

# Epidemiology and treatment of knee luxation

## Epidemiologia e tratamento da luxação de joelho

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### ABSTRACT

**Introduction:** Knee dislocation is a rare and serious injury, associated with complications such as ligament instability, neurovascular injuries, loss of range of motion and associated fractures. High-energy traumas are the most common, with young men being the most affected.

**Objectives:** Analyze ligament and concomitant injuries, trauma mechanisms, patient profile and treatment for knee dislocations.

**Method:** Data collection through medical records of patients who met the diagnosis of knee dislocation, covering epidemiological, therapeutic and prognostic data, and treated at a trauma reference hospital. Demographic variables, causes of dislocation, mechanisms of trauma, side of the dislocated knee, injured ligaments and neurovascular impairment, fractures or concomitant injuries and their Schenck classification, were investigated.

**Results:** The most affected knee was the right, with greater involvement of the cruciate ligaments, with the KDI classification being more prevalent. Regarding therapeutic management, it was found that 18 patients (56.25%) had spontaneous reduction of the dislocation, while 14 (43.75%) needed to undergo closed reduction. Regarding treatment, 27 (84.37%) were treated surgically, with external fixator and ligament reconstruction, while 5 (15.62%) underwent conservative treatment with the use of an inguinopectic and inguinomaleolar plaster splint, brace and plaster.

**Conclusion:** Knee dislocation has a clear predilection for young men, being frequently caused by traffic accidents, and the high rate of associated injuries results in a worse prognosis. The most affected ligaments were the cruciates and the most prevalent classification was the KDI. This dislocation has a high rate of associated injuries, such as fractures, meniscal and neurovascular injuries, which leads to a worse prognosis, affecting quality of life. Knee dislocation has a heterogeneous profile and there are divergences between management and epidemiological data.

**KEYWORDS:** Knee dislocation. Injury. Epidemiology.

### Central Message

Knee dislocation is a rare and serious injury, associated with complications such as ligament instability, neurovascular injuries, loss of range of motion and associated fractures. High-energy traumas are the most frequent, with young men being the most affected. The analysis of ligament and concomitant injuries, trauma mechanisms, patient profile, and treatment is opportune because it is a low-prevalence disease and therapeutic attitudes that are still controversial.

### Perspective

In the choice of therapeutic approach in knee dislocation, patients should be distributed according to the severity of the injuries, based on the Schenck classification, which guides which patients conservative therapy and surgical treatment should be indicated for. This study helps and assists in decision making.

### RESUMO

**Introdução:** Luxação de joelho é lesão rara e grave, associada à complicações como instabilidade ligamentar, lesões neurovasculares, perda de amplitude do movimento e fraturas associadas. Traumas de alta energia são os mais frequentes, sendo homens jovens os mais afetados.

**Objetivos:** Analisar as lesões ligamentares e concomitantes, mecanismos de trauma, perfil dos pacientes e o tratamento nas luxações de joelho.

**Método:** Coleta de dados através de prontuários de pacientes que se enquadravam com o diagnóstico de luxação de joelho abrangendo dados epidemiológicos, terapêuticos e de prognóstico, e atendidos em hospital de referência em trauma. Pesquisaram-se às variáveis demográficas, as causas da luxação, os mecanismos do trauma, lado do joelho luxado, ligamentos lesados e, comprometimento neurovascular, fraturas ou lesões concomitantes e sua classificação de Schenck.

**Resultados:** O joelho mais afetado foi o direito, com maior acometimento dos ligamentos cruzados, sendo a classificação KDI mais prevalente. Com relação à conduta terapêutica, verificou-se que 18 pacientes (56,25%) tiveram redução espontânea da luxação, enquanto 14 (43,75%) necessitaram realizar redução incruenta. Em relação ao tratamento, 27 (84,37%) foram tratados cirurgicamente, com o fixador externo e reconstrução ligamentar, enquanto 5 (15,62%) ao tratamento conservador com uso de tala gessada inguinopédica e inguinomaleolar, brace e gesso.

