Bone Anchors

Bone anchors, also called suture anchors, are an idea implant for reattachment of soft tissues to bone or anchoring of suture material to bone. Soft tissue fixation to bone is a basic technique of orthopedic surgery for which many procedures and devices have been developed. Early techniques used bone tunnels, screws and washers and bone staples. These techniques are relatively simple, but can have disadvantages including increased surgical exposure, damage to suture material, interference with joint structures and non-isometric placement. Suture anchors were developed in the late 1980s and present distinct advantages over the above methods. Suture anchors can be used effectively for reattaching avulsed soft tissues to bone, thus reestablishing integrity to tendons and ligaments. Suture anchors are usually made of stainless steel, titanium or an absorbable polymer. Design features that vary with suture anchors include size, method of anchoring (toggle, thread, tine), thread design, whether they are preloaded with suture, suture type, position of the anchor after insertion and method of insertion. Suture anchors have the advantage of a lower profile than screws and washers, which help avoid interference and abrasion of articular surfaces and adjacent soft tissues during joint movement. They also can be more precisely placed to allow improved reattachment of ligamentous structures to their isometric origin or insertion. Anchor pull-out from the bone is also a possible method of failure, but can be avoided by selection of the appropriate type of anchor for the type of bone present. More aggressive threads are need in the anchor if the bony cortex is thin. Anchors are available that have a cortical or cancellous type of thread design. Suture anchors are designed to protect the suture by chamfering the edges of the hole. This minimizes trauma to the suture material at the suture/anchor interface. The most common method of failure is suture breakage at the suture/anchor interface. The size and instrumentation for insertion allow for quick surgical application due to the ability to place them through a small surgical approach. Bone anchors are usually inserted into a hole drilled in the bone using a handle device or a drill inserter.

Suture anchors are often designed for a particular surgical repair technique in human medicine. Suture anchors may be designed to sit below (subcortical) or above (supracortical) the surface of the bone. Subcortical anchors leave no protruding portion of the implant that might interfere with adjacent structures or overlying skin. The suture material is anchored securely to bone and protrudes from the hole in the bone created during insertion of the suture anchor. Subcortical anchors, such as the Bone Biter® anchor (Innovative Animal Products, Rochester, MN) are practical in areas where there is little soft tissue to cover anchors that sit above the cortical surface or where range of motion of the joint may impinge a protruding anchor. Subcortical anchors require a preloaded suture. Supracortical anchors leave a portion of the anchor above the surface of the bone. This typically is the eyelet of the anchor, the portion of the anchor that holds the suture material. Anchors that sit above the surface of the bone aow placement of the suture after placement of the anchor. Many veterinary
bone anchors are available that have an eyelet that sits above the cortex of the bone (Innovative Animal Products, Securos, IMEX, Jorgenson). The most commonly used anchors in veterinary medicine can be placed in a subcortical or supracortical position. The corkscrew and fastak anchors are manufactured by Arthrex Vet Systems and distributed by Innovative Animal products in the U.S. The corkscrew anchor is 5 mm in diameter and has an aggressived thread which provides excellent pull-out strength in trabecular bone. This anchor can be used with 2 strands of #2 Fiberwire, one strand of #5 Fiberwire or 2 mm Fibertape (Arthrex Vet Systems). The Fastak anchor is 2.8 mm in diameter and has a smaller thread which holds well in dense cortical bone. The Fastak anchor is used with one strand of #2 Fiberwire. Little instrumentation is required for most styles of bone anchors. Suture anchors are used very commonly for joint stabilization and tissue reattachment in human patients. The implants used for human patients are quite expensive, usually costing $200 or greater for each anchor. Affordable suture anchors designed for the veterinary market are now available from many veterinary orthopedic companies. The cost of these anchors range from $25-$80 and are commonly used for repair of collateral ligament injuries, hip dislocation and cranial cruciate ligament tears.

