hemiarthroplasty (15%) *versus* THA (9%). No statistically significant difference was found for the following: 30-day readmission rates; 36-Item Short-Form Health Survey (SF-36) and EuroQol five-dimension (EQ-5D) quality-of-life scores; length of stay (which was shorter for THA following adjustment for covariables); and time to surgery (although two RCTs demonstrated a difference of approximately one hour with THA within the propensity score matched cohort). The duration of surgery was statistically longer for THA, albeit only by 15 minutes, which the authors note is unlikely to be of clinical relevance. There were higher rates of discharge to the patient's own home after THA (albeit only within the propensity score matched cohorts), and one paper showed a marginally superior functional outcome with THA. While the authors are careful to acknowledge the potential for confounding, even with well-designed RCTs (for example, surgical approach and its effect on dislocation), they conclude that concerns about the increased provision of THA leading to clinically significant delays for hip fracture patients appear to be groundless. The authors also surmise that there is no evidence to suggest that dislocation or revision rates are higher outside the context of clinical trials. Notwithstanding the limitations, these conclusions appear to be supported by the data presented.

Bioglass bone cement X-ref

■ Bioglasses are promising materials that are yet to find their application in orthopaedic surgery. Bioglasses are bone compatible and biocompatible, and are known to osseointegrate. The most commonly used bioglasses are 45S5 glass, named due to its 45% silica content and 5:1 ratio of calcium to phosphorus. It is this high calcium-to-phosphorus ratio that results in the biocompatibility and osseointegration properties. We were interested to see this long term follow-up study from **Kyoto (Japan)** describing their experiences using bioglass-based cement.[6] Their cement was a locally developed apatite-wollastonite glass-ceramic powder and bisphenol-a-glycidyl methacrylate resin, and is a bioactive bone cement (BABC). The authors describe the long-term follow-up of their unique bone cement used to fix cemented acetabular components in the 1990s. Their trial reports the outcomes of 20 total hip arthroplasty patients who had a BABC cementation to the acetabular component. All of the patients were young, with a mean age of 57 years, and the results are reported using survival analysis. The authors report a mean follow-up of just over 17 years, with two patients lost to follow-up. The overall loosening-free survival rate was 85% at ten years and 70% at 20 years, while the implant retention rates were 95% and 85% at ten and 20 years, respectively. These results are on the lower end of what can be achieved with traditional methods and so, although BABC has advantages to bone ingrowth and a favourable biocompatible approach, the authors hypothesize that the mechanical properties may be to blame for the poor longevity.

The natural history of patient-reported outcome measures for total hip arthroplasty

■ In these days of accountability, payment by results, and heightened patient expectations, patient-reported outcome measures (PROMs) are routinely collected on almost all patients undergoing total hip arthroplasty (THA). However, despite these vast volumes of data, we are uncertain of what to do with all the results. Although most PROMs in common use are now validated, the responsiveness to change over time – and, indeed, the best way to interpret monitoring PROMs – is not entirely clear. In this timely paper from **Boston, Massachusetts (USA)**, the authors set out to establish the improvement seen in a range of commonly reported PROMs after undergoing THA.[7] Secondarily, the authors were able to describe the natural history of PROMs. Overall, the authors recruited 976 patients into their prospective, multicentre study. PROMs reported included the Harris Hip Score (HHS), the 36-Item Short-Form Health Survey (SF-36) Physical Component Summary (PCS), the SF-36 Mental Component Summary (MCS), and the EuroQol five-dimension (EQ-5D) index preoperatively and at regular intervals until seven years following surgery. As would be expected with THA, the improvements from the baseline score were marked in each of the PROMs reported. However, there were lesser improvements in the HHS in those with self-care issues, while anxiety or depression dampened the improvements seen in the PCS and EQ-5D scores. Deterioration in scores over time was associated with obesity, other joint pain, and difficulty in self-care. This paper is useful in that it quantifies the complex interplay between comorbidity, mental health, and outcomes following THA, as measured by a battery of commonly used PROMs.

