

## Demographics of Multiligamentous Knee Injuries at a Level 1 Trauma Centre

### Dear Editor,

Multiligamentous knee injuries account for 0.02% to 0.2% of all orthopaedic injuries<sup>1,2</sup> and can result in significant functional disability. The aim of this study is to review the aetiology, characterise the injury patterns and present our management of multiligamentous knee injuries.

### Materials and Methods

A case review was performed for 18 consecutive patients who presented with multiligamentous knee injuries. These patients were managed over a 34-month period from 2010 to 2013 by the senior author who managed majority of the cases in our centre. Our institution is a 1300-bed Level 1 trauma centre that manages the highest number of trauma patients in our locality.<sup>3</sup> A multiligamentous knee injury was defined as an injury to 2 or more knee ligaments. These included the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), lateral collateral ligament (LCL), posteromedial (PMC) and posterolateral complexes (PLC). Assessment of the injured knee involved clinical examination and imaging modalities including x-rays and magnetic resonance imaging (MRI).

### Results

#### *Epidemiology and Mechanism of Injury*

Eighteen patients were identified from an injury database. The average age was 36 years old (range, 19 to 60 years) and 94% (17 patients) were male. High-energy trauma accounted for 72% of the injuries. These included motorcycle collisions (33%, 6 patients) and motorcyclists who self-skidded (22%, 4 patients), fall from height (11%, 2 patients) and a pedestrian who was hit by car (1 patient). Low-energy trauma accounted for 28% of the cases. These included sports injuries (11%, 2 patients) and low-energy falls (17%, 3 patients).

#### *Timing of Presentation and Associated Injuries*

Fourteen patients (78%) presented acutely and 4 patients (22%) were referred for management following resolution

of the more emergent injuries. Associated injuries in the ipsilateral lower extremity were present in 5 patients (28%) as follows: 2 open fractures of the tibia shaft with one of them having compartment syndrome at presentation, 1 chip fracture of the fibula head, 1 tibia plateau avulsion fracture and a metatarsal fracture. All the patients with associated fractures sustained high-energy trauma except 1 patient.

#### *Injury Patterns of the Knee*

The extent of injury was classified according to the ligaments involved (Table 1). The most common injury pattern involved the anterior cruciate ligament, posterior cruciate ligament, and medial collateral ligament complex (33%, 6 patients). The majority of injuries were closed except 1 patient who presented with an open knee dislocation.

#### *Initial Management*

All patients that presented following high-energy trauma underwent a full trauma evaluation in the emergency department. Four patients (22%) required emergent surgery at time of their initial presentation including debridement of open knee dislocation, intramedullary nailing, external fixation and fasciotomy.

Table 1. Patterns of Multiligamentous Knee Injury

Injury Pattern	No. of Knees (n = 18)	Percentage
ACL-PCL-MCL	6	33
ACL-PCL-PLC	4	22
ACL-PCL	2	11
PCL-PLC	2	11
ACL-PCL-MCL-LCL	1	6
ACL-PCL-PLC-PMC	1	6
PCL-MCL	1	6
PCL-PLC-MCL	1	6

ACL: Anterior cruciate ligament; PCL: Posterior cruciate ligament; MCL: Medial collateral ligament; LCL: Lateral collateral ligament; PLC: Posterolateral corner; PMC: Posteromedial corner

### Subsequent Management

Seven patients (39%) underwent definitive multiligamentous knee reconstruction (Table 2). Four patients underwent surgery at an average of 12 weeks after injury (range, 8 to 16 weeks) while the remaining 3 patients underwent surgery at 10 months and 3 years after the initial injury due to delayed presentation and patient preference for a trial of non-operative treatment. Eleven patients (61%) were managed non-operatively (Table 3).

The ACL was reconstructed using a transportal technique, while transtibial outside-in technique was used for PCL reconstruction, and a fibular-based reconstruction technique for PLC reconstruction. The sequence of graft tensioning was as follows: PCL, ACL, PLC/LCL, MCL. Postoperatively, all patients underwent a standardised rehabilitation protocol with their knee brace locked in extension for the first 6 weeks, except during therapy where passive range of motion from 0° to 45° was allowed. From 6 to 12 weeks postoperatively, the knee brace is unlocked and active range of motion is allowed. In the presence of a PCL reconstruction, patients were advised to avoid active hamstring contraction for 12 weeks and to sleep in a prone position to minimise the posterior directed forces on the tibia.

## Discussion

### Epidemiology and Injury Pattern

Multiligamentous knee injuries are complex extremity injuries that may be associated with neurovascular injuries and concomitant fractures of the involved limb. They may result in significant functional disability.

