

**X-ref** For other Roundups in this issue that cross-reference with *Knee* see: *Sports Roundups 1 & 5; Trauma Roundups 1 & 3; Research Roundups 1, 4 & 6.*

### Same-day discharge in the octogenarian?

■ With the increase in demand for total knee arthroplasty (TKA) set to continue, there is even greater pressure on healthcare providers and, by extension, surgeons to drive costs down. The length of stay in-hospital following a TKA has become a focus for the 'enhanced recovery' pathways, with some centres even managing stays of less than 'two midnights' and, sometimes, 24 hours for TKA. However, a significant number of patients undergoing a TKA are octogenarians, and the authors of this paper from **New Haven, Connecticut (USA)** questioned whether a very short hospital stay of just one day is appropriate in this age group.<sup>1</sup> In this study, 18 196 patients underwent rapid-recovery primary TKA (defined as a length of stay of one day or less), of which 17 191 were performed in patients who were less than 80 years old; 1005 were performed in patients aged 80 years or more. On average, the patients aged 80 years or more had a lower body mass index, had a higher American Society of Anesthesiologists (ASA) class, were more functionally dependent, and were less likely to be smokers compared with the younger group. After controlling for preoperative and procedural characteristics, there were increased rates of readmission during the first 30 days following surgery for patients aged 80 years or more, but there was no difference in terms of risks of complication. The mean time post-discharge for readmission was ten days in both groups; patients aged 80 years or more were more likely to be discharged to a different place of residence. Patients aged 80 years or more had a higher percentage of readmissions for non-surgical site complications, including anaemia and cardiac complications. On further analysis, the only risk factor for a patient undergoing a serious adverse event was a high ASA and not the patient's age per se. Rapid recovery following total joint arthroplasty is here to stay, but studies like these are essential for the surgical community to understand which patients are suitable for rapid recovery and which are not. Clearly, this applies to patients in any age group but is particularly important in those patients aged 80 years or more. However, the findings of this study would suggest that it is the patients' comorbidities that are important rather than their age. A comprehensive preoperative assessment and optimization led

by a physician is an important component of rapid recovery, as is robust follow-up care on discharge. Without investment in all aspects of the patient pathway, readmission rates can be expected to be high in patients aged 80 years or more if rapid recovery is undertaken.

### Accuracy and soft-tissue balance in total knee arthroplasty

■ It is part of accepted orthopaedic wisdom that soft-tissue balancing in total knee arthroplasty (TKA) is an essential component of the surgical procedure. Techniques including kinematic alignment and balancing the flexion and extension gaps are based on the concept that the knee ligaments, if correctly balanced, will result in better patient outcomes following surgery, both from a clinical perspective and potentially also from a longevity perspective. Incorrect balance can result in instability or restricted range of movement. Despite the implied surgical importance of soft-tissue balance, it is achieved by serial releases and adjusted cuts. Evaluation of this process is clearly very subjective and open to error and misinterpretation. The authors of this study from **Kogarah (Australia)** utilized pressure sensors that were placed within polyethylene trial tibial components equipped with dual force plates and wireless connectivity to assess the medial and lateral compartment pressures, and to define the contact points through the range of movement of the joint.<sup>2</sup> They then compared balancing with the pressure sensors to the accuracy of 'manual' soft-tissue balancing by the surgeon. Surgeon soft-tissue balancing was achieved by assessing the joint in three positions: 10°, 45°, and 90° of flexion. A varus and valgus stress on the knee was applied, with one hand on the tibia and one hand on the femur. Balancing of the collateral ligaments was determined by visual and tactile assessment of the medial and lateral opening during the varus and valgus stress. A balanced knee was assumed when there was an equal opening clinically of no more than 1 mm on both the medial and lateral sides, and whether there was separation of the tibiofemoral surfaces in any one compartment due to collateral ligament tightness without any stress being applied. Surgeon balancing was compared with sensor balancing in 10°, 45°, and 90° of flexion. The results of 322 TKAs revealed that the ability of the surgeon to accurately balance the knee at 10°, 45°, and 90° of flexion using the sensors as the benchmark was 63%, 57.5%, and 63.8%, respectively. In terms of