**Conclusão:** A luxação de joelho apresenta, clara predileção por homens jovens, sendo frequentemente causada por acidentes de trânsito, e a alta taxa de lesões associadas resulta em pior prognóstico. Os ligamentos mais acometidos foram os cruzados e a classificação mais prevalente foi o KDI. Essa luxação possui alta taxa de lesões associadas, como fraturas, lesões meniscais e neurovasculares, o que acarreta pior prognóstico afetando a qualidade de vida. A luxação de joelho possui perfil heterogêneo e há divergências entre condutas e dados epidemiológicos.

**PALAVRAS-CHAVE:** Luxação de joelho. Trauma. Epidemiologia.

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Conflict of interest: None | Financial source: None | Received: 06/02/2024 | Accepted: 15/05/2024 | Correspondence: [cassio\\_zini@yahoo.com.br](mailto:cassio_zini@yahoo.com.br) | Associate Editor: Luiz Fernando Kubrusly<sup>1</sup>

How to cite:

Muniz MHG, Costa PTG, Zini C, Manso JEF. Epidemiologia e tratamento da luxação de joelho.. BioSCIENCE. 2024;82:e030

## INTRODUCTION

**T**raumatic knee dislocation is a rare and serious injury, with an incidence of less than 0.2% among orthopedic injuries. Some authors state that it is characterized when there is the involvement of 2 ligament structures; others say that the loss of tibiofemoral congruence together with the damage to the joint capsule is what characterizes this type of injury.<sup>1,2</sup>

The most commonly used classifications are those of Kennedy and Schenck.<sup>3,4</sup> The first describes the anatomical position that the distal segment assumes in relation to the proximal segment, but it is not widely used due to the frequency of spontaneous reductions. The second, on the other hand, is described, taking into account, the involvement of cruciate and collateral ligament injuries.

The most frequent trauma mechanisms are high-energy (car accidents), and when low-energy, sports accidents are described, affecting mostly the young population.<sup>5</sup>

The diagnosis of ligament, capsular and neurovascular injuries is made from the clinic, through the main complaint and the history of the trauma. On physical examination, local deformity, functional disability, joint instability, neurological function, extremity perfusion, and pulse are evaluated. In addition, confirmation is made with the help of radiological examinations, magnetic resonance imaging, angiography and computed tomography.<sup>6</sup>

This lesion is also considered complex, since it is associated with several possible complications: ligament instability, injury to the common fibular nerve and popliteal artery, loss of range of motion, arthrofibrosis, deep vein thrombosis of the lower limb, and amputation.

Surgical treatment demonstrates more satisfactory results compared to conservative treatment; however, it is still discussed due to the diversity of existing protocols.<sup>7</sup> This injury is in high demand in public health, since the patient is most often young and economically active, who will need complex treatment, as well as a long rehabilitation program.<sup>8</sup>

Since knee dislocation is rare and with heterogeneity of its ligament and neurovascular injuries, there is still no standard on which injuries are the most commonly found, their incidence and characteristic, making it difficult to interpret the results and the treatment protocol.

Treatment is based on the initial approach, in which the joint is reduced and stabilized to avoid additional injuries such as neurovascular injuries, and definitive treatment, in which the ligaments are repaired, which can be in the acute phase (up to 3 weeks) or in the chronic phase (after 3 weeks).<sup>9</sup> There is a consensus that surgical treatment brings superior results in relation to conservative treatment, in terms of range of motion, and adaptive stability to daily activities.<sup>10</sup> There is still a discussion about whether to operate on all injured ligaments in the first stage, or in more than one

procedure, since there are chances of arthrofibrosis occurring when more than one ligament is operated. It is defended by Levy et al.<sup>11</sup> the use of external fixator in unstable reduction that cannot be maintained with the use of splints, in emergency and ligament reconstruction between 3-6 weeks after the injury with the use of grafts and when there is vascular repair, severe KDV injury, decompressive fasciotomy. Arthroscopic reconstruction of cruciate ligaments and repair of peripheral injuries should be performed as soon as possible, according to Clark et al.<sup>12</sup> Definitive surgery is indicated within 2 weeks, that is, in the acute phase.

