-rays taken that rule out bone lesions and possibly CTs as well. Indicating an MRI is fundamental so as to allow us to see important details of the meniscal, ligament and capsular lesions.

15.2 Classification

To approach the treatment of knee dislocation, we base ourselves on the anatomic classification described by Robert Schenck [5].

	Lesion
KD I	Knee dislocation with ACL or intact PCL and variable involvement of collateral ligaments
KD II	Both cruciate ligaments injured, with intact collaterals
KD III	Both cruciate ligaments injured + one of the collaterals as well. M or L
KD IV	Both cruciate ligaments and both collaterals injured
KD V	Knee dislocation + peri articular fracture

There are specific indications for urgent surgery in the following cases [6]:

1. Irreducible dislocation.
2. Compartment syndrome.
3. Popliteal artery lesion.
4. Exposed dislocations.

Once the urgency has been treated, there are different treatments to apply according to the time elapsed since the injury occurred: during the acute period (before the 3 weeks), during the chronic stage or to plan a treatment in steps.

There are controversies concerning the optimal moment for surgery. Some authors conclude that treatment in the acute stage is the one that gets better results [7]. Other authors indicate that there is no difference, in long-term results, in patients treated in the acute or chronic stage [8].

And lastly, some authors propose that the best results are achieved approaching treatment for knee dislocation in stages [9].

We do believe that it is very important to evaluate each particular patient and to make individual decisions according to several factors. The presence of a vascular lesion, of associated lesions that require a priority approach; the status of soft tissues; the inflammatory process; and articular mobility are parameters that we really have to keep in mind at the moment of deciding the time for surgery as well as the techniques to be applied. We do obtain the best results performing surgical treatment as soon as possible. When we are able to perform the surgery in the acute period, we opt for performing a repair plus reconstruction with an allo- or autograft of the ligament structures involved.

We rarely do just repair since, coinciding with most published papers, the rate of residual laxity is high. That is the reason why we always associate it to the reconstruction.

When we approach treatment in the chronic stage, healing of the tissues makes it difficult to identify anatomical structures.

15.2.1 KD I

This type of dislocations is normally produced due to low-energy mechanisms, and they can very well be sports trauma. In such cases, there is a lesion of one of either cruciate ligaments and a variable involvement of one of the collateral ligaments. These patients usually present unidirectional instability which can be anterior or posterior. There might be a generally partial affectation of the medial collateral ligament. Depending on the medial collateral ligament involvement, we can indicate immobilization for 4 or 6 weeks to favour its healing process, to avoid residual laxity and to improve the inflammatory process of the joint. If one of the collateral ligaments is to be reconstructed, the surgery is carried out at the same time of the cruciate ligament reconstruction. The surgical techniques will be described ahead in this chapter.

Then we proceed to the ACL or PCL reconstruction according to the case. For this recon-

struction, we can use bone–tendon-bone autograft (BTB) or semitendinosus gracilis autograft (hamstring tendon (HT)) or allograft (anterior tibial or Achilles).

We use anatomic reconstruction techniques either for ACL or PCL, respecting as much as possible anatomic ligament insertion footprints (Fig. 15.1 (a–d)).

In the post-op period, we do not use immobilizers for ACL reconstruction, but in PCL we do immobilize the knee for 6 weeks with posterior enhancement at the height of the calf to protect reconstruction, and then we indicate a knee brace for 3 months. For ACL, regarding partial weight bearing on crutches, the patient uses it according to their tolerance. And for PCL, they use them for 6 weeks. For collateral reconstruction we immobilize the knee and indicate weight bearing on crutches for 6 weeks. The patient starts with assisted passive mobility and physical and kinetic therapy from the second post-op day.