assessment, the surgeon's manual balancing had a combined sensitivity of 81% and a specificity of 37.7% at the three flexion angles. The least accurate position for assessing knee balancing was 45°. The authors did not see any learning effect on the surgeon with the continued use of the sensors. Statistical analysis revealed that the surgeon's ability to judge soft-tissue balancing was only in fair agreement with the sensors near extension. The surgeon's ability to judge whether the knee was unbalanced was poor. The specificity of surgeon balancing deteriorated as the flexion angles were increased. The surgeon appeared to have a better capacity to judge a balanced knee than an unbalanced knee. This study, which is the largest of its type published to date, confirms the difficulties in achieving intraoperative soft-tissue balancing by the surgeon. More studies looking into the relation between accurate soft-tissue balancing and clinical outcomes are needed. It would also be interesting to explore the role of contemporary computer navigation and soft-tissue knee balancing and its impact on patient outcomes.

### Staggered or staged? Total knee arthroplasty and acute kidney injury

■ The debate surrounding staged or simultaneous total knee arthroplasties (TKAs) continues. Although a niche approach, the proponents of bilateral simultaneous TKAs cite ease for the patient, significantly improved total health economic costs, reduced total rehabilitation time, and very high patient satisfaction rates. There have been a range of studies looking at intraoperative and postoperative complications to this approach, which give a slightly conflicting message surrounding the complication profile. The majority of studies in print fail to account properly for all of the three potential strategies: simultaneous, staggered, or staged bilateral TKAs. This study from **Seoul (South Korea)** focused purely on acute renal failure, and has the strength that it looks at a single complication and adequately reports all three strategies for TKA in a single teaching institution.<sup>3</sup> For the purposes of the study, the authors divide their cohort of around 1400 patients into staggered (seven or more days between procedures; n = 368), staged (eight days to one year between procedures; n = 265), and simultaneous (n = 820). They used the single outcome measure of postoperative acute kidney injury (AKI) and utilized the universally recognized Kidney Disease Improving Global Outcomes (KDIGO) criteria.

While the authors also reported other major and minor complications in their cohort, the main finding of this study is that there was a significantly lower rate of AKI in the staggered (2.4%) versus the staged (6%) and simultaneous (11%) groups. The authors sensibly conclude that, “The assessment of additional risk factors for the development of AKI is essential before deciding on surgical strategy”. It would seem to us, here at 360, that the use of simultaneous TKA should be reserved for those at extremely low risk of AKI. There are a number of risk models that can be used, and here is yet more evidence that bilateral simultaneous TKA is a significant physiological insult to the patient, potentially risking increased complications for the sake of patient and surgeon convenience and payer value.

### Cost-effectiveness of surgical and nonsurgical treatments for unicompartmental knee arthritis

■ The now-familiar Markov modelling technique enables analysis of the total health economic costs for competing treatments that are well reported in the literature. It also helps to establish the outcome and complication profile needed for value with fixed costs, and the cost threshold at which each treatment becomes cost-effective with a known complication profile. In this paper from **Philadelphia, Pennsylvania (USA)**, the authors have used the latter approach to determine the lifetime costs and quality-adjusted life-years (QALYs) as age varies at the time of initial treatment.<sup>4</sup> The authors evaluated total knee arthroplasty (TKA), unicompartmental knee arthroplasty (UKA), and non-surgical treatment for patients with end-stage unicompartmental knee osteoarthritis. The authors used Markov economic modelling to evaluate the cost-effectiveness of the three treatments for patients presenting at between 40 and 90 years of age with isolated medical compartment osteoarthritis, at five-year intervals. A literature review gave direct medical costs, QALYs, and transition probabilities for each of the three treatments. Indirect costs, including lost economic output and social security payments, were also calculated. The authors therefore calculated cost-effectiveness and incremental cost-effectiveness ratios (ICERs) for each treatment at each age point. Overall, surgical treatments were cheaper and better (in terms of QALY assessment) for patients under the age of 69. From 70 years onwards, they were more expensive; however, they remained cost-effective when compared with non-surgical treatments. When surgical treatments were compared, UKA dominated TKA at all ages. While this goes against the flow in terms of published survival data, Markov modelling is an