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Knee

X-ref ***For other Roundups in this issue that cross-reference with Knee see: Hip & Pelvis Roundups 2 & 6; Sports Roundups 1, 3 & 4.***

How to measure an acceptable result in total knee arthroplasty

■ A research team from **Boston, Massachusetts (USA)** have investigated the interpretation of patient-reported outcome measures (PROMs), reasoning that the acceptability of the joint arthroplasty to the patient is a good bar to measure against.[1] The authors designed a study to assess the patient acceptable symptom state (PASS) for PROMs at one and three years following total knee

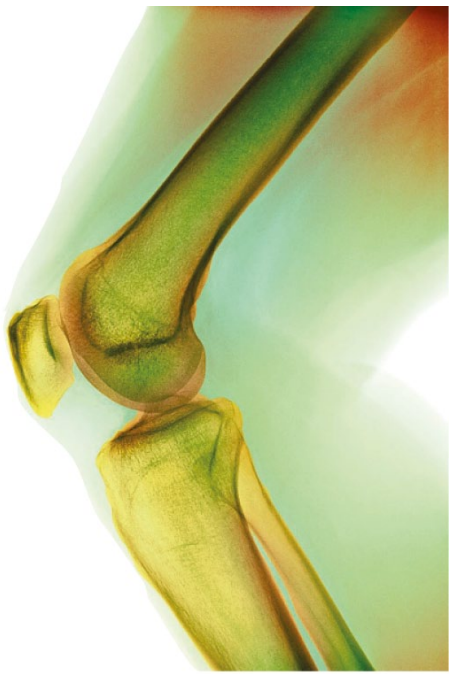
arthroplasty (TKA). PROMs collected at one and three years included the Knee Injury and Osteoarthritis Outcome Score (KOOS), EuroQoL 5-dimension 3-level (EQ-5D-3L), EuroQol visual analogue scale (EQ-VAS), and numerical rating scales (NRS) for knee-related pain and satisfaction. Overall PASS thresholds were calculated at each follow-up interval utilizing three anchor-based approaches, with patient-reported satisfaction used as the anchor. The anchor-based approach is a method for establishing how scores recorded on a PROM relate to a global rating scale, such as satisfaction or improvement. Anchor-based approaches are commonly used to estimate variables such as minimally clinically important change. The authors of this cohort-based study detailed the outcomes of 499 patients, all of whom underwent TKA as part of a large multicentre international cohort. The bulk of the value in this study is in the reporting of several anchor-based measures and the use of these to establish some of the measurement properties of the KOOS score. The authors undertook an overall satisfaction anchor for their TKAs. In line with many of the previous studies on outcomes following TKA, 79% of patients were satisfied at one year and 80% at three years. In terms of the actual threshold values, the authors calculated that there were thresholds for pain of 84.5 and 87.5 points at one and three years, respectively. For the symptoms subscale, the thresholds were 80.5 and 87.5 points, respectively, while the threshold for the KOOS quality of life (QOL) score was 66 at both one and three years. A similar exercise was undertaken for the EQ-5D VAS scale, which was determined to have a PASS of 0.80 at both one and three years, with a PASS score of 1.8 for the NRS pain scale. Studies like this are important in the evaluation of clinical results. The fact that this study provides evidence collected prospectively and validated against an anchor adds to its strength, and we are certain here at *360* that these will become accepted thresholds.

Osteonecrosis and unicompartmental knee arthroplasty

■ Despite being a relatively common diagnosis, focal osteonecrosis can be one of the trickiest conditions to treat. The traditional thinking is that unicompartmental knee arthroplasty (UKA) should not be performed for focal femoral osteonecrosis, as the disease may affect the entire joint. However, for large lesions, there are few good options. Regenerative medicine is not able to reliably deal with isolated osteochondral defects, let alone larger osteonecrotic lesions. This large series from **New Albany, Ohio (USA)** challenges the traditional wisdom that treatment of isolated osteonecrotic lesions of the medial femoral condyle is likely to lead to early failure of the unicompartmental knee.[2] The authors drew the study cohort from a single-centre series of over 5000 UKAs performed for all indications. The authors screened these for patients who had undergone UKA with the aim of treating osteonecrosis in whom there was also two years of follow-up. The authors went through the preoperative records and imaging to classify the location and size of the lesions being treated. In all, they were able to identify 65 UKAs undertaken for osteonecrosis in 64 patients with a mean age of 64 years. In this group of patients with a mean follow-up of 5.3 years, the index lesion occupied a mean 64% of the width of the condyle and was 11 mm deep, with the vast majority demonstrating subchondral collapse. There were four implants that required revision surgery (6%) with just one for a loose femoral component. While this very large case series does demonstrate that patients could undergo UKA for focal femoral osteonecrosis of the knee, the authors only undertook this surgery for patients within their own inclusion criteria. It is possible to say, therefore, that clinicians should be aware of the success possible with this potential surgical intervention, but should also be aware of the relatively narrow group of patients in whom this intervention has been shown to be successful. UKA should not be attempted in patients in whom lesions are too wide or deep.

