

# Complications in knee surgery

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## Abstract

This is a comprehensive review of complications that can occur with common knee surgical procedures. Procedures have been grouped into arthroscopic & soft-tissue knee surgery, articular cartilage restoration procedures, osteotomy, and arthroplasty. As newer implants and procedures are developed it is anticipated that new complications may arise. However, the overall trend will be towards a generalized reduction. At the same time, patient expectations are increasing in tandem with improvements in health and longevity. It is important to counsel patients regarding any risks of potential complications associated with any intervention as part of the informed consent process.

**Keywords** arthroplasty; complications; knee surgery; osteotomy; reconstruction

## Introduction

The purpose of this article is to provide a comprehensive overview of the complications associated with common knee surgical procedures. Complications in knee surgery can be broadly divided into venous thromboembolic (VTE), infective, mechanical failures and issues related to function. Some (e.g. infective) have reduced over the years with improvements in sterilization and antimicrobial prophylaxis. VTE rates have reduced over recent years due to our appreciation of the importance of early mobilization following surgery, using enhanced recovery approaches and the use of mechanical and/or chemoprophylaxis. Unfortunately, patients still die following surgery due to thromboembolic events.

Catastrophic mechanical failure does occasionally occur, as for example was seen with metal on metal resurfacing hip replacements. Counselling patients regarding these types of serious complication is imperative.

Patient expectations are increasing in tandem with improvements in their health and longevity. At the same time there has been a clear reduction in the scores derived from patient reported outcome measures.

We have considered in this review the most important aspects of knee surgery, excluding emergency procedures carried out for trauma. The procedures are grouped into arthroscopic & soft-

tissue knee surgery, articular cartilage restoration procedures, osteotomy, and arthroplasty.

## Arthroscopic and soft-tissue knee surgery

The commonest arthroscopic procedures carried out in the knee include meniscectomy, meniscal repair, ACL/PLC ligament reconstruction, synovectomy, removal of loose body, micro fracture or drilling, arthroscopic osteosynthesis and medial plicae resection.<sup>1</sup>

Knee arthroscopy in general has an overall complication rate of 0.56–2.4%.<sup>2</sup> The infection risk is 0.008–1.1%.<sup>3</sup> The deep infection rate is between 0.008% and 0.8% and increases to 1.1% following complex surgery such as ACL reconstruction.<sup>1</sup> The most common organisms are *Staphylococcus* (coagulase negative/epidermidis), *Enterobacter cloacae*, *Streptococcus* and *Serratia marcescens*.<sup>3</sup> Risk factors for infection include morbid obesity, smoking, diabetes, being male, use of intra-articular steroids following surgery, prolonged tourniquet times, surgery in patients aged over 50, increased procedure complexity and a history of previous procedures. Antibiotic prophylaxis may be helpful; the infection rate was reduced from 0.14% to 0.08% in one study.<sup>4</sup>

The DVT rate following knee arthroscopy is between 0.13% and 17.9% (symptomatic PE 1.9%).<sup>5</sup> There is no correlation with surgical time, tourniquet use or anaesthetic type.<sup>6</sup> It is unclear whether chemoprophylaxis is of benefit.

Mild tourniquet paresis may occur following prolonged surgical procedures. A tourniquet should be deflated after 90–120 min of use. Nerve injury can also occur through direct trauma from a scalpel or other instrument, over distraction or fluid extravasation. In a series of 375,069 patients, 30 saphenous nerve injuries and six peroneal nerve injuries were reported.<sup>2</sup> Careful dissection, padding and familiarity with techniques can reduce the chances of these injuries.

Haemarthrosis and persistent effusion is common, seen in 1–5.9%.<sup>7</sup> It most frequently occurs after lateral release, meniscectomy and synovectomy through injury to the genicular vessels. The incidence of vascular injury has been reported to be between 0 and 0.003%.<sup>8</sup> Direct penetration or laceration of the saphenous vein as it passes behind the posterior border of the medial epicondyle can occur. Meniscectomy and PCL reconstruction may put popliteal vessels at risk and genicular artery injury may result in an arteriovenous fistula or pseudoaneurysm. Compartment syndrome may occur through extravasation of fluid. There were no cases of CRPS in a series of 2623 patients undergoing knee arthroscopy.<sup>1</sup>

Fatty tissue herniation through the portals may result in a synovial fistula. These can be treated with immobilization for 7–10 days and the administration of prophylactic antibiotics. Synovial fistula may require surgical treatment to close the opening between the knee joint and the fistula.<sup>9</sup>