15.2.2 KD II

In this type of lesions, both cruciate ligaments are injured, and there is indemnity of both collateral ligaments. It is a rare lesion which usually occurs due to a hyperextension mechanism of the knee. Once mobility range of the knee is

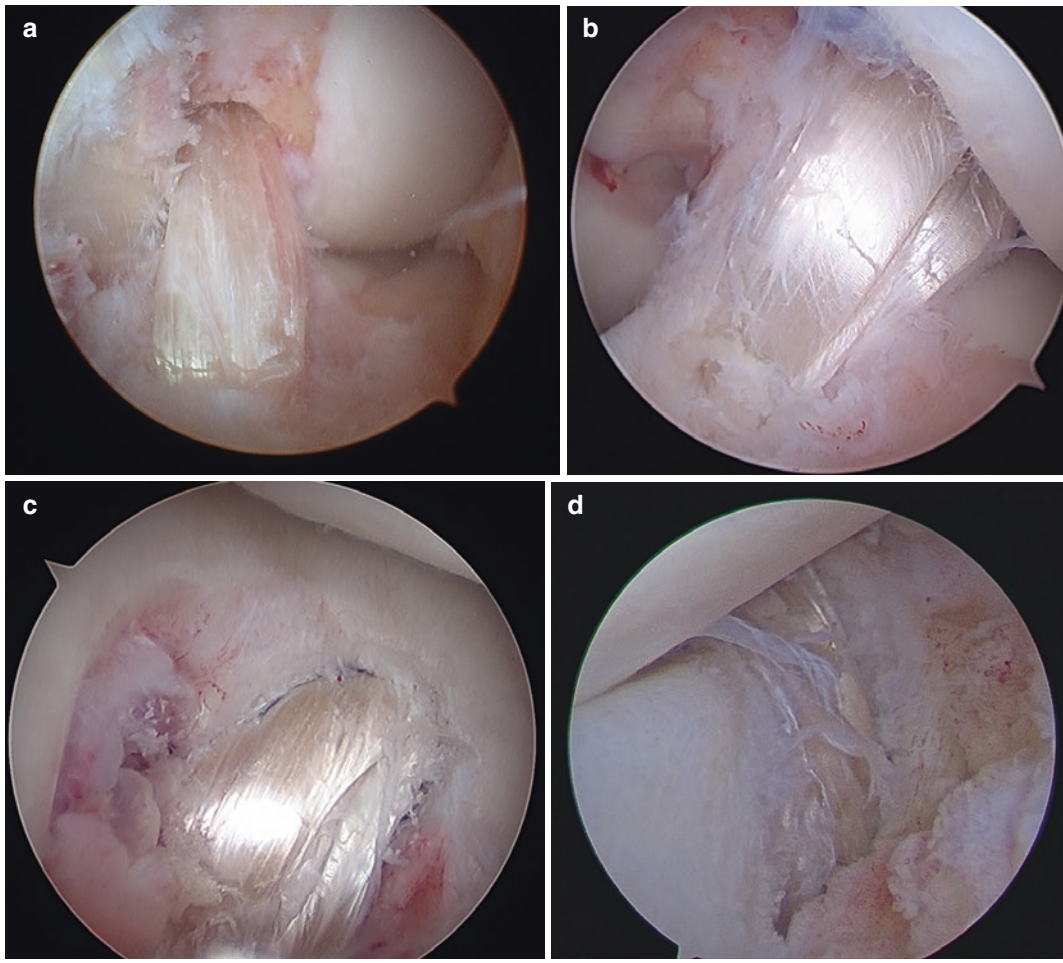

Fig. 15.1 (**a**) ACL reconstruction femoral view. (**b**) ACL reconstruction tibial view. (**c**) PCL reconstruction femoral view. (**d**) PCL reconstruction tibial view

recovered and joint swelling improved during the first days, we indicate reconstruction of both cruciate ligaments in one time. If we have the possibility to use allograft, we would rather use it since it diminishes knee morbidity and allows a faster rehabilitation and mobility range recovery. In these cases, we use anterior tibial or Achilles to reconstruct PCL and anterior tibial or BTB to reconstruct ACL.

In those cases in which it is not possible to use allograft, we resort to HT for PCL reconstruction and BTB for ACL reconstruction. We obtain both of them through the same medial anterior incision over the patellar tendon, slightly extended to distal, so as to be able to have access to the goose-leg insertion.