excellent way of establishing the QALYs and ICERs for a variable patient population. The authors go on to comment that, “the preferential use of UKA in all U.S. patients with unicompartmental osteoarthritis would result in an estimated lifetime societal savings of 987 million to 1.5 billion U.S. dollars per annual wave of patients undergoing treatment”. In light of the findings of this study, perhaps thought should be given to undertaking a higher rate of UKAs in this patient population.



### Early surgery versus physical therapy on knee function among patients with nonobstructive meniscal tears: the ESCAPE randomized clinical trial

■ Arthroscopic treatments of all varieties appear to be under fire, not only from healthcare commissioners and payers the world over, but also in the literature. The most recent high-profile arthroscopic trial is the ESCAPE trial, originating in **Amsterdam (The Netherlands)**, which evaluates early surgery versus physical therapy in patients sustaining an isolated meniscal tear without a mechanical block.<sup>5</sup> The authors designed a non-inferiority randomized clinical trial. The investigation was undertaken in nine hospitals in The Netherlands. Patients aged 45 to 70 years were enrolled with meniscal tears without knee joint locking. The non-inferiority margin here was set at eight points on the International Knee Documentation Committee (IKDC) Subjective Knee Form score, which is a reasonable margin, especially after 24 months of follow-up. The study reports the outcomes of 321 patients randomized to one treatment or another. There was a 90% follow-up rate. In the physical therapy group, 29% of patients (n=47) underwent a secondary partial meniscectomy during the 24-month follow-up, with eight participants randomized to meniscectomy not undergoing treatment. The functional improvement, as measured by the IKDC Subjective

Knee Form score, was within the defined non-inferiority margin (26.2 points in meniscectomy group and 20.4 points in the physical therapy group). The difficulty here is that the IKDC has been reported to have a minimal clinically important difference (MCID) of around six points for meniscal injury, and it is difficult to make the clinical argument that a difference above the MCID is non-inferior. In terms of adverse events and unplanned returns to theatres, there were few and no differences between the groups, respectively. This paper sheds some light on the longer-term outcomes of non-mechanical meniscal tears over a two-year period. There are clearly a number of factors to consider here. One is the real risk of osteoarthritic changes on those patients who have a reasonable-sized partial meniscectomy. Another is the recognition that the non-inferiority margin is rather wide and there is the risk of leaving patients with a small, but clinically significant, deficit in function by pursuing a nonoperative approach. The other consideration here for healthcare commissioners and other payers is that the paper reports a 30% crossover towards arthroscopic meniscectomy and, as such, is only really reporting the initial treatment choice, not nonoperative treatment of persistently symptomatic meniscal tears. A sensible interpretation of this paper – even given the inherent drawbacks of the trial design and criticisms – is that initial treatment should be with nonoperative measures. However, given the high crossover rate, it wouldn't be reasonable not to fund arthroscopic treatment for those who have failed a physiotherapy trial.