The medial collateral ligament can be torn by severe valgus stress during surgery in an attempt to open the medial compartment. The incidence of ligament injuries is 0.04%.<sup>10</sup> Femoral fractures are rare (0.0007%).<sup>2</sup>

Other complications include injuries such as scuffing of cartilage with the tip of the arthroscope leading to degenerative changes and arthritis, damage to the fat pad, menisci, patella

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tendon and cruciate ligaments. The incidence of intra articular instrument breakage is 0.05%–0.11%.<sup>1</sup>

A complication rate of 2.4% has been reported following meniscectomy and meniscal repairs. This includes failures of the repair and a 0.1% risk of vascular injury. Radiological studies report increased osteoarthritic changes following meniscectomy compared with meniscal repair.<sup>11</sup> In a series of 2640 patients who underwent partial medial meniscectomy, Sherman reported a haemarthrosis rate of 3.3%.<sup>12</sup> One study reported a revision rate of 0.4% following meniscal surgery.<sup>7</sup>

Samitier published a systematic review on outcomes following meniscal transplant in 2016, reporting on 62 studies. Graft shrinkage and graft extrusion were common but had no clinical/functional implications. Other complications included partial tears of the meniscal allograft 11.1%, arthrofibrosis 3.6%, and infection 2.0%.<sup>13</sup>

Whilst there have been no reports of prion infection involving meniscal transplant, The FDA has reported one case of allograft tissue prion transmission in 2005 out of 1.5 million transplanted allografts). 83 infections were reported in total, 33% involving tendons, and 8% bone). Twenty-five were fungal.<sup>14</sup>

Following arthroscopic synovectomy, major complications include septic arthritis 0.5% and rupture of the joint capsule with oedema of the thigh and leg 1.5%. Minor post-arthroscopic complications included infection of the operative skin incisions 2.0%, haemarthrosis 3.5%, severe postoperative pain 1.5% and gout relapse 0.5%.<sup>15</sup> Subcutaneous lateral release, is associated with a 0.8% incidence of adhesions.<sup>12</sup> Even removal of loose bodies may sometimes not be possible because of being unable to locate them or to remove them.

Complication rates relating to arthroscopic anterior cruciate ligament (ACL) reconstruction range 0.7%–1.8% and include loose/poor staple positions, stiff knees, infection and neurological injuries, ruptured or attenuated grafts and unstable knees.<sup>2</sup> Persistent rotational instability may occur in up to 40–60% of patients 2 years after reconstruction.<sup>16</sup>

Several authors have reported complications following ACL reconstruction. The rate of symptomatic DVT is reported to be 0.30–0.83% (PE 0.18%), no deaths were reported, patients had wound complications in 0.75% of cases, 0.25% had a washout of knee joint and 1.36% were re-admitted into the NHS within 30 days.<sup>17</sup> Patients may develop an extension deficit following ACL reconstruction surgery; the incidence ranges between 1 and 38%. Pre-operative effusion, limited range of motion, other knee ligament injuries, graft placement errors, extra-articular procedures, soft tissue injury, inadequate notchplasty, immobilization following surgery and infection are risk factors. There is controversy regarding whether graft tension, graft choice (hamstring or patellar tendon) and timing of surgery are related to stiffness.<sup>18</sup>

Strength deficits are common following ACL reconstruction. The rate of 'return to play' at the same pre-injury level has been reported to be 35%–84%. A quarter of patients will develop osteoarthritis at a mean of 10 years, and some may not return to high level sport. The risk of ACL graft failure following reconstruction is reported as 12–24%.<sup>19</sup> Risk factors include patient age, sex, body mass index (BMI), time from surgery, graft size, meniscal integrity, tibial tunnel malposition and early return to sport.<sup>20</sup> The incidence of persistent anterior knee pain following

bone-patellar tendon-bone autograft is between 0 and 34%. This may be associated with persistent flexion contracture or quadriceps weakness. Patients who have undergone revision ACL reconstruction have greater laxity and a larger reduction in the Tegner activity score compared to primary ACL procedures.<sup>21</sup>

Following posterior cruciate ligament reconstruction a DVT rate of 21.9% has been reported. Proximal DVT extension occurs in 3.1%. Age and tourniquet time appear to be related to risk.<sup>22</sup> Rarely, iatrogenic popliteal lesions may occur including arterial laceration, but this is rare. A more common complication is recurrent laxity, which may be helped by internal bracing. Neurological injury is extremely rare. The failure rate of posterolateral corner reconstruction is 4.7%. Infection in this procedure is quoted as 0.3–12.5%.<sup>23</sup>

