

Considerations around total and partial joint replacement surgery

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MALCOLM MCKEE and GARETH ARTHURS discuss the issues for practitioners planning joint replacement in small animals, including prerequisites, contraindications and alternatives

Summary

Joint replacements are performed with increasing frequency in dogs and cats to manage chronic joint pain and disability. Hip replacement has been an established procedure in the dog for more than 20 years and is now available for cats. Stifle and elbow replacements in dogs have also become available in the past six years.

Joint replacements in dogs and cats are “total” with replacement of the articular surfaces of both sides of the entire joint. “Partial” joint replacements are those in which only a proportion of the joint is replaced and these are under investigation, especially to manage medial compartment disease of the canine elbow, which is a common, often debilitating condition associated with elbow dysplasia and osteoarthritis.

Joint replacement procedures are among the most demanding small animal orthopaedic operations. They are exacting and unforgiving of technical error, with potential complications that can be challenging to manage. Referral to a specialist centre with personnel who have advanced training in joint replacement surgery should be discussed and offered to clients who are interested in such surgery for their animal. The prognosis following hip replacement surgery is excellent, and the prognosis for stifle and elbow replacements is good and fair respectively, based on limited numbers.

Key words

joint, replacement, pain, osteoarthritis

THE first joint replacement procedure reported in people was by Charnley in 1961 when he described replacement of the acetabulum and femoral head, referred to as hip arthroplasty or total hip replacement (THR).

Since then, joint replacement has become a widely accepted method of managing chronic joint pain and disability in humans and small animals. The first hip replacement in a dog was reported by Hoefle nearly 40 years ago. There have subsequently been numerous publications detailing advancements in prosthesis design, surgical instrumentation and operative technique. Today, clinical results are considered to be excellent and this has resulted in total hip replacement surgery being a widely accepted procedure, with many owners seeking this option to manage chronic hip pain in their dog.

The development of miniature prostheses means this is now an option in small dogs and cats. While hip replacement remains the most common, reliable and predictable joint replacement in dogs and cats, it is now also possible to replace other joints, such as the stifle and elbow.

Indications for joint replacement surgery

Replacing a joint is a major procedure with potentially significant complications that can be limb if not life-threatening. As a result, it is extremely important candidates for surgery are selected carefully. Joint replacement surgery should be considered in patients with lameness and joint pain that is unresponsive to appropriate conservative management, or where the joint has been irreparably deranged so that chronic pain and disability are likely – such as a non-reconstructable femoral head fracture.

In addition, there should be no contraindications such as septic arthritis or pyoderma.

Common indications for joint replacement surgery include:

- osteoarthritis causing chronic intractable joint pain;
- articular fractures that cannot be reconstructed; and
- joint (sub)luxation that cannot be satisfactorily managed by alternative methods.

Contraindications for joint replacement surgery

A number of important contraindications exist to joint replacement surgery including:

- joint disease that is not causing pain or lameness, regardless of radiographic appearance;
- mild joint pain or lameness that can be readily managed non-surgically (conservatively);
- pain or lameness due to another condition (for example, degenerative lumbosacral stenosis, brachial plexus neoplasia);
- concomitant neurological disorder (unless the prognosis is good);
- joint sepsis (especially when active);
- other septic focus, such as dental disease, pyoderma or otitis externa;
- articular/periarticular neoplasia; or
- inability of the owner to manage the patient appropriately postoperatively.

A thorough clinical examination is essential for any patient being considered for joint replacement surgery. This allows any factors that may constitute a contraindication to joint surgery to be detected early – for example, concurrent neurological disorder, septic focus distant to the joint or pyoderma. A thorough orthopaedic examination is also critical to confirm the presence of lameness and joint pain, and to eliminate other possible causes of pain and lameness. Radiography and synovial fluid analysis are the most valuable diagnostic aids. The latter enables differentiation of osteoarthritis from inflammatory arthropathies, such as septic arthritis.

Further investigations, such as CT, MRI, electromyography (EMG) and scintigraphy, may be necessary to eliminate concurrent disease, if doubt exists following clinical, radiographic and joint fluid examination.

Alternatives to joint replacement surgery

Alternatives to joint replacement surgery should be considered when treating chronic joint pain, including non-surgical (conservative) management and alternative surgical options, including excision arthroplasty, arthroscopic surgery, arthrodesis, osteotomy techniques and even limb amputation.