### Does 24-hour stay adversely affect readmission rates for arthroplasty?

■ As we make changes to discharge times after total knee arthroplasty and move towards outpatient surgery, we all need to ensure that this is done in a safe manner. Most surgeons would agree that, given the low complication rate and relative independence of most patients undergoing total knee arthroplasty, a 24-hour stay is an advantageous approach for most patients. However, surgeons may also harbour doubts about frailer, older patients. Not only might these patients 'fail discharge' within the 24-hour target window, but premature discharge may increase their complication profile or in some way affect their outcomes. The purpose of this study from **Flint, Michigan (USA)** was to compare the 90-day complication rate between patients discharged after one versus two nights in the hospital following primary total knee arthroplasty.<sup>6</sup> The authors used more than 96 000 total knee arthroplasties recorded on the Michigan Arthroplasty Registry Collaborative Quality Initiative to identify

46709, undertaken over a five-year period, that met their inclusion criteria. The use of both a multiple logistic regression model and propensity score matching allowed for the comparison of 90-day readmission between 24-hour and 48-hour lengths of stay. The outcomes assessed were readmissions and complications within the 90-day period. While a number of covariates increased the odds of 90-day readmission (male gender, single marital status, age more than or equal to 80 years, diabetes mellitus type 1, smoking, preoperative opioid use, and higher American Society of Anesthesiologists (ASA) scores), there were no differences between the two length-of-stay groups when these were adjusted for. This paper is reassuring, in that the current practice is not resulting in higher readmission rates, and points to some fairly simple patient profiling that could be done to identify those who are, and are not, suitable for a 24-hour stay.

### **Better luck next time? Two-stage revision following failed debridement for infected total knee arthroplasty**

■ Two-stage revision exchange procedures are considered the benchmark for treating a chronic prosthetic joint infection following total knee arthroplasty (TKA). The success rate of two-stage revision procedures for infected TKAs is reported to range between 80% and 100%. However, this varies considerably based on risk factors such as culture-negative organism presence, methicillin-resistant organism presence, diabetes, heart disease, and increased re-implantation operative time. In sensitive organisms and 'good hosts' with uncompromised soft tissues, results for a debridement, antibiotics, and implant retention (DAIR) procedure have been reported as relatively good. A small number of studies have evaluated the effect of a previous failed irrigation and debridement procedure on the rate of infection clearance after a subsequent two-stage revision. However, the results are inconsistent, no real consensus exists, and little is known about the long-term functional outcomes of patients following this combination of procedures. This study from **New Delhi (India)** attempts to compare the long-term failure rates, function outcome scores, and final range of movement (ROM) between patients who completed a two-stage revision following a failed irrigation and debridement, and those who only completed a two-stage revision.<sup>7</sup> The authors retrospectively identified and reviewed 88 TKAs that had undergone irrigation and debridement followed by a two-stage revision, and 96 TKAs that had only been treated with a two-stage revision, all with a minimum of two years' follow-up. There

were no demographic or comorbidity differences between the groups. Failure occurred in 23.86% of patients treated with irrigation and debridement and a two-stage revision, and in 15.62% of patients treated with a two-stage revision only. Although patients treated with a two-stage revision only had significantly better ROM at final follow-up, mean functional outcome scores were not different between groups. Six patients in the irrigation and debridement and two-stage revision group required an additional soft-tissue procedure for wound coverage. Patients treated with irrigation and debridement and a two-stage revision for methicillin-resistant *Staphylococcus aureus* (MRSA) and *Pseudomonas* infections fared far worse than those treated with only a two-stage revision for the same organisms (57.1% recurrence vs 33.3% recurrence for MRSA; 80% recurrence vs 25% recurrence for *Pseudomonas*). The results of this study seem to suggest that a failed irrigation and debridement followed by a two-stage revision is associated with a higher risk of failure than a direct two-stage approach. Additionally, the chance of successful eradication of MRSA and *Pseudomonas* infections is diminished when treated with an irrigation and debridement prior to a two-stage revision. It would seem that the DAIR procedure and its various cousins should really be reserved for those patients in whom it is highly likely to be successful.