High-energy trauma is the most common cause of multiligamentous knee injuries. Wascher et al<sup>4</sup> reported 80% (40 patients) of cases were due to high-energy trauma involving motor vehicle accidents. Similarly, 76% (13 patients) in our series were due to high-energy trauma with a high proportion (10 patients, 59%) attributed to motorcycle accidents. A systematic review done to compare globally the distribution of road traffic deaths by road user group found that in Southeast Asia, motorcyclists contribute more to road traffic fatalities (up to 50%) compared to Europe and America (3% to 21%).<sup>5</sup> In our locality, motorcycles formed 15% of the total vehicles registered in 2011,<sup>6</sup> yet were implicated in 46% to 54% of all road traffic fatal accidents.<sup>7,8</sup>

Fractures of the ipsilateral extremity (12% to 58%)<sup>9</sup> are commonly associated with the multiligamentous injured knee. In our cohort of patients, 28% (5 patients) had associated ipsilateral limb fractures. In the polytrauma setting, the diagnosis of multiligamentous knee injury may be delayed as the management of life and limb threatening conditions will take precedence. In our series, 22% (4 patients) presented more than 3 months after the initial injury. Three of them were referred after the more emergent injuries were treated. This highlights the need to be vigilant for concomitant joint injuries in the setting of polytrauma. The initial knee dislocation may have spontaneously reduced and the injury to the knee is underestimated.<sup>10</sup>

### Management

The surgical management of multiligamentous knee injuries is complex and controversial. Two approaches had

Table 2. Timing of Definitive Ligamentous Reconstruction

Case	Surgery	Timing from Injury
1	ACL, PCL reconstruction with partial lateral meniscectomy and medial meniscus repair	2 months
2	ACL, PCL reconstruction with partial lateral meniscectomy	3 months
3	ACL, PCL, MCL reconstruction	3 months
4	LCL repair	3 weeks
	Staged reconstruction of ACL, PCL, PLC	4 months
5	ACL, PCL, MCL reconstruction*	10 months
6	PCL, MCL reconstruction*	3 years
7	PCL, PLC reconstruction†	3 years

ACL: Anterior cruciate ligament; PCL: Posterior cruciate ligament; MCL: Medial collateral ligament; LCL: Lateral collateral ligament; PLC: Posterolateral corner; PMC: Posteromedial corner

\*Delayed surgery due to patients' request for trial of non operative treatment.

†Delayed surgery due to late presentation.

Table 3. Reasons for Non-operative Management

Reason	No. of Patients	Injury Pattern
Functional stability	3	Patient 1: PCL/MCL
		Patient 2: PCL/PLC
		Patient 3: ACL/PCL/MCL
Comorbidities/low functional demand/functionally stable	3	Patient 1: ACL/PCL/PLC
		Patient 2: ACL/PCL/MCL
		Patient 3: ACL/PCL/PLC
Stable after acute MCL bony avulsion repair	1	Patient 1: MCL/PCL
Delayed presentation	1	Patient 1: PCL/MCL/PLC
		Patient 1: ACL/PCL/MCL/LCL
Transfer to country of origin for treatment	3	Patient 2: ACL/PCL/LCL
		Patient 3: ACL/PCL/PLC

ACL: Anterior cruciate ligament; PCL: Posterior cruciate ligament; MCL: Medial collateral ligament; LCL: Lateral collateral ligament; PLC: Posterolateral corner; PMC: Posteromedial corner

been adopted include the early, single stage reconstruction and staged reconstruction. Early surgery is defined as surgical repair or reconstruction performed within 3 weeks of the injury. In a systematic review by Levy et al,<sup>11</sup> early surgical treatment resulted in higher knee outcome scores than delayed surgery. There was no significant difference in mean range of motion or flexion loss. However, patients who underwent early surgery had higher sports activity scores. Staged reconstruction involves performing extra-articular ligamentous reconstruction in the early phase followed by intra-articular reconstruction subsequently. A systematic review by Mook et al<sup>12</sup> reported superior subjective outcomes in the staged treatment group when compared with both early and late surgery. Liow et al<sup>13</sup> highlighted that the advantages of performing a staged procedure are that of lower operative time as well as a lower risk of arthrofibrosis.

We adopted a staged surgical approach to the management of multiligamentous knee injuries due to associated risk of iatrogenic compartment syndrome during arthroscopy in the acute phase of injury.<sup>14,15</sup> Thirty-nine percent of our patients (7 patients) underwent definitive multiligamentous knee reconstruction. Four patients had surgery at an average of 12 weeks after injury (range, 8 to 16 weeks) while the remaining 3 patients underwent surgery 10 months to 3 years after the initial injury due to late presentation and patient preference for a trial of non-operative treatment (Table 3). Other factors that affect surgical timing are concomitant injuries such as open fractures, extensive soft tissue injury and other systemic medical conditions.

In a systematic review of studies<sup>11</sup> comparing operative and non-operative management, the Lysholm scores of the operative group was statistically significantly better than that of the non-operative group. There was also a high rate of return to work and sport in the group treated operatively. In our series, 11 patients (61%) were managed non-operatively, most commonly due to good functional stability of the affected knee, and/or low functional demand of the individual, medical comorbidities or returned to their country of origin for management (Table 3). This highlights the need for an individualised treatment approach for these complex knee injuries.

## Conclusion

The majority of our patients with multiligamentous knee injury were high-energy motorcycle accidents. The most common pattern of injury involved the ACL, PCL and MCL complex. An individualised and staged surgical approach was adopted in the management of this complex knee injury.

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