Ligament Injury

Ligamentous injuries occur frequently in dogs and cats. Almost any diarthrodial joint is susceptible to ligamentous injury. These injuries are classified as grade 1, 2 or 3 sprains. The consequence of damage to ligaments may be minor, as in a grade 1 sprain, or major, as in a grade 3 sprain. Disruption of the medial glenohumeral ligament can lead to shoulder instability and luxation. Elbow dislocations are associated with collateral ligament tears. The carpus and tarsus may sustain injuries to the collateral, talocalcaneal, palmar or plantar ligaments. Coxofemoral dislocation requires tearing of the ligament of the head of the femur. Lastly, the stifle is the most common joint affected by ligamentous injury. Disruption of the cranial cruciate ligament is probably the most common injury seen in dogs and also is frequently diagnosed in cats. Other ligamentous injuries in the stifle include caudal cruciate, collateral ligament and multiligamentous tears. Treatment of these conditions varies depending on the severity of injury and include exercise restriction, external coaptation, primary ligament repair, ligament augmentation, transarticular external fixation, arthroplasty and arthrodesis. Suture anchors are used to reconstruct ligaments. The anchors are placed at the origins and insertions of the components of the ligament. Monofilament or braided suture material is placed between the anchors to form a prosthetic ligament. It is important to place the anchors at the anatomic origin and insertion of the ligament to be reconstructed because this will be the most isometric position. An isometric position is desired to decrease the chance of the ligament stretching or breaking, and to improve stability throughout the entire range of motion. Suture anchors are most commonly used in repair of cruciate ligament injuries and collateral ligament injuries of the elbow, carpus, stifle and tarsus.

Tendon Injury

Tendinous injuries occur infrequently in dogs and cats, but the consequence of such an event can lead to marked dysfunction due to disruption of the muscle-tendon unit (MTU). The MTU is composed of the muscle origin, muscle belly, tendon and tendon insertion. Clinically, MTU disruption causes inability to properly flex or extend the joint served by the affected muscle. Pain, swelling and lameness also are present. Injuries may be acute or chronic. Tendon injuries of the biceps brachii, triceps, patellar tendon, long digital extensor, superficial digital flexor, gastrocnemius, supraspinatis and infraspinatus are most commonly seen. Avulsion of tendons from their bony insertion require reattachment using bone tunnels, screw and washer, bone staple or suture anchors. This lecture will discuss the use of suture anchors for treatment of tendinous injury. Suture anchors can also be used to place augmentation sutures for tendon injuries repaired primarily near their insertion.

Tendon injury usually results from substantial trauma. An important factor to consider in treatment of tendon injuries is the ability to maintain not
only structural strength, but also gliding function. Structural strength will be greatest if the structure can be returned to as near as normal as possible; the tensile strength of scar tissue is inferior to that of normal tendinous tissue. Prompt repair of tendinous injuries increases the chance of optimal healing and decreases the amount of scar tissue formation. Scar tissue formation between the tendinous and surrounding soft tissues also leads to adhesion formation and loss of gliding function. Factors to limit adhesion formation include early surgical intervention, meticulous handling of tissues, anatomical apposition of tendinous tissues, adjunctive postoperative bandaging, passive range of motion exercise, and appropriate postoperative restriction of activity. Early healing of tendons occurs with formation of immature collagen during the initial four postoperative weeks. Tensile strength of the repair tissue increases as remodeling of the collagen occurs until about 20 weeks postoperatively. Tendon repair is accomplished using a variety of suture materials and suture patterns, depending on the preference of the surgeon. A variety of locking-loop and three-loop suture patterns have been used effectively. Nonabsorbable suture material such as monofilament nylon, polypropylene and braided polyester is preferable to absorbable material due to the long period of time until adequate tensile strength is reached in the repair tissue. After the tendon is repaired, the paratenon or synovial sheath should also be primarily repaired with appositional sutures if possible. Reestablishment of these structures decreases the chance of adhesions and preserves gliding function.

References are available upon request.