



Editorial commentary: the multiligament injured knee: current controversies and strategies for improving outcomes

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Multiligament knee injuries (MLKIs) are rare. Their importance lies in the fact that they can result in severe morbidity including arthrofibrosis, persistent pain, instability, and of course amputation. Management of these injuries can undoubtedly be challenging due to their infrequency, difficulties in accurate diagnosis, and the complex decision-making processes that are required to determine the optimal reconstructive procedures, graft choice, the timing of surgery, and strategies for rehabilitation.

Clinical research for MLKIs is limited by the infrequency of these injuries and their diverse nature. High level evidence is therefore sparse, and many aspects of management remain controversial. For the *Annals of Joint* focused issue entitled “The Multiligament Injured Knee”, Guest Editors, Dr. Camilo Helito and Dr. Jorge Chahla, preface a superb collection of reviews which combine the best evidence and expert opinion to provide an important resource for clinicians dealing with these complex injuries (1).

Mueller and O’Brien review return to sport and the factors that limit it following a multiligament knee injury (2). It is highlighted that only 30% of NFL athletes are able to return to the pre-injury level of sport (3) and the authors conclude that although return to a high level is very difficult to achieve, it is possible through surgery and rehabilitation (2). On that basis one could assume that bilateral knee dislocations, which occur even less frequently than unilateral injuries, would have considerably less favorable outcomes. However, Sonnery-Cottet *et al.* (including myself) recently reported successful return to the pre-injury level of sport in an elite skier after bilateral knee

dislocations (Schenk KD IV and V injuries) (4). In this case report we demonstrated that return to elite sport is possible even after such a severe injury and we highlighted some of the concepts that we consider important in minimizing the risk of key post-operative complications including ligament failure, persistent instability and stiffness. These issues are also thoroughly addressed in the special focus issue.

Lucidi *et al.* tackle one of the most controversial aspects—the use of external fixation (5). Although the topic benefits from a higher level of evidence than many areas of controversy in MLKIs (with evidence provided by two prospective randomized studies) (6,7) it remains controversial. Stannard *et al.* demonstrated a significantly reduced ligament failure rate with hinged external fixation and recommended its use post-operatively in highly unstable dislocations (7). However, it is important to note that even though the application of external fixation in general trauma scenarios can be straightforward, the use of a hinged-fixator following MLKI reconstruction requires great care in order to allow normal knee kinematics during flexion/extension. This is important because malpositioning may result in an inadvertent application of deleterious forces upon the reconstructions instead of protecting them. Although the use of external fixation is associated with some potential advantages, and Stannard *et al.* must be commended for publishing one of the few randomized prospective studies in this field, it remains the case that important outcomes including return to work and activity, and range of motion were not improved with this strategy (7). Furthermore, deep and superficial infection are recognized complications of external fixation, and

concerns exist regarding cost effectiveness and the extra surgical time that is required for application. In contrast to this strategy, in our recent case report we describe excellent knee stability, no stiffness-related complications and return to elite sport following reconstructions for bilateral knee dislocations (4). Each knee underwent single-stage surgery using an extensor mechanism allograft (one for each knee) to provide grafts for all reconstructions. Although the choice of allograft *vs.* autograft is also a controversial topic, the advantage of reduced operating time and avoidance of donor site morbidity are appealing, particularly when recent reviews have not identified any significant differences in the outcomes of MLKI reconstruction based upon whether the chosen graft is autograft or allograft (8). We prefer to avoid external fixation and therefore we institute post-operative immobilization in an extension brace, but place an early emphasis on quadriceps activation exercises, and then a planned manipulation under anesthesia at 6 weeks post-operatively. In our opinion this approach protects the reconstructions, but also minimizes the risk of undue stiffness. Although further study is clearly required, our case report demonstrates an alternative philosophy with potential advantages.

