ANIMAL REHABILITATION

SPECIAL INTEREST GROUP

REHABILITATION FOR CANINE TOTAL JOINT REPLACEMENT

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The primary goal for total joint replacement (TJR) is to relieve disabling joint pain that fails to respond to conservative treatments and/or alternative surgical procedures. Ideally the replacement should provide a pain-free joint with "normal" biomechanics for the life of the patient. Currently, total hip replacements (THR), total knee replacements (TKR), and total elbow replacements (TER) are available for canine patients; THRs are also available for feline patients.

SURGICAL CONSIDERATIONS FOR TJR

The surgical approaches to the hip, knee, and elbow for joint prosthesis implantation are slight variations of the approaches for other procedures involving those joints. The cranial approach to the hip includes a partial deep gluteal tenotomy that is repaired during closure. No other muscles or tendons are incised. The lateral approach to the knee is the same approach used to repair a distal femur fracture. A medial epicondyle osteotomy is necessary to expose the medial compartment for TATE© elbow prosthesis implantation. The osteotomy is performed in preference to transection of the medial collateral ligament and flexor muscles. The medial epicondyle must be reattached with screws during closure. The Iowa State elbow prosthesis uses a lateral approach by detaching the lateral collateral ligament and luxating the joint. The collateral ligament must be reattached during closure. Healing time for the reattached collateral ligament can be prolonged.

Ultra high molecular weight polyethylene (UHMWP) articulates with highly polished cobalt chrome in the prostheses. These materials are the same quality as those used in human implant manufacture. Implant wear is about 0.1 mm per year in humans and is anticipated to be approximately the same in dogs. Implant survival is therefore projected to be greater than 15 years for all implants. The modular hip system has both cementless and cemented versions in 16 sizes with an acetabular component (cup), a femoral stem, and a femoral head. Total hip replacement implants are available for dogs and cats weighing from 2.45 kg to greater than 75 kg. The knee prosthesis includes a cementless or cemented femoral condyle (cobalt chrome) and a tibial component with an UHMWPE articular surface. The base of the tibial component has both cementless and cemented versions. All sizes are interchangeable for dogs ranging from 20 kg to about 60 kg. The patella is not resurfaced in dogs. The cementless TATE elbow prosthesis is implanted as a single articulated humeral and radial-ulna component cartridge and is available for dogs of similar size to knee replacement candidates. The Iowa State TER components are implanted separately; the most recent generation of implants uses composite fixation (both components are cemented; the humeral component also includes cementless fixation at the condyles).

Vigorous activity is not allowed for a minimum of 6 to 8 weeks postoperatively following all procedures to facilitate soft tissue and bony healing and to allow adequate bone in-growth and/or bone on-growth at the host-implant interfaces. Excessive loading inhibits bony in-growth into the implant due to development of a layer of fibrovascular membrane between the implant and the bone. Future applications of nanotechnology may allow the clinician to monitor exact cumulative forces placed through implants and make appropriate adjustments in patient activity during postoperative healing. Until then, it is critical to maintain a balance between overexertion and judicious exercise to stimulate in-growth, minimize loss of surrounding bone mineral density, and allow earlier restoration of muscle control for dynamic support and protection of the new joint without deleterious effects.

REHABILITATION FOLLOWING TKR

Interventions for canine patients are similar to those for human patients. In our practice, rehabilitation begins immediately postoperatively, while the patient is still recovering from anesthesia, with passive range of motion (PROM) of the stifle followed by application of a compressive cold pack (CP). These treatments are continued throughout hospitalization. During the first two weeks at home, the owner completes short, slow leash walks of 10 to 15 minutes to stimulate use of the operative limb followed by PROM and CP application a minimum of 3 times per day. Early ambulation and weightbearing is expected but falls must be prevented by avoiding slick flooring surfaces and using a sling as needed to minimize the risk of complications such as prosthesis luxation, periprosthesis fractures, or collateral ligament injuries of the knee.

Two weeks postoperatively, the patient returns to the clinic for suture removal and initiation of outpatient rehabilitation. Post-op weeks 2 through 4 focus on gait retraining on the underwater treadmill, manual therapies to improve flexibility and normalize arthrokinematics, and LASER therapy to support soft tissue healing and prevent post-exercise "rebound" inflammation. Neuromuscular electrical stimulation may also be initiated if significant arthrogenous inhibition of the quadriceps is present, dependent on patient temperament and tolerance. Aquatic exercise, including underwater treadmill walking, has numerous benefits over land exercise during the early phases of rehabilitation following canine TKR. Increased AROM excursion of all joints is demonstrated compared to gait on land. Weightbearing on the hind limb is decreased by ~62% (depending on the patient's body mass index and conformation) when the water in the underwater treadmill chamber is filled to the level of the patient's greater trochanter. This weight reduction decreases the compressive forces through the joint and prosthesis and helps protect the collateral ligaments during the early phases of healing and remodeling. Water provides a safe exercise opportunity for high-energy dogs with "cabin fever" and

thereby may decrease the risk of complications due to excessive high-level activity. Finally, when compared to swimming, walking in water follows the principle of specificity of training while targeting the quadriceps and allows better control of exercise intensity.