Which patients stay and for how long after a total knee arthroplasty?

■ With the removal of total knee arthroplasty (TKA) from the inpatient-only list for Medicare, and with other healthcare systems having moved to a bundled payment system a number of years ago, there is a pressing need to establish which patients can undergo same-day or limited-stay surgery. This prospective study from **Cleveland, Ohio (USA)** included over 4500 patients, who were all operated on and received primary TKA across four hospitals in a single healthcare system.[3] The study authors set out to evaluate potential patient, procedural, and system-related risk factors. The authors undertook a comprehensive multivariable cumulative link (proportional odds logistic regression) analysis. Using this, models were constructed that helped to identify likely factors predicting a length of stay lasting one day, two day, and three or more days. The authors of this study indicate that the biggest drivers for length of stay were procedural or system-related risk factors, including hospital site, surgeon, implant type, start time, and day of the surgical procedure. Patient factors, such as older age, higher body mass index, higher Charlson Comorbidity Index, lower Veterans RAND 12-Item Health Survey Mental Component Summary, and female sex were related with longer length of hospital stay, but were less important than system factors. Thus, institutions should focus on surgeons, start time, and day of surgical procedure when deciding whether or not a patient is likely to stay overnight after a TKA, and develop programmes to implement same-day discharge, if desired.



Which single-stage revision total knee arthroplasties fail?

■ One-stage exchange arthroplasty is becoming more popular, as outcomes have been shown to be equivalent to two-stage exchange arthroplasty with regards to reinfection rates. However, not all patients are candidates for one-stage exchange arthroplasty, and it is important to understand reasons for failures. If we were able to predict which patients were likely to do well with a single-stage revision, this would be a big step forwards in the decision-making process surrounding revision arthroplasty where the spectrum of treatments is available (debridement, antibiotics, and implant retention (DAIR), one-stage, and two-stage). There is now ample evidence to support the view that all three procedures have a place in the management of the infected arthroplasty, and that all three can give successful results. However, there are relatively few studies regarding which patients

should be managed with each intervention (i.e. which patients are most likely to be successfully treated with each strategy). This series of patients from **Hamburg (Germany)** is excellent, in that it tries to answer just a single simple question: which patients with an infected total knee arthroplasty will do well with a single-stage revision?[4] Their series charts the results of this unit as they introduced single-stage revisions, and are drawn from a cohort of patients treated over ten years (2008 to 2017). The authors identified 91 patients who had an unsuccessful single-stage revision and compared them in a 1:1 fashion with randomly selected patients from the same period who had successful treatment. A range of analyses were then undertaken in an attempt to establish the covariates that were most likely to be associated with failure of single-stage revision. From their bivariate analysis, the study team identified ten potential covariates that might be predictive of failure of a single-stage revision. These were: a previous history of single-stage or two-stage exchange for infection (odds ratio (OR) 27 and OR 4.0, respectively), isolation of enterococci (OR 17.0), and isolation of streptococci (OR 6). For these patients, one should therefore have a lower threshold for undertaking a two-stage exchange instead of a single-stage exchange arthroplasty.

Autologous chondrocytes or microfracture for articular-cartilage defects of the knee? X-ref