### **Revision total knee arthroplasty for arthrofibrosis**

■ Despite the success of modern total knee arthroplasty (TKA), up to 20% of patients remain unsatisfied with their knee symptoms even years after surgery. The causes for this are varied, with pain, instability, and limitation in function often cited. A further, but less studied, common reason for dissatisfaction is limited postoperative range of movement (ROM). The aetiology of arthrofibrosis is multifactorial, with preoperative stiffness, complexity of the surgery, extensive surgical history, poor patient motivation, delay in starting a rehabilitation programme, lack of compliance, poor pain tolerance, and infection all being factors at play. In most institutions, the first line of treatment options include aggressive physical therapy, manipulation under anaesthesia, and arthroscopic debridement with scar-tissue excision. However, the efficacy of these interventions is significantly reduced if they are performed more than three months after the index procedure. When it is possible to determine the cause of arthrofibrosis (such as malrotation, incorrect sizing, or poor soft-tissue balancing), revision surgery may benefit the patient, but little is reported in the literature surrounding

the outcomes of this option as a last resort. In this study from **Denver, Colorado (USA)**, the authors retrospectively reviewed a series of 46 patients who underwent TKA revision for arthrofibrosis with a minimum of two years' follow-up.<sup>8</sup> This study aims to report the clinical outcomes of patients undergoing revision TKA for arthrofibrosis, and also to establish the factors predicting successful outcomes and the complication profile of revision TKA for stiffness. Causes for arthrofibrosis were determined in 38 of 46 cases; these included internal rotation, oversized components, instability, malalignment, extensor mechanism disruption, and implant failure. All revision surgeries were performed at more than 12 months following the index procedure. Both femoral and tibial components were revised in 40 cases, femoral component only in five cases, and tibial component only in one case. Physical therapy was started immediately following revisions. Mean flexion, extension, Knee Society Score (KSS) pain scores, and KSS function scores all significantly improved after revision TKA; however, some patients did not report improved outcomes. Of the 46 patients, 13 (30%) had a net decrease in ROM or a decrease in one or more KSS category. Interestingly, when these patients were compared with those patients who reported improved outcomes, there was no statistically significant predictor of success. Additionally, those patients with an undermined aetiology for their arthrofibrosis performed just as well as those with a determined aetiology. Six patients required additional surgical treatment for recurrent arthrofibrosis (three manipulations under anaesthesia, two removals of scar tissue with liner exchange, and one total re-revision). Based on the results of this study, revision TKA for arthrofibrosis is a good treatment option in the event that less invasive treatments have been attempted and failed. It is important to note, however, that only around 70% of patients will experience improved clinical outcomes.

### **Protocol-driven revision for stiffness after total knee arthroplasty improves movement and clinical outcomes**

■ Postoperative stiffness is reported to affect anywhere between 1.3% and 6.9% of patients. In this paper from **Stanford, California (USA)**, the authors set out to evaluate operative options to alleviate stiffness in a mixed cohort of 69 patients.<sup>9</sup> All procedures involved one of a range of different component revisions; the authors assessed their respective results by comparing pre- and post-operative range of movement (ROM) and Knee Society Score (KSS) to better define treatment plans for stiffness after total knee arthroplasty. In this study, stiffness is defined as flexion contracture

of greater than 15° or less than 75° of composite motion arc accompanied by pain and dysfunction. Patients were followed for a mean duration of 43 months. There were 26 patients who underwent a soft-tissue debridement with/without polyethylene downsizing, 27 who underwent a single (either femoral or tibial) component exchange with soft-tissue debridement, and 16 who underwent complete component revision of both tibial and femoral implants. Both ROM and KSS improved considerably following operative treatment. Mean arc of motion improved significantly by an average of 34° for all subgroups, with the most progress seen in the complete component revision group, from a ROM of 48° (SD 20°) preoperatively to 94° (SD 20°) at the most recent follow-up. Mean KSS knee score improved by 28 points, with the biggest improvement in the complete component revision from 38 (SD 10) to 71 (SD 13), while KSS function score increased by 27 points. Based on the results of the study, which are comparable to previous publications, operative treatment can provide patients with improved ROM, with complete component revisions being the most effective in clinically indicated patients.