Land-based exercises are begun 4 weeks postoperatively, with the inclusion of a home exercise program (HEP) tailored to address each patient's specific needs through progressive resistive exercise and proprioceptive retraining. Unless complications exist or the client chooses to continue, the patient is typically discharged to a home program at postoperative week 8. Discontinuation of clinical rehabilitation has been largely due to constraints of clients' time and finances. Extended rehabilitation would likely benefit patients' rate and extent of recovery but this has not been confirmed in dogs through a controlled clinical trial. Patients return at set intervals (postoperative months 3, 6, and 12, then annually thereafter) for measurements of limb girth, PROM, posture, function, and force plate gait analysis. This data serves to document and objectively evaluate patient progress, to guide modification of the home program as needed, and to trouble-shoot for complications.

ANTICIPATED TKR OUTCOMES

Results of the TKR prospective study completed at Gulf Coast Veterinary Specialists indicate the canine course of recovery closely mirrors that of humans. Preoperatively, patients present with end-stage osteoarthritis (OA) and exhibit restricted PROM in response to periarticular fibrosis and bony changes. Immediately postoperatively, PROM is improved. By 3 months, it is restored to an average excursion of greater than 114°, adequate for all functional activities. Some dogs have continued to increase their PROM over the next 9 months while others exhibit a slight decrease, possibly due to owner cessation of structured exercises.

Significant disuse muscle atrophy is present preoperatively of both the quadriceps and hamstrings. Some dogs are non-weightbearing prior to surgery and present with especially severe atrophy. A further decrease of thigh girth continues for about 6 weeks postoperatively, and then slowly starts to reverse. The rate of girth restoration appears tied largely to consistency of structured exercise completion. To date, full restoration of thigh girth (eg, equal to the contralateral limb) has occurred as early as 7 months postoperatively. Force plate values (peak vertical force and impulse) mirror these trends.

Long term outcomes reveal patients return to high levels of function that provide owner satisfaction. Patients are able to resume running, playing, and community mobility. Clients typically report restored patient ability to posture normally to void (including standing on the surgical leg to hike the nonoperative leg when urinating), safely navigate stairs, and achieve endurance sufficient for quality of life activities.

POSTOPERATIVE RECOVERY FOLLOWING THR

Published studies and commentaries are more readily available for the canine THR. Exuberant activity in the first 8 to 12 weeks post THR has been tied in the literature to increased risk of complications including luxation, propagation of surgically-induced femoral fissures into fractures, and compromised long-term stability of prostheses due to inhibition of bony on-growth or in-growth. Although not yet proven in canines, rehabilitation potentially can mitigate the risk of these complications.

Luxation is the most frequent postoperative complication, occurring in 1.1% to 8.5% of THR cases. Luxation typically occurs in the first 6 postoperative weeks as a spontaneous event or tied to trauma. An excessive angle of lateral opening of the acetabular component increases the risk of luxation by a factor of 8. However, not all prostheses with excessive angles luxate, suggesting soft tissue competency plays a significant role in joint stability through periarticular fibrosis, healing of the joint capsule, and increased muscle strength and support in the first 3 to 4 months postoperatively. Consequently, surgeons routinely prescribe 6 to 8 weeks of activity restriction to walking on surfaces with traction when indoors and on leash when outdoors followed by 4 weeks of progressive leash walks before permitting increased ad lib activity levels. During this time of protection, controlled therapeutic exercise targeting the hip stabilizer muscles in a protected environment, such as in water or on a leash, may increase strength and neuromuscular control more rapidly to protect the joint against luxation, particularly in dogs with marked muscle atrophy preoperatively.

The incidence of femur fractures following total hip replacements has been reported as 2.9% to 4.5%. In one study, over 70% of the fractures were due to trauma, including falls. Although femur fractures can occur at any time, 71% occurred within 4 months, before remodeling of the diaphysis occurred as described by Wolff's Law. The typically recommended 8 to 12 weeks of postoperative restrictions against high-level vigorous activity provide time for cortical bone hypertrophy to occur; this process may take longer in older dogs with chronic OA and bone atrophy. Controlled rehabilitative low impact activities during this time, such as underwater treadmill walking, gentle strengthening, and proprioceptive retraining can help facilitate bone remodeling while improving neuromuscular control and coordination to avoid falls and injury.

SPECIAL CONSIDERATIONS FOR TER

Understanding which implant is used by the surgeon (TATE or Iowa State) allows the therapist to appropriately progress forces during recovery dependent upon the healing tissues. Due to the potential for catastrophic complications (detachment of the medial epicondyle or rupture of the lateral collateral ligament), rehabilitation remains very conservative during the first 6 weeks after surgery. After the 6 week exam, appropriate rehabilitation interventions are provided using the rationale and criteria previously described, extrapolating from those presented for the knee. Special consideration should be added for the dorsal plane of rotation. The TATE radial-ulnar prosthesis is a single component so pronation and supination is lost; rotation is greatly restricted by the Iowa State component. Consequently, patients typically attempt to compensate with shoulder internal and external rotation. Strengthening exercises focusing on the shoulder stabilizers should be added to ensure pain and instability does not develop.

SUGGESTED READING

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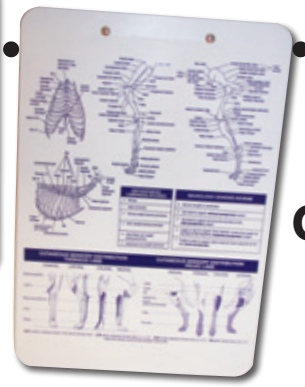

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