We start reconstruction from posterior to anterior: first, PCL femoral tunnel and ACL femoral tunnel then PCL tibial tunnel and then the ACL tibial one. Concerning graft passing, first we place the PCL graft and fix it proximal, and second we place ACL graft and fix it proximal too. The next step is to fix PCL, in 70–90°, distally. Finally we fix ACL, 0–10°, distally. The post-op is similar to PCL post-op.

15.2.3 KD III

In this type of dislocation, there is a lesion in both cruciate ligaments and in one of the collateral ligaments. Therefore, there are two subtypes: lesion of both cruciate ligaments + lesion of the MCL (KD III M) and lesion of both cruciate ligaments + lesion of the LCL (KDM III L). It is one of the most frequent types of knee dislocations.

These are patients that present an important anterior and posterior instability plus medial or lateral instability depending upon the affected collateral ligament.

15.2.4 KD III (M)

In this subtype, besides the lesion of both cruciate ligaments, there is a medial collateral ligament lesion as well. There is an anterior, posterior, medial or posteromedial instability. Our approach consists in the reconstruction of the three ligaments in only one time. We would rather use allograft not to add morbidity to the knee. We use anterior tibial tendon or semitendinosus for the reconstruction of MCL, anterior tibial tendon or Achilles' tendon for PCL reconstruction and anterior tibial or bone-patellar tendon-bone for ACL reconstruction. We always use anatomic reconstruction techniques; we do prefer the technique described by R. LaPrade for the case of medial collateral ligament lesion [10].

When instability is only medial, we reconstruct the superficial band of the MCL. We make tunnels on the anatomic bone footprints, and for fixation we use interferential screws. We perform this fixation in neutral rotation and in 30° of knee flexion (Fig. 15.2).

When there is a posteromedial corner (PMC) lesion, or on physical exam, we detect a medial instability in full extension; we carry out the posterior oblique ligament (POL) reconstruction, as LaPrade describes. This reconstruction is fixed in full knee extension (Fig. 15.3).

Fig. 15.2 Superficial band MCL reconstruction

Fig. 15.3 Superficial band MCL and POL reconstruction

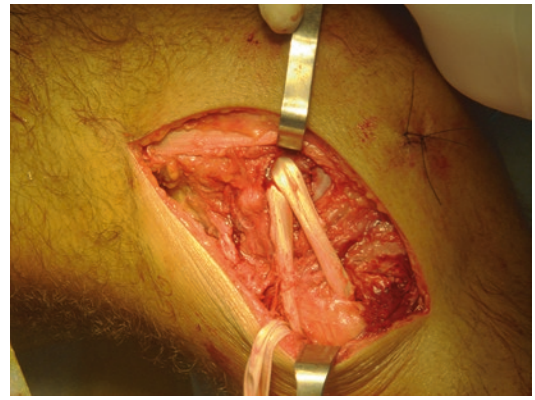

Fig. 15.4 Lateral knee Larson reconstruction

15.2.5 KD III (L)

In these cases, there is a lesion in both cruciate ligaments plus in the lateral side of the knee. The instability found is anterior, posterior and lateral or posterolateral. Like with the anterior type, we would rather perform the approach of all lesions in one time.

When, besides the lesion in both cruciate ligaments, we are faced with lateral instability, we use the technique described by Larson or Arciero to reconstruct the lateral collateral ligament [11, 12] (Fig. 15.4).

In those cases when instability is posterolateral, we prefer the anatomic reconstruction technique described by LaPrade (Fig. 15.5), even though there are papers that indicate the same rate of good results comparing it to Larson or Arciero's techniques [13].