The key principles when managing chronic joint pain conservatively are:

- weight control to a lean body condition;

- exercise management including hydrotherapy – patients with degenerative joint disease typically benefit from frequent low-impact exercise to a level that does not exacerbate joint pain and lameness;
- physiotherapy, including balance and range of movement exercises, massage, transcutaneous electrical nerve stimulation (TENS) and hot and cold therapy; and
- anti-inflammatory and other analgesia therapy, such as NSAIDs and opioids.

Arthrodesis is a good option for managing chronic pain affecting the shoulder, carpal and hock joints. Limb function is good, hence this procedure is performed routinely in cases of osteochondrosis, degenerative joint disease, and carpal and hock joint instability.

However, the outcome following arthrodesis is much less favourable when the elbow and stifle joints are fused because these are high range of movement joints that are associated with significant disability if movement is restricted. This is because the limb tends to be circumducted during the swing phase of the gait to avoid excoriation of the digits. Therefore, arthrodesis of the elbow and stifle tends to be reserved for the very worst cases and is actually performed very rarely.

Arthrodesis of the hip gives very poor results so this procedure is almost never performed, particularly because the much more straightforward procedure of femoral head and neck excision arthroplasty (FHEA) gives much better results. However, the outcome with the latter can be variable and unpredictable, with some dogs and cats doing better than others.

Although limb function is generally reasonable, recovery tends to be protracted with extensive rehabilitation and prolonged analgesia necessary to optimise the outcome. Limb shortening, restricted range of extension, pain on hip extension, lameness and persistent muscle atrophy are common features following FHEA surgery; in other words, the outcome following FHEA surgery is poorer compared to total hip replacement.

Osteotomy techniques aim to correct or alter load distribution within the affected joint. For example, pelvic osteotomy techniques – such as double or triple pelvic osteotomy – are available for management of hip dysplasia in the skeletally immature patient; these procedures aim to alleviate the symptoms of hip dysplasia and prevent the development of degenerative joint disease. More recently, sliding humeral osteotomy and ulnar valgus osteotomy for treating medial compartment disease of the elbow have been described, but outcome following these procedures is not reliably established.

Prerequisites to performing joint replacement surgery

Joint replacement surgery is challenging, technically exacting and unforgiving ([Figure 1](#)). It should be considered that complications can be complex and difficult to manage.

There are a number of important considerations to take into account before embarking on joint replacement surgery.

- There is a very steep learning curve to each joint replacement technique. Success rates increase and complications rates decrease with increasing surgeon experience. Therefore, surgery should be performed by those who have specialist training and broad experience of general orthopaedic surgery, in addition to specific training in joint replacement surgery (ideally there should be more than one trained surgeon in the joint replacement team).
- Specifically trained and committed support staff.
- “Tried and tested” prostheses and implantation instrumentation.
- Ultra-clean surgical suite and ‘gold standard’ theatre practice.
- Ability to manage complications.
- Dedicated owner who is capable of rehabilitating his or her animal and coping with possible complications.

Hip replacement

In medium and large-breed dogs there is a choice of cemented and cementless acetabular and femoral prostheses, but in small dogs and cats only cemented implants are available ([Figures 2](#) and [3](#))

Considerable debate surrounds the advantages and disadvantages of cemented and cementless prostheses. In general, the authors’ preference is a hybrid hip replacement using a cementless cup and a cemented stem. Femoral stems are typically manufactured from cobalt chrome and acetabular cups from ultra-high molecular weight polyethylene (UHMWPE); cementless cups also have a porous titanium outer cover to encourage osteointegration. Poly(methyl methacrylate) or PMMA is the most commonly used cement and may have antibiotics mixed into the cement to reduce incidence of infection. The cement-bone interface is extremely important to provide long-term stability. Injecting the cement in a liquid phase and under pressure is desirable to improve cement penetration into cancellous and cortical bone. Cementless implants rely on osseous ingrowth into porous metallic surfaces in order to achieve long-term stability.

A rapid improvement in limb function is expected following hip replacement surgery with most patients bearing weight within 48 hours of surgery ([Figure 4](#)). Exercise is markedly restricted for 12 weeks to allow capsular healing, implant settling and initial bone remodelling. After this time, exercise is gradually increased over three to six months during which time remodelling of femoral bone occurs. With the advent of advanced prostheses, refined instrumentation and new cementing

techniques the complication rate in specialist centres where THRs are performed on a regular basis is now low (Gemmill et al, 2011).

Possible complications associated with total hip replacement surgery include:

- luxation;
- aseptic loosening;
- femoral or acetabular fracture;
- sepsis;
- sciatic neuropraxia; and
- pulmonary embolism.