Most medial collateral ligament (MCL) injuries are treated conservatively. There is little information on the complications following primary repair of the MCL. One series reported an infection rate of 1.8% (septic arthritis 0.3%), knee stiffness 0.6%, haematoma and delayed wound healing 0.3%, painful metalwork 1.5%, and residual laxity 0.6%.<sup>24</sup> Bohl et al. reported on 48 (1.2%) patients from a series of 3922 total knee replacement patients who underwent direct repair of the MCL. Of this group one patient died, one was lost to follow-up, and one underwent intra-operative conversion to a constrained total knee replacement. At a mean follow-up of 99 months (range 24–214 months) there was no instability. 5 had stiffness 10.5%, 2 required revision for aseptic loosening 4%.<sup>25</sup>

### Articular cartilage restoration procedures

Articular cartilage treatments can be reparative or reconstructive. Reparative techniques aim to stimulate the patient's own cells to form hyaline cartilage; a period of maturation is required. Reconstructive procedures aim to restore cartilage through transplantation of autograft or allografts. with mature subchondral bone and mature hyaline cartilage.

Four typical major complications can occur following autologous chondrocyte implantation or cartilage grafting. These include hypertrophy of the transplant 15.4%, disturbed fusion of the regenerative cartilage and the healthy surrounding cartilage 4.9%, insufficient regenerative cartilage 3.8% and delamination 3.8%. Other reported complications include arthrofibrosis 5.75%, and osteonecrosis 3.8%.<sup>26</sup>

Mosaicplasty, a technique where cartilage damage is treated by harvesting and transplanting cylindrical plugs of bone and cartilage, is associated with a superficial infection rate of up to 5%, persisting effusion in 5%, haemarthrosis in 10%, stiffness and locking in up to 30%. Transient disturbance of the peroneal nerve was seen, lasting for 3 weeks, in up to 15% of patients.<sup>27</sup>

Mega-OATS (autograft transfer of posterior femoral condyle) is associated with complications including VTE 3%, persisting effusion 3% and superficial infection 3% and progressive degenerative changes<sup>28</sup>

Microfracture is another commonly performed procedure. It may be associated with haemarthrosis. Importantly, 31% of patients treated with microfracture of subchondral bone require further treatment at 5 years.<sup>29</sup>

Stem-cell therapy appears to be relatively safe. A recent systematic review and meta-analysis of trials involving 1012

participants receiving intra-vascular MSC therapy for various clinical conditions including ischaemic stroke, Crohn's disease, cardiomyopathy, ischaemic heart disease and graft versus host disease, did not identify any significant adverse events other than transient fever. Pan et al., in 2014, showed that bone marrow and hepatic MSCs showed evidence of malignant transformation after culture beyond 5 weeks, with the development of malignancy in immune deficient mice.<sup>30</sup> There is no evidence of this occurring in humans.<sup>31</sup>

### Osteotomy

There are several types of osteotomy around the knee. A DVT rate of 1.42% has been observed, with a PE rate of 0.71%, in patients who have undergone either a distal femoral osteotomy, high tibial osteotomy or tibial tubercle osteotomy. There were no significant reports of neurovascular injury following distal femoral osteotomy, but it is prudent to mention injury as a risk due to the anatomy.<sup>32</sup> Three types of osteotomy will be discussed: distal femoral osteotomy, proximal tibial osteotomy and tibial tubercle osteotomy.

Distal femoral osteotomy may be closing or opening. Complication rates of up to 73% have been reported in patients undergoing a closing wedge osteotomy. These include discomfort over the fixation plate 72%, PE 0.9%, failure of fixation 0.9%, wound infection 0.9%, femur fracture 0.45%, knee stiffness 3.3% and non-union 0.9%–5%.<sup>33</sup> Chahla reported complication rates of 0–30% in patients who have undergone opening wedge distal femoral osteotomy. These include symptomatic hardware 3%, delayed union/non-union 2.4%, periprosthetic fracture and stiffness.<sup>34</sup>

Medial opening or lateral closing wedge proximal (or high) tibial osteotomies may delay joint replacement surgery. At 10–15 years following osteotomy, 40% of patients required conversion to a total knee replacement. Loss of correction is thought to occur in 5–30% of patients with a proximal tibial osteotomy.