Injuries to the articular cartilage are surprisingly common, with 60% of patients who complain of knee pain having some sort of articular cartilage damage present. Symptoms can include pain, recurrent effusions, and mechanical symptoms. The problem with articular cartilage lesions is the poor regenerative capacity. This has led to several surgical techniques that try to address chondral and osteochondral defects. These techniques include methods that stimulate the bone marrow through microfracture, simple arthroscopic debridement, and more novel approaches, usually including the implantation of cultured autologous chondrocytes or transplantation of autologous osteochondral grafts. Of all these techniques, microfracture and autologous chondrocyte implantation (ACI) are globally the most frequently used. There has been a considerable amount of orthopaedic literature written about both techniques, but there appears to be very little consensus on the best treatment strategy, with surgeons tending to fall into either a 'regenerative medicine' camp and favouring chondrocyte transplantation or preferring the simpler microfracture approach. Considering the ongoing lack of clarity, despite previous reviews and meta-analyses on the subject, the authors of this systematic review aimed to identify high-quality studies with a minimum follow-up of five years to provide a current view on the best treatment option. The authors from **Hohhot (China)** describe a rigorous selection criteria for their systematic review and meta-analysis.[5] However, they were unable to complete a meta-analysis as the data was too heterogeneous, and they therefore reviewed and summarized the data in tables. There were just five comparative studies included in this systematic review (three randomized controlled trials and two prospective cohort studies) of 448 patients with a mean age range of 25.1 years to 35 years. Three studies utilized periosteum-based ACI (ACI-P), one study employed ACI with a porcine-derived collagen membrane (ACI-C), and one study utilized the matrix-associated ACI (MACI) technique. The treated lesion size within the series varied from 1.5 cm^2 to 5.1 cm^2 in the 214 patients in the ACI group, and from 1 cm^2 to 4.9 cm^2 in the 234 patients in the microfracture group . Most lesions were located on the medial femoral condyle, with typical lesions graded Outerbridge III/IV. The reported clinical outcomes using a range of physician-completed and patient-completed outcome scores appeared to be better in the ACI-C and MACI group compared with the microfracture group, but not in the ACI-P group, which did worse. In addition, improvements in the activities of daily living (ADL) were better following MACI compared with microfracture. There was also the suggestion that bigger defects $\geqslant 3cm^2$ treated by MACI were better at five years compared with the microfracture group. Patients under 30 years of age appeared to do better after a five-year follow-up for both treatment groups. Patients who had been symptomatic for less than three years appeared to do better when using ACI compared with the microfracture group. However, two of studies showed very little difference between the two groups at five years. Some of the studies discussed 'treatment failure', meaning a result that was identical to – or worse than – when the index procedure was performed, an improvement of less than 10% in the Knee Injury and Osteoarthritis Outcome Score (KOOS) pain subscale, physician-diagnosed failure, or the physician deciding that further surgical intervention was required. None of the studies, however, appeared to show any significant difference in failure rates. From their review of the very best papers, the authors concluded that the clinical results with the ACI-C and MACI were superior compared with microfracture, using the KOOS pain and function scores, ADL assessments, Tegner Activity Scale (TAS) score, and the International Knee Documentation Committee (IKDC) objective and subjective scores at midterm follow-up at five years. Microfracture seemed to yield poorer results when used to treat patellofemoral lesions, while ACI appeared to be a better option for trochlear defects. In terms of defect size, the authors concluded that defects $\geqslant 3cm^2$ should be treated cautiously with microfracture, as the ACI group appeared to do better. ACI-P appears to have been superseded by MACI and ACI-C due to problems of periosteal hypertrophy. Treatment failure in all groups appeared to increase for all techniques with time. In summary, there is still a dearth of high-quality literature to guide the regenerative knee surgeon as to which technique is superior. Rather than one technique being better overall, it may be that one technique is superior over another technique depending on the location of the defect, the duration of symptoms, the size of the lesion, and the age of the patient. The biggest problem with all these techniques, however, is that none are able to regenerate the 3D collagen scaffold with its zonal differences. Until we are able to regenerate articular cartilage in all its complexity, a durable repair may remain elusive.

Infection elsewhere is bad news for total knee arthroplasty X-ref

The incidence of prosthetic joint infection (PJI) has been estimated to be between 0.5% and 1.8% in primary total knee arthroplasty (TKA). Like all complications, however, prevention is better than cure. Significant progress has been made in identifying risk factors that may contribute to PJI. It is not entirely clear if a previously infected joint arthroplasty is a contraindication to a new TKA. Patients that have been through one infected joint arthroplasty may, quite justifiably, ask about their chances of developing another. There is relatively little literature to answer this question, so the authors of this useful study from **Rochester, Minnesota (USA)** report the outcomes of their series of patients undergoing primary TKA with a previous history of an infected contralateral TKA or any total hip arthroplasty (THA). These results were compared with a matched cohort of patients undergoing a primary TKA after a contralateral TKA or any THA without an associated PJI.[6] A total of 102 TKAs were included in this study, with a mean age of 69 years, a mean body mass index (BMI) of 36 kg/m^2, and a mean follow-up of six years (2 to 16). The mean time between the last surgical treatment of a patient's prior PJI to the primary TKA was eight years (four months to 28