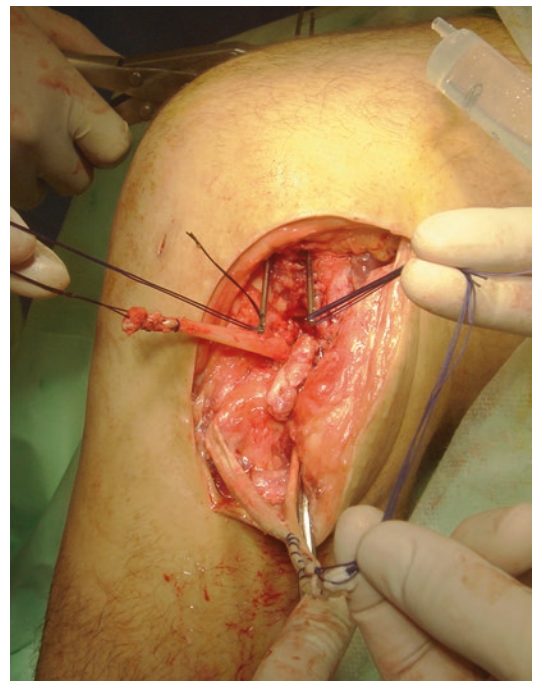

Fig. 15.5 Posterolateral knee LaPrade reconstruction

15.2.6 KD IV

In these cases, there is a complete disruption of the four main ligament structures of the knee. Both cruciate ligaments and both collateral ligaments are injured. In most cases, these lesions are caused by high-energy traffic accidents. We have to take into account several aspects when planning the surgical strategy in these patients. The general condition of patients and their associated lesions are factors that are going to condition us for the surgery. These patients usually present skull, chest or abdomen trauma of variable seriousness, and they demand priority. Likewise, vascular knee lesions due to the dislocation itself may delay the moment for surgery. The status of soft tissues and the inflammatory process are also conditioning factors to keep in mind.

Once the above-mentioned factors are solved, we have to plan the procedure to be performed.

The surgeons' experience is highly important. This can determine whether the procedure will be performed in one time or in stages to minimize the risks of ischemia of the thigh tourniquet. The availability of an allograft is crucial to minimize surgery morbidity. In case there is not one available, what can be considered is the use of an autograft from the contralateral knee.

Our conduct, whenever possible, is to plan just one surgical moment for the reconstruction of all lesioned structures. If we can use an allograft, our tendency is to apply one from the anterior tibial tendon or from Achilles tendon for PCL reconstruction, from anterior tibial or BTB for ACL reconstruction, anterior tibial or semitendinosus for medial structures and anterior tibial or Achilles for lateral structures.

Another option we draw upon is to handle both types of graft: allograft and autograft. In these cases, we employ allograft to reconstruct extra-articular structures (MCL; LCL) and autograft for the intra-articular ones (ACL; PCL). The techniques we use are the same ones which were previously described.

We indicate immobilization for 6 weeks, with crutches and partial weight bearing, and then knee brace for 3 months. The patient begins with active and passive mobility as from the second day post-op.

15.2.7 KD V

In these dislocations, a periarticular fracture is associated. The philosophy for their ligament approach does not vary from the anterior types, and the same premises are to be followed to plan the treatment strategy. But in these cases, the reduction and fixation of the associated fracture are added to allow for a rapid mobilization and rehabilitation of the articulation. Should it be impossible to resolve all lesions in only one surgical act, we have to take into account the possibility of proposing a treatment in stages, and it is in the first stage when the fracture must be resolved.

15.3 Conclusion

Knee dislocations in young patients are quite infrequent, and if they are not treated in time and correctly, they can have devastating consequences.

An accurate initial diagnosis is highly important. To achieve this, we must have an important rate of suspicion, bearing in mind that there are high number of cases that present already are spontaneously reduced.

We must always suspect a knee dislocation in those multiligament lesions or with important multidirectional instability.

The initial physical examination must be thorough so as not to misdiagnose a neurovascular lesion of extremely serious consequences. Currently, it has been demonstrated that surgical resolution of these lesions within the first 3 weeks leads to better results. It has also been demonstrated that the anatomic reconstruction of the injured structures versus their repair gets better results as well.

The availability of an allograft is relevant since it lowers morbidity and surgical time. Also, the surgeon's experience in the treatment of this type of lesions is crucial in the final results.

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