Despite indications in the literature that surgical treatment brings more benefits, most patients continue to be treated conservatively. The most common indications for conservative treatment are severe polytrauma, traumatic brain injury, advanced age, comorbidities, and involvement of the soft tissues around the knee joint. However, it is still controversial that conservative treatment affects the outcome of knee dislocations.<sup>13</sup>

**TABLE 1** – Schenck classification.<sup>4</sup>

Classification	Structures affected
KDI	Single hook + collateral
KDII	LCA + LCP
KDIIIM	LCA+LCP+LCM
KDIIIL	LCA+LCP+LCL
KDIV	LCA+LCP+LCL+LCM
KDV	Periarticular fracture

ACL = anterior cruciate ligament; PCL = posterior cruciate ligament; LCL=lateral collateral ligament; MCL=medial collateral ligament

Thus, this study aimed to analyze the epidemiological profile of patients diagnosed with knee dislocation, identifying age, gender, trauma mechanism, dislocated side, injured ligaments, neurovascular involvement, fractures, concomitant injuries, length of hospital stay, treatment and prognosis, and their type according to the Schenck classification<sup>4</sup> (Table 1).

## METHOD

This work was submitted to evaluation and approved by the Human Research Ethics Committee of the Mackenzie Evangelical College of Paraná, registered under opinion no. 5.371.388, CAAE: 57711522.4.0000.0103. This is an individual observational cross-sectional study of medical record review, in which epidemiological data on knee dislocation in a specific population was collected. Data were obtained from the computerized registry of the Mackenzie Evangelical University Hospital, Curitiba, PR, Brazil, between March 2012 and March 2022, using the International Classification of Diseases (ICD) of knee dislocation S83.<sup>1</sup>

The research included the analysis of 39 medical records. Patients who did not have the necessary data for collection, as well as injuries that did not qualify as knee dislocation, were excluded. The identities of the patients, holders of the medical records, were preserved, in compliance with Resolution 466/12 of the National Health Council. Demographic variables, causes of dislocation, trauma mechanisms, dislocated side of the

knee, injured ligaments, neurovascular involvement, fractures or concomitant injuries, and their Schenck classification were investigated.

Regarding the therapeutic approach, the patients were distributed among those who underwent conservative treatment and surgical treatment, length of hospital stay, as well as prognosis and complications.

### Statistical analysis

Quantitative variables were analyzed using mean, median, mode, standard deviation, coefficient of variation, absolute and relative frequency.

## RESULT

The study had 39 patients, but 7 met the exclusion criteria, totaling 32. The patients were between 21 and 80 ( $\pm 12.1$ ) years, mean of 36, median of 35 years, resulting in a coefficient of variation (VC) of 0.33, which demonstrates great heterogeneity in age. Table 2 shows 1 80-year-old patient, which is unusual for this type of lesion. Regarding gender, 8 were women (25%) and 24 men (75%), giving a ratio of 3:1 (Table 2).

**TABLE 2** – Demographic variables and age distribution

Variables	n (%)
Age – Median (Mean $\pm$ SD)	35 (36 $\pm$ 12.1)
Sex	
Male	24 (75%)
Female	8 (25%)
Total	32 (100%)

The most frequent trauma mechanisms were being run over ( $n = 5$ , 15.63%), car accidents ( $n = 13$ , 40.63%), which include car accidents ( $n = 7$ , 21.88%) and motorcycle accidents ( $n = 6$ , 18.75%), sports trauma ( $n = 5$ , 15.63%) and falls from the same level ( $n = 7$ , 21.88%). Other mechanisms described in the study were bicycle accidents and direct trauma (Table 3).

**TABLE 3** – Mechanisms of trauma

Variables	n (%)
Mechanism of trauma	
Car	7 (21,88%)
Falls	7 (21,88%)
Motorcycling	6 (18,75%)
Hit	5 (15,63%)
Sports 5 (15,63%)	
Bicycle	1 (3,13%)
Direct trauma	1 (3,13%)
Total	32 (100%)

The right knee was the most affected, with 17 cases (53.12%) and the left knee in 15 (46.87, Table 4). The most affected ligaments were the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL), both with the same amount, 25 cases corresponding to 78.12%. Seventeen (53.12%) had medial collateral ligament (MCL) involvement, while 12 (37.5%) had lateral collateral ligament involvement (LCL, Table 4).