Medial Opening Wedge High Tibial Osteotomy has an overall complication rate of approximately 30%. Complications include symptomatic hardware in 6.2%, deep wound infection 1.9%, minor wound infection 10%, vascular injury 1.7%, compartment syndrome 0.9%, hardware failure with loss of correction 0.5%, non-union 0.5%, early conversion to arthroplasty 0.5%, displaced (>2 mm) lateral hinge fracture 2.4%, undisplaced lateral hinge fracture 12%, delayed wound healing 1.9%, undisplaced (<2 mm) lateral tibial plateau fracture 1%, superficial wound infection 1%, hardware irritation 1.4%, CRPS 0.5%, and, cellulitis 1%. Up to 64% of patients may develop patella baja following opening wedge high tibial osteotomy. The incidence is higher following supra-tubercle osteotomies due to shortening of the patella tendon and prolonged immobilization. Subsequent joint replacement may become difficult as a result. The incidence of DVT in opening wedge high tibial osteotomies is 0.45% (PE 0%) without chemoprophylaxis. Anticoagulants or aspirin did not significantly reduce the incidence of DVT.<sup>35</sup> The incidence of joint stiffness is 6.5%.<sup>36</sup> Propagation of an opening wedge osteotomy into a fracture of the opposite cortex can occur in 82% of cases; a correction over 8 degrees is associated with a higher risk of fracture.<sup>37</sup>

Lateral Closing Wedge High Tibial Osteotomy has a 12.7% post-operative complication rate. Individual rates include 4.2%

for temporary peroneal nerve palsy, 0.8–41% DVT (and fatal PE), 2.5% skin necrosis, 0.8–10.4% wound infection, 0.8% haematoma requiring debridement. Non-union and loss of correction occur in 1.6% of patients.<sup>38</sup> Vascular injuries and compartment syndrome are rare.<sup>39</sup> Stiffness is more common than an opening wedge osteotomy. Intra-articular fractures following a closing wedge high tibial osteotomy have a reported incidence of 0–20%. The incidence of symptomatic peroneal nerve injury is between 3.3% and 11.9% and may be due to tourniquet use, tight bandages, plaster casts, compartment syndrome, and, iatrogenic peroneal nerve palsy. Under correction may occur. Closing wedge osteotomies have a lower rate of non-union than opening wedge osteotomies because of good bone apposition and the osteotomy is in compression.<sup>40</sup>

Tibial tubercle osteotomy is used to treat patellar instability and unload the patellofemoral joint.<sup>41</sup> Complications rates may be as high as 29–46% of patients including delayed union 23%, painful hardware 21–44%, DVT 2.6%, clinical non-union 2%, stiffness 2%, sensory deficit 2%, wound breakdown 0.6–2%, broken screw 0.7%, fascial hernia 0.7%, quadriceps dysfunction 0.7%, tibial fracture 0.7–3.3%, loss of fixation 1.7%, non-union 0.6%, delayed union 2.8%, DVT 1.1%, Arthrofibrosis requiring surgery 8.3%, superficial infection 1.7–8% (no deep infections), reduced cutaneous sensation 3.9%, Painful hardware was associated with the use of larger, 4.5 mm screws. Delayed union is more likely to be associated with distalisation of the tubercle.<sup>41</sup>

### Arthroplasty

#### Total knee replacement

Knee osteoarthritis is a common, disabling condition in old age; approximately 10% of those over the age of 60 suffer regular symptoms. Total knee replacement (TKR) is an effective treatment with 66–71% of patients reporting improvements in symptoms following surgery, but only 22% rating their results as excellent. 14–53% of TKR patients have persisting knee pain and 7–50% have poor function. 33–40% reported pain, stiffness, grinding and other noises, swelling/tightness. A similar proportion had difficulty getting in and out of cars. 54% reported difficulty on stairs. Dissatisfaction ranges from 15 to 30%. However, 47% report a complete absence of a limp and 50% had participated in their most preferred sport or recreational activity in the previous 30 days. Overall, 89% of these patients were satisfied with their ability to perform their activities of daily living (ADLs) and 91% were satisfied with their pain relief.<sup>42</sup>

The overall prevalence of DVT after TKR is 40–84% without prophylaxis. Proximal, above knee DVT occurs in 9–20% of patients and below knee in 40–60% of patients. 6–23% of these migrate proximally. The risk of PE is 10–20%. Symptomatic PE occurs in 0.5–3%, and fatal PE in 2%. The incidence is lower using chemoprophylaxis.<sup>43</sup> The frequency of infection following TKR is 2%–3%. 1.5% of patients develop a deep infection within the first 2 years.<sup>44</sup>

Patellofemoral instability can occur through extensor mechanism imbalance (e.g. tight lateral retinaculum or loose medial structures). Excessive facet resection can cause patella tilting. A malpositioned patellar component, can lead to subluxation of the patella in extension. Excessive internal rotation of the tibial component can increase the Q-angle resulting in lateral

subluxation and instability. Internal rotation and medial translation of the femoral component can position the trochlea medial relative to the extensor mechanism resulting in lateral subluxation.

