Coxofemoral Luxation System

Tech Sheet

The Securos Coxofemoral Luxation Management System

Traumatic dislocation of the coxofemoral joint disrupts the joint capsule as well as the round ligament of the head of the femur. The hip needs to be reduced as soon as possible to make the patient comfortable and to provide a functional joint. Prompt reduction reduces cartilage and soft tissue damage. The hip should be radiographed prior to reduction so as to assess the joint for acetabular fractures or femoral head trauma, and to assess the joint for degenerative changes. Good quality, high contrast radiographs are necessary to determine the presence of small bone chips present within the acetabulum. These are associated with avulsion fractures of the femoral head accompanying the round ligament

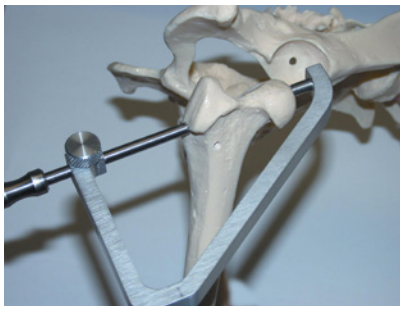
Closed reduction of a dislocated hip can usually be performed with the patient anaesthetized. To be successful, the hip must have no articulating bone fractures, and joint capsule occupying the acetabulum must be cleared for subsequent closure to retain the femoral head.

Open reduction is necessary if joint fractures are noted radiographically, or if reduction cannot be maintained. Given appropriate acetabular depth, inability to maintain reduction is commonly due to failure of clearing joint capsule from the acetabulum.

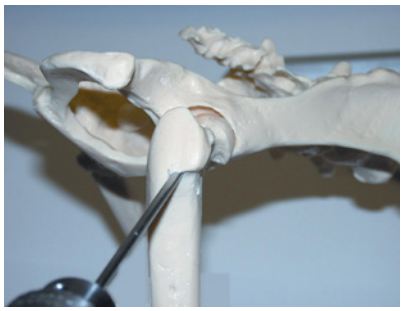
Open reduction can be performed via a standard cranio-lateral approach to the hip. The deep gluteal tendon attachment to the trochanter should be maintained, and the acetabulum is explored by retracting the femur caudally. Remnants of the round ligament should be removed and the cartilage assessed. The hip should then be reduced and damage to the joint capsule evaluated. If the capsular tear(s) can be sutured, this will usually provide sufficient stability for maintaining reduction. If the capsule is extensively damaged, the Securos Coxofemoral Management System can be used to substitute a synthetic round ligament.

Technique:

1. Luxate the hip. Elevate the femur and rotate it 45° to debride remnants of the round ligament from the femoral fovea. Place the drill guide point in the middle of the fovea. Position the drill sleeve on the lateral aspect of the femur at the base of the greater trochanter and tighten the sleeve to stabilize the guide.



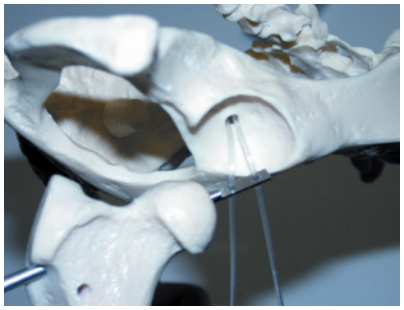
2. Drill the femoral neck tunnel with a 3.2mm drill bit and remove the guide.



3. Reduce the hip and hold the limb in a normal standing position. This requires the leg being raised parallel to the table top. Drill through the femoral neck tunnel and continue through the medial wall of the acetabulum (fossa). (Note: if the limb is not in the correct position, drilling may damage the acetabular

articular cartilage and the resulting femoral head position will be inaccurate.)

4. Disarticulate the hip. Thread the nylon through the toggle pin then load the toggle pin and nylon into the inserter. Roll the 'O' rings over the nylon to help hold the toggle pin in place.