years). The cumulative incidence of PJI in the primary TKA was reported at 4.9% at two years and 6.1% at five and ten years. Compared with the matched cohort, there was a significantly greater risk of PJI, with a hazard ratio of 3.25. There were no statistically significant differences in risk of PJI between the study group and the matched cohort considering the following potential risk factors for infection: age, sex, BMI, time from previous PJI surgery to primary TKA, history of a PJI in a THA *versus* TKA, host grade, or history of PJI with a resistant organism. However, multivariable analysis showed that patients on chronic antibiotic suppression at the time of the primary TKA had a significantly increased risk of PJI (hazard ratio 15.2). Seven patients developed a PJI in the study group, six of whom were on chronic antibiotic suppression. Only two patients developed an infection with the same organism. From this study, it is clear that those patients on chronic antibiotic suppression following a PJI elsewhere are at high risk. What was interesting was that the organism that subsequently infected the primary TKA was different in five out of six cases. This helpful study should inform the discussions in the outpatient setting when considering primary TKA in patients with a prior infected joint arthroplasty. For some patients, a three-fold increase in the risk for PJI may be too high to stomach, having already been through one infected joint arthroplasty. Considerable caution should be exercised in those patients on chronic antibiotic suppression following a prior PJI when considering a primary TKA.

Tourniquet and pain in total knee arthroplasty

■ Proponents of the tourniquet-free knee arthroplasty have argued that the relative ischaemia, combined with postdeflation haemorrhage, results in poorer functional outcomes and more postoperative pain. Proponents argue that it makes the operation quicker, improves cementation, and reduces blood loss. There is much published on the topic but little in the way of consensus available. We were delighted to come across this paper from **Dublin (Ireland)**, which is an evidence synthesis and review of the current body of published work. The authors aimed to perform a meta-analysis on all previous randomized controlled trials to establish whether tourniquet use is associated with increased postoperative pain, decreased range of movement, and longer lengths of hospital stay. For the purposes of the review, the authors defined tourniquet use as use of a tourniquet for any portion of the procedure. The authors undertook a comprehensive search and registered their review with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). They were able to find 218 studies, of which 14 were included in the evidence synthesis. In regards to pain, eight studies were included. The authors were not able to establish any differences in mean pain scores between groups. They were also unable to establish any differences in range of movement or length of stay. Given that the authors were unable to establish any benefit from the use of a tourniquet, they conclude that this is essentially down to the surgeon's discretion. As this review does not consider long-term harms – and cannot, based on current evidence – these should also potentially be taken into consideration. There is a body of surgeons who argue that the cementation is poorer, and that potential for surgical error with poorer visualization is also a possible problem.

Distal femoral geometry: does it matter? X-ref

■ As the distal femur is a bone of significant variation, a number of sex-specific knee arthroplasties in multiple sizes have been developed. These authors from **Stuttgart (Germany)** set out to establish the actual distal femoral geometry – and how closely this matches what is commonly available.[8] The authors utilized a large dataset of CT scans to establish the variation in geometry within the knee, and then went on to establish the proportion of knees that would have a substantial mismatch if nonstandard designs were used. This study is an impressive one, but there is some commercial interest here as the datasets were generated when producing a customized TKA implant. Nevertheless, the authors had access to just over 24 000 femoral scans. For each, they measured the overall anteroposterior (AP) and mediolateral (ML) widths, widths of the lateral condyle and the medial condyle, the distal condylar offset (DCO) between the lateral and medial condyles in the superoinferior direction, and the posterior femoral offset (PFO) as the difference between the medial and lateral posterior condylar offset (PCO) measured in the AP direction. These data were supplemented with a further 2367 datasets, with the aim of establishing the differences between the AP and ML dimensions of the femur and available size matches from two commercial vendors. This study reinforces the casual observer's thoughts on femoral geometry, with high variability seen between AP and ML dimensions as well as PFO and DCO measurements. There was no correlation between the latter two measurements. The authors established that both the symmetrical and asymmetrical knee designs that they tested would have resulted in around 25% of patients having more than 3 mm of mismatch. The authors conclude that customizable knee implants may be the way forwards. We would note, of course, that this paper was generated during the development of such a device.

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