Patellar fracture is associated with excessive patellar resection, vascular compromise following lateral release, patellar maltracking and excessive joint line elevation. It occurs in less than 1% of patients. Other associations include knee flexion >115 degrees, thermal necrosis from PMMA polymerization, and revision TKR. Patella component loosening occurs in 0.6%–2.4% of arthroplasties. Patellar clunk, first described by Hozack in association with posterior stabilized knees, is due to the formation of a fibrous nodule on the posterior surface of the quadriceps. The nodule becomes trapped in the intercondylar notch of the prosthesis causing it to clunk at 30–45 degrees of flexion.<sup>45</sup> Extensor mechanism rupture occurs in 0.1–0.55% of patients and may be related to lateral release and vascular compromise. Arterial compromise occurs in 0.03–0.2% of patients; 25% require amputation.

Peroneal nerve palsy is the most often reported nerve deficit following TKR (less than 1–2%). The incidence of mild palsies may be higher, but is not reported. It is more likely to occur with combined fixed valgus and flexion deformities. Risks include post-operative epidural anaesthesia, tourniquet time over 90 min and valgus deformity.

Periprosthetic supracondylar fractures of the femur occur 0.3–2% following TKR. Risk factors include anterior femoral notching, osteoporosis, rheumatoid arthritis, steroid use, female gender, revision arthroplasty and neurological disorders.

### Medial, lateral and patellofemoral unicompartmental knee replacement

Aseptic loosening, pain 14%, dislocation 11% and progression of OA 29% are complications that can occur after medial and lateral unicompartmental knee replacement.<sup>46</sup> Snapping pes syndrome can occur due to a posterior overhang of the tibial tray or the mobile bearing.<sup>47</sup> Polyethylene wear (12%) and instability (12%) occur with fixed bearing implants; mobile bearing implants are at risk of dislocation.

There may be little difference in survivorship between patients who have undergone lateral unicompartmental replacement compared to medial unicompartmental knee replacement. Implant survivorship is about 95% at 10 years. Fixed flexion deformity of greater than 10 degrees is associated with a poor clinical outcome.<sup>48</sup> The most common reason for failure is progression of medial joint disease.<sup>49</sup> Walker et al. reported that 98% of young patients return to recreational activity, 66% reaching high activity levels.<sup>50</sup> Matthews et al. reported that satisfaction was similar between TKR and UKR patients.<sup>51</sup>

For patients who have had a patellofemoral joint replacement, Lonner reported the 5-year cumulative revision rate was greater than 20% for inlay prostheses and less than 10% for onlay designs.<sup>52</sup> Inlay-style implants have a patellar maltracking incidence of 1%–36%.<sup>52</sup> 25% of patients require further surgery for progressive arthritis at 15 years.<sup>53</sup>

Short-term complications frequently include patellar catching and maltracking. Long-term failure occurs most commonly due to progression of tibiofemoral arthritis. Obese patients are at

higher risk of failure and revision.<sup>54</sup> Loosening occurs 2–14% at around 15 years.<sup>53</sup> Cemented components do substantially better than uncemented.<sup>55</sup>

### Conclusions

Complication rates are expected to gradually reduce over time as our understanding improves and as technology continues to develop. For example, modern sterilization processes and prophylactic antibiotic use contributes to low infection rates. The introduction of disposable instruments may further reduce this. VTE, however, remains a major problem despite advances in chemoprophylaxis.

The failure rate of operations is lessening through improved surgical techniques. An example is the augmentation of soft-tissue reconstructions using internal bracing. Robotic-assistance and patient-specific instrumentation in knee arthroplasty and osteotomy surgery may show reduced failure rates and improved outcomes and longevity. Early data is already showing promise for custom knee replacements. One should however always adopt changes with caution and continue to counsel patients regarding all the risks of complications associated with their proposed surgical procedures. ◆

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