5. Push the toggle pin through the hole in the medial wall of the acetabulum. Pushing on the plunger delivers the toggle pin completely through the hole.

6. WHILE CONTINUING TO HOLD THE PLUNGER IN PLACE, pull on the nylon to seat the toggle pin. The plunger will prevent the toggle pin from pulling back into the acetabulum. Remove the inserter and plunger. Pull firmly on the nylon to ensure that the toggle is engaged.

7. Feed the nylon suture up the hole from medial to lateral in the femoral neck, and reduce the hip. Pull firmly on the nylon while pushing the femoral head into the acetabulum. Holding the nylon at the level of the trochanter, manipulate the hip through full flexion and extension, and simulate weight bearing in a normally abducted position. Secure the nylon by tying over an additional toggle pin or nylon button. Alternatively, nylon ends can be routed in opposing directions through a cranio-to-caudal bone tunnel and secured with a crimp or knotted. Five throws are suggested if knotting.

8. Close the joint capsule and other supporting periarticular tissues.
9. Post-operative radiographs are made to document position of the toggle pin and that the hip is appropriately reduced.

Postoperative Care:

The patient's activity must be strictly limited to slow leash walks ONLY. Avoid slippery floors, or any limb twisting motion. If properly placed, the synthetic suture enables the hip to flex and extend close to normal, but abduction and adduction is restricted. If forced abduction or adduction occurs, the suture could break and the hip re-luxate.

The extent of limited activity is determined by the need for healing of the joint capsule. This will likely vary from 8 to 12 weeks, depending on the extent of capsule injury and other patient factors that may affect maturation of the new supporting tissues. It is anticipated that the nylon will fail; relying on reconstructed capsule and fibrous scar tissue to maintain joint reduction when this occurs.

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Toggle Pin Fixation for Management of Coxofemoral Luxation: Technique Tips

The toggle pin (rod) fixation technique can be used to stabilize the hip after open reduction in any case of coxofemoral luxation, but is ideally suited to those polytrauma patients in which there are multiple limb injuries requiring that the patient be weight bearing on the reduced hip immediately postop. This would also apply to cases in which placement of an Ehmer sling postop would be either difficult or impossible; such as in the presence of open wounds or in male dogs where a belly band would be impractical. Arguably, the procedure is more physiologic-mimicking than some other methods in that it substitutes a round ligament (ligament of the head of the femur) suture prosthesis. Toggle pin fixation is best suited for craniodorsal/dorsal luxations rather than for ventral luxations; not because it won't work in the latter cases, but rather because the dorsal joint capsule is usually intact in ventrally luxated hips. Therefore, simple open reduction combined with use of hobbles to prevent abduction is usually sufficient to manage ventral luxations. (Avulsion fractures of the greater trochanter can occur in combination with ventral luxations, and should be stabilized by tension band fixation).

Contraindications for use of toggle pin fixation would include pre-existing hip dysplasia in a trauma patient, poor hip conformation leading to spontaneous luxation/subluxation in patients with no history of significant trauma, avulsion fractures of the femoral head, and acetabular fracture. To reiterate the point regarding hip conformation: this method is not intended to be used in dysplastic hips, because the acetabulum is too shallow to maintain femoral head articulation.

Ultimately, long-term success of the procedure depends on there being a normal hip conformation to begin with, one that is conducive to maintaining reduction had there not been trauma. A toggle pin repair performed in a patient with a shallow/subluxating hip conformation is doomed to failure. Take-home message: pick your patients wisely; considering femoral head and neck ostectomy (FHO) as a salvage procedure.