### Outpatient total knee arthroplasty: the new reality?

■ As the current population ages, the number of total joint arthroplasties performed annually is also expected to rise, as is the economic burden of health care. Current efforts are focused on reducing medical costs while maintaining high-quality patient care, specifically in reducing the length of hospital stays. On 1 January 2018, total knee arthroplasty (TKA) was removed as an inpatient procedure for Medicare beneficiaries, suggesting that TKA is becoming more feasible as an outpatient procedure. Since the concept is still relatively new, there are still many learning points and much room for improvement. Questions raised by this editorial, published in *The Journal of Arthroplasty*, include what surgeons and hospitals can do to better equip themselves for outpatient procedures, and how they can improve patient outcomes and outpatient TKA techniques for the future.<sup>10</sup> About 5% of all TKAs are now performed in an outpatient setting, with successful clinical outcomes (range of movement, knee function, and pain scores) comparable to the traditional inpatient surgery. This percentage is expected to increase significantly as more hospitals familiarize themselves with the outpatient procedure. Financially, the patient benefits as well, with a cost reduction of \$8527 for same-day discharge post-surgery versus a standard inpatient hospital stay of three to four days. However, there

is still debate about how and when patients should be billed as an inpatient or an outpatient. Generally, the 'two-midnight' rule is applied: patients who stay more than two nights will be billed as an inpatient procedure. When adopting the outpatient arthroplasty procedure, hospitals should expect a learning curve and plan to decrease the length of stay gradually rather than abruptly. Successful undertaking of the procedure requires a multidisciplinary approach, starting with preoperative education, pain management, and post-surgery intensive mobilization. Determination of eligible patients for this type of procedure still requires clarification, as several morbidity classification systems are currently in use, with varying degrees of success. Although outpatient TKA has been deemed safe and cost-effective, more research is needed to optimize the procedure for patients.

### Metaphyseal bone defects in septic revisions using metaphyseal sleeves

■ Bone loss is a major problem in revision total knee arthroplasty (TKA). Defects can be caused by infection or by previous arthroplasty procedures, and must be treated at the time of revision. Surgical treatment options include cementation, allografts, or metal augments depending on the extent and location of the deficit. The reported usage of metaphyseal sleeves in revision TKA is encouraging, with short-term and mid-term results showing a high rate of osseointegration at the sleeve surface and a low incidence of aseptic loosening. Prosthetic joint infection (PJI) is one of the most common reasons for TKA failure, and this study from **Graz (Austria)** examines the outcomes of patients with metaphyseal sleeves in a population of patients undergoing revision TKA for infection.<sup>11</sup> Outcomes, including survivorship of the implant, osseointegration, and clinical and radiological outcomes at the mid-term period were collected for analysis. This paper reports the outcomes of 56 patients undergoing two-stage revision TKA procedures for PJIs using metaphyseal sleeves, at an average final follow-up of 5.3 years. There were no cases with evidence of aseptic loosening within the follow-up period reported here. As perhaps would be expected, 16% of the patients were revised again for recurrent PJI, with three patients ultimately undergoing above-knee amputations for persistent infection. One patient was treated with an arthrodesis and another underwent two subsequent two-stage revisions with metaphyseal sleeves to clear the infection. Bacteria were found in 35 of 69 procedures performed: staphylococci in 77%, streptococci in 11%, enterococci in 17%, and *Fingoldia magna* in 3%. Of the 47 patients who did not undergo a second re-revision,

only 4.2% of patients did not achieve osseointegration at the bone-sleeve interface. There were ongoing radiological signs of loosening reported by the investigators at the mean follow-up time of 7.7 years in these two particular patients, but no clinical symptoms were reported. This study shows an aseptic loosening rate of 0% in the 56 patients that were followed for revision TKA for PJI. There was no difference, clinically or radiologically, in the rate of bone resorption or osseointegration when comparing patients with varying extents of bone defects. Overall, the use of metaphyseal sleeves for septic revision TKA shows promising results at the mid-term follow-up. Further research is needed to determine the efficacy of the treatment in the long-term.

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