Based on the injured ligaments, the patients were classified according to the Schenck classification,

with the KDI type being the most present, totaling 11 patients (34.37%), followed by the KDIII in 10 (31.25%), subdivided into KDIIIM with 6 (18.75%) and KDIIIL in 4 patients (12.5%). There were 6 cases (18.75%) classified as KDII and 5 (15.62%) as KDV (3 as KDV4, associated with fracture of the tibial plateau, lateral femoral condyle, and fracture of the proximal femur; 1 as KDV1 associated with fracture of the tibial plateau; and 1 as KDV2, associated with fracture of the tibial spine (Table 4).

**TABLE 4** – Dislocation variables

Variables	n (%)
Side	
Right	17 (53,125%)
Left	15 (46,875%)
Ligaments	
LCA	25 (78,125%)
LCP	25 (78,125%)
LCM	17 (53,125%)
ISC	12 (37,5%)
Schenck Classification	
KDI 11 (34,375%)	
KDII	6 (18,75%)
KDIIIM	6 (18,75%)
KDIIIL	4 (12,5%)
KDV	5 (15,625%)
Neurovascular	
Popliteal artery	1 (3,125%)
Common peroneal nerve	2 (6,25%)
Fractures	
Tibial Plateau	2 (6,25%)
Lateral Femoral Condyle	1 (3,125%)
Proximal Femoral Fracture	1 (3,125%)
Tibial Spine	1 (3,125%)
Open Fracture Femoral Shaft	2 (6,25%)
Concomitant Injuries	
Medial Meniscus	4 (12,5%)
Lateral Meniscus	4 (12,5%)
Clavicle Fracture	2 (6,25%)
Pneumothorax	1 (3,125%)
Popliteal Ligament	2 (6,25%)
Patellar tendon	3 (9,375%)
Total	32 (100%)

Only 1 patient (3.12%) had popliteal artery involvement, and he was classified as KDV4 (injury of all ligaments with transarticular fracture). The popliteal pulse was decreased, and the prognosis was not included in his medical record. A total of 2 (6.25%) patients were found to have common fibular nerve injuries, 1 of whom was classified as KDIIIL and the other as KDV with fracture of the lateral femoral condyle, with lower limb paresthesia as symptoms.

Other injuries were observed in the dislocations, an expected fact due to the severe nature of the injury and related to the high energy of the trauma. They were meniscal injuries, clavicle fracture, pneumothorax, popliteal ligament rupture, patellar tendon rupture, and open femoral fracture, which together accounted for 43.75% of the cases (Table 4).

The length of hospital stay ranged from 1 to 12 days (mean 5.4 and mode of 6 days), demonstrating that the lesions were treated in the acute phase (Figure).

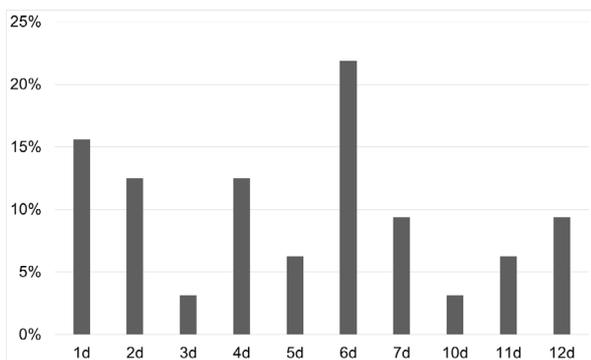


FIGURE — Length of hospital stay

It was found that 18 patients (56.25%) had spontaneous reduction of the dislocation, while 14 (43.75%) needed to undergo closed reduction (Table 4). Regarding treatment, 27 (84.37%) were treated surgically, with external fixator and ligament reconstruction, while 5 (15.62%) were treated conservatively with the use of an inguinopedalic plaster splint and inguinomalleolar, brace and plaster cast (Table 5).