Some of these complications, such as joint luxation, aseptic loosening and femoral fracture, can usually be successfully managed by revision surgery (Figure 5). Other complications – such as acetabular fracture – are more challenging. Complications such as sepsis are much more difficult to manage successfully because resolving the infection may not be possible without explanting the prostheses and bone cement. Infected cementless implants may respond to a prolonged course of an appropriate antimicrobial drug, but explanation (implant removal) may still be necessary. Implant explanation usually means the THR surgery is revised to a FHEA, usually permanently.

Injury to the sciatic nerve intraoperatively is uncommon; if it occurs, it tends to be neuropraxic in nature (temporary nerve bruising and dysfunction), therefore function usually recovers and the prognosis is good. Pulmonary embolism from fat or air is common with hip replacement surgery, but fortunately, the associated clinical signs are extremely uncommon and death, although possible, is rare.

Stifle replacement

Total stifle replacement involves use of a cementless femoral component and cemented tibial component inserted using instrumentation similar to that used in people (Figure 6).

Stifle replacement is only available for medium and large size dogs. Rehabilitation over a period of six to nine months with regular physiotherapy and hydrotherapy is an important component of post operative care.

Despite the majority of dogs having had previous surgery, for example for cranial cruciate ligament

rupture, the prognosis tends to be good. Sepsis and other complications such as collateral ligament rupture, patellar tendon injury, patellar luxation and aseptic loosening are uncommon. A femoral trochlear prosthesis (partial stifle replacement) is being trialled in dogs with chronic patellar luxation and advanced trochlear ridge pathology.

Elbow replacement

There are several total and partial elbow joint replacement systems available, including one total elbow replacement system that uses cementless humeral and radioulnar components, which are implanted as a cartridge via a medial approach using precision instrumentation ([Figure 7](#)).

Similarly to stifle replacement, total elbow replacement systems are only available in sizes appropriate for medium and large breed dogs. Careful case selection and an effective rehabilitation programme following surgery are vital to optimise outcome. Early results are encouraging, although a degree of persistent lameness is not uncommon. Possible complications include ulnar fracture, humeral fracture, aseptic loosening and sepsis.

Summary

Joint replacement is an excellent and well-established option, with low complication rate, for the surgical management of hip pain in all sizes of dogs and cats. Stifle and elbow joint replacement systems for medium and large-breed dogs are not as well developed so are used more cautiously, but early results are encouraging when used in the right patients. Surgery usually results in resolution of pain, improvement in lameness and a satisfied patient and owner.

Joint replacement surgery should, however, not be underestimated as potential complications are numerous. The likelihood of complications is significantly reduced, but not entirely eliminated, when surgery is performed by an experienced surgeon.

Many complications can be successfully managed with prompt therapy, but others may result in the need for salvage surgery. In the minority of patients that are unlucky enough to suffer complications necessitating salvage surgery, the results are far from ideal, including the need for excision arthroplasty, arthrodesis, limb amputation or euthanasia as “worst case” scenarios. Since joint replacement procedures are demanding and unforgiving, referral to a specialist centre with personnel with advanced training should be considered.

References and further reading

- Charnley J (1961). Arthroplasty of the hip: a new operation, *Lancet* **1**: 1,129-1,132.
- Conzemius M G, Aper R L and Corti I B (2003). Short-term outcome after total elbow arthroplasty in dogs with severe, naturally occurring osteoarthritis, *Veterinary Surgery* **32**:

545-552.

- Gemmill T J, Pink J, Renwick A, Oxley B, Downes C, Roch S and McKee W M (2011). Hybrid cemented/cementless total hip replacement in dogs: seventy-eight consecutive joint replacements, *Veterinary Surgery* **40**: 621-630.
- Hoefle W D (1974). A surgical procedure for prosthetic total hip replacement in the dog, *Journal of the American Animal Hospital Association* **10**: 269-276.
- Lascelles, B D, Freire M, Roe S C, DePuy V, Smith, E and Marcellin-Little D J (2010). Evaluation of functional outcome after BFX total hip replacement using a pressure sensitive walkway, *Veterinary Surgery* **39**: 71-77.
- Liska W D and Doyle N D (2009). Canine total knee replacement: surgical technique and one-year outcome, *Veterinary Surgery* **38**: 568-582.
- Liska W D (2010). Micro total hip replacement for dogs and cats: surgical technique and outcomes, *Veterinary Surgery* **39**: 797-810.
- Warnock J J, Dyce J, Pooya H and Schulz K S (2003). Retrospective analysis of canine miniature total hip prostheses, *Veterinary Surgery* **32**: 285-291.