The timing of surgery is also an important topic of discussion with some authors preferring early surgery and others adopting a delayed or two-stage approach in order to try to minimize the risk of stiffness and also provide an opportunity for extra-articular structures to heal. Hirschmann *et al.* reported that patients treated more than forty days after injury had to give up professional sport more frequently than patients treated earlier (9). Although we agree that early surgery is an important determinant of outcome, we have adopted a milestone-based rather than time-based approach, and prefer to defer surgery until patients are able to demonstrate good quadriceps activation. The time interval between injury and the first surgery in our case report was only 9 days because of the strong emphasis on frequent isometric quadriceps activation exercises that were commenced shortly after the dislocations were reduced.

Also in the special issue are the articles from Franciozi *et al.* and Cinque *et al.*, which provide a comprehensive overview of current techniques for the surgical management of posterolateral corner injuries, (with and without the involvement of other ligaments) (10,11). One of the main controversies with respect to PLC injuries is whether to perform anatomic or non-anatomic reconstructions given that the majority of studies have demonstrated similar

outcomes for both. However, it is highlighted that there are some biomechanical and clinical studies reporting superior outcomes with the latter. Surgeons must balance these findings against both the increased complexity of surgery and the increased risk of complications, particularly tunnel collision in anatomic reconstructions. On that basis Cinque *et al.* suggest that anatomic reconstructions are particularly indicated in those patients with important hyperextension, external-rotation recurvatum, proximal tibio-fibular instability or an associated PCL injury. They also provide tips and tricks for reducing technical errors with these complex procedures (11). This is particularly important because there is no doubt that multiligament reconstructions can be very technically challenging. However, it is also essential to highlight that even with single ligament reconstructions (e.g., isolated ACL), it is recognized that surgeon volume is an important determinant of outcome (12). Surgeon volume is therefore likely to have greater importance in the MLKI setting and ideally these procedures are performed only in high volume centers with experienced teams. Despite the requirement for expertise, we must not neglect the basics of physical examination and imaging that form the cornerstone of diagnosis and surgical planning, and these issues are comprehensively addressed in the articles from Bonadio *et al.* and Helito *et al.* (13,14). Furthermore, Moatshe *et al.* provide a masterclass in surgical planning with abundant tips and tricks on reducing the risk of tunnel collision in complex reconstructions (15).

Gelber and Perelli provide an overview of medial collateral ligament (MCL) injuries and present a very useful algorithm for their management (16). The authors remind us that although many MCL injuries can be treated non-operatively, grade III lesions in the MLKI setting should be repaired or reconstructed. It has previously been reported that there is a plethora of medial-sided reconstruction options and none has been clearly demonstrated to be superior (17). The review from Gelber *et al.* demonstrates that this remains the case and further study is still needed (16).

Injury to the anterolateral ligament (ALL) is an emerging concept in the setting of multiligament knee injury. Although combined ACL and ALL injuries (the most common pattern of ALL injury) are most frequently non-contact sports injuries that are not associated with the same degree of morbidity as knee dislocations, the article from Delaloye *et al.* is exciting because the literature demonstrates that concomitant ALL reconstruction is associated with major improvements in the outcomes of ACL surgery (18).

The authors present compelling results demonstrating that combined ACL and ALL reconstruction decreases the risk of graft failure by three-fold and confers a protective effect on medial meniscal repairs by significantly reducing the secondary meniscectomy rate, when compared to isolated ACL reconstructions (19,20). Although the role of the ALL in knee stability has previously been controversial with some authors even describing it as fictional, there is now not only international consensus that it exists (21), but furthermore there is a wealth of anatomical, biomechanical, imaging and clinical studies demonstrating its important role in improving the outcomes of ACL reconstruction. However, it should also be noted that Marwan *et al.* described a high incidence of ALL injury in the MLKI setting (majority KD IV) but until now a possible role for ALL reconstruction has not been studied or described in the context of knee dislocations (22).

Further articles in this issue provide information on the role of osteotomy and also a perspective on management of the often-forgotten patellofemoral joint in MLKIs (23,24). Overall this special issue provides an important resource containing the latest evidence and expert insights into areas of ongoing controversy. A detailed understanding of these issues is essential in order to successfully navigate the complex decision-making processes required to manage multiligament knee injuries.

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None.

Footnote

Conflicts of Interest: Professor Saithna is a Consultant for Arthrex and has provided Consultancy for Smith & Nephew within the last 12 months.

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