TABLE 5 — Therapeutic management and prognosis

Variables	n (%)
Reductions	
Spontaneous	18 (56,25%)
Bloodless	14 (43,75%)
Treatment	
Surgical	27 (84,375%)
Conservative	5 (15,625%)
Prognosis	
Decreased ROM	5 (15,625%)
Quadriceps atrophy	2 (6,25%)
Gait instability	1 (3,125%)
Infectious process	1 (3,125%)
Joint stiffness	1 (3,125%)
Claudication	1 (3,125%)
Venous thrombosis	1 (3,125%)
Total	32 (100%)

Some complaints had a poor prognosis; They were: decreased range of motion (n = 5, 15.62%); quadriceps atrophy (n = 2, 6.25%), gait instability (n = 1, 3.12%); infectious process (n = 1, 3.12%), joint stiffness (n = 1, 3.12%), claudication (n = 1, 3.12%) and thrombosis (n = 1, 3.12%), resulting in 37.5% of patients with a worse prognosis.

## DISCUSSION

The initial assessment of the patient is primarily based on the Advanced Trauma and Life Support (ATLS) protocol. Upon admission, a physical examination should be performed as soon as possible when knee dislocation is suspected. It is of great importance to perform the neurovascular evaluation, paying attention to the injury to the common fibular nerve, popliteal artery and the possibility of compartment syndrome, where paresthesia of the limb is verified, based on the physical examination.<sup>14</sup>

On inspection, there is usually the presence of edema and hematoma, which suggests hemarthrosis - an important finding that can diagnose knee dislocation

– and, also, the range of motion of the knee is reduced. On palpation, the patient reports diffuse pain, and on palpation he seeks asymmetry, vasospasm, and in the absence of a pedalic dorsal pulse, there is evidence of vascular injury, predominantly of the popliteal artery. Tests are performed to exclude injury to the common peroneal nerve, and there is a decrease in ankle strength and decreased or absent sensitivity when there is injury to this nerve.

Hollis et al.<sup>15</sup> indicate that if there is an absence of pulse asymmetry, additional studies are no longer necessary to investigate vascular injury. Mills et al.<sup>16</sup> state that if the patient has an ankle-brachial index ABI <0.9, he or she should be further investigated due to the probable complications resulting from it, such as necrosis and subsequent amputation.

In the study by Green and Allen<sup>17</sup>, patients treated in less than 8 h had an 11% amputation rate, while those who prolonged more hours had an 86% limb loss rate.

The use of angiography in suspected knee dislocation is still under debate; however, studies affirm that everyone should undergo this test, because the physical examination does not always detect lesions, such as subendothelial lesions. Other authors, on the other hand, state that angiography is reserved for those with inadequate circulation in the affected limb.<sup>17,18</sup>

After the physical examination and before the ligament tests, it is necessary to perform an imaging exam, most often simple radiographic, to plan the reduction and rule out associated fractures, since 10-20% of patients who dislocate the knee have fractures. CT scan is used to more accurately visualize fracture, while MRI can show soft tissue or ligament injuries not elucidated by X-rays thus improving surgical planning.<sup>19</sup>

Reducing the joint early is essential since there is a probability of skin necrosis when this process is delayed. However, it is not always necessary to carry out the reduction, since according to Twaddle et al.<sup>20</sup>, 67% of dislocations are reduced spontaneously. To perform the reduction maneuver, the knee must be pulled in attempt to perform extension, and when the joint does not reduce, it requires open reduction in the operating room. Once the reduction maneuver is finished, the physical examination should be performed again and the neurovascular function should be checked to see if the neurovascular function is normal, and then proceed to the ligament tests.<sup>19-24</sup>

The ACL can be tested with Lachman's maneuvers, anterior drawer and pivot-shift; the PCL with the reverse Lachman maneuvers, reverse pivot-shift, posterior drawer and Godfrey's sign. Collateral ligament injuries are usually tested with valgus and varus 0-30° stress. The posterolateral corner is examined with the recurvate test, dial-test, and posterolateral drawer.

## CONCLUSION

The study showed that patients with knee dislocation are more seen in young men, with the most frequent trauma mechanisms being traffic, car and motorcycle accidents. The most affected ligaments were cruciate ligaments and

the most prevalent classification was KDI. This dislocation has a high rate of associated injuries, such as fractures, meniscal and neurovascular injuries, which leads to a worse prognosis, affecting quality of life. Knee dislocation has a heterogeneous profile and there are divergences between conducts and epidemiological data due to the fact that similar studies are based on a number of cases limited by the relative rarity of the injury.

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