Approach

Some use a caudal approach (see Piermattei, et. al., Surgical Approaches to the Bones and Joints of the Dog and Cat) to the hip in preference to a craniolateral approach for several reasons. First, with craniodorsal hip luxation, a craniolateral approach requires that the femoral head be distracted ventro-caudally to visualize the acetabulum. This necessitates overcoming significant gluteal muscle contraction in the opposing direction, and can make for very difficult and frustrating retraction yielding limited joint visibility. A dorsal approach by trochanteric osteotomy provides very good visualization, but is technically more difficult and subsequent repair of the osteotomy by tension band fixation places the suture prosthesis at risk for being cut by the k-wires as they are driven down the femoral shaft. This osteotomy also tends to interfere with the transverse bone tunnel that may be utilized to secure the suture laterally. With a caudal approach, the hip is naturally retracted craniodorsally by virtue of it being luxated, thereby providing excellent access to and visualization of the acetabulum with minimal additional retraction. If the external rotator tendon (combined tendons

of internal obturator and gemelli muscles) insertion on the femur at the trochanteric fossa is intact, you will need to perform a tenotomy for gaining access to the acetabulum. However, not uncommonly, this tendon is already ruptured as a result of the trauma, in which case the approach is almost 'ready-made'.

Acetabular Preparation

Open the joint capsule as needed to allow complete visualization of the acetabulum; orienting the incision in such a way that will leave sufficient capsule tissue on either side for closure. Completely remove remnants of the round ligament (RL): easily done with a Hatt Spoon instrument. This is very important, in that any significant amount of RL remaining will interfere with subsequent placement of the toggle suture. Drill a bone tunnel thru the medial acetabular wall centered in the acetabular fossa using a 3.2mm drill bit. Take care not to allow the drill bit to extend too far into the pelvic canal when drilling, i.e., caution potential rectal perforation or sciatic nerve injury. Pass a length of suture material thru the eye of the toggle pin . Mason hard nylon works well, but braided polyester suture can also be used (e.g., 1 or 2 strands of #5 OrthoFiber or a polyester suture). If you are using nylon, it should specifically be 'hard' nylon material, which is much more resistant to abrasion than conventional nylon. Also, if you are securing the suture on the lateral cortex of the femur using a crimp sleeve, use the Mason nylon specifically sized and Securos sourced for that purpose. This provides the most secure crimp due to uniformity of suture to crimp clamp. The crimp sleeves are available for use with 100lb, 80lb and 40lb test nylon. Compatible toggle pins can accommodate a single strand of Mason hard nylon as large as 100lb test. Load the toggle pin onto the insertion instrument and fold the suture back along the grooves of the toggle. Hold the suture in this position by sliding an 0-ring over the toggle and onto the insertion instrument, pinning the suture between the 0-ring and sides of the insertion instrument. Insert the end of the toggle into the acetabular bone hole as deeply as it will go. Then, while pressing the insertion instrument firmly into the fossa with one hand, depress the plunger with the other hand to advance the toggle thru the hole to the medial side of acetabular bone. It is very important to keep the insertion instrument pressed firmly into the fossa while the plunger is depressed. Otherwise, the insertion instrument will be pushed up and out of the fossa rather than the toggle being inserted thru the bone hole. It is also important to have removed all of the round ligament from the femoral head fossa.

Any remaining RL that is interposed between the fossa and the tip of the insertion instrument will in effect shorten the depth to which the toggle is inserted when the plunger is advanced, thereby risking the possibility that the toggle will not be able to turn effectively and lock onto the trans side of the medial acetabular cortex. WHILE CONTINUING TO HOLD THE PLUNGER IN PLACE, gently tug on the suture strands a few times to dislodge the toggle and cause it to rotate 90 degrees; seating on the medial cortex, but do not yet pull hard on the suture. Remove the insertion device gently and insert the tips of a closed Kelly hemostat thru the bone tunnel as deeply as they will easily advance. Rotate the hemostat 90 degrees clockwise and then 90 degrees counterclockwise. This is to ensure that the toggle has been pushed completely to the medial side of the bone hole. While continuing to hold the hemostat in place within the hole, pull firmly upward on both ends of the suture to ensure that the toggle has securely engaged the trans cortex. Remove the hemostat. You should, at this point, literally be able to lift the pelvis off the table, although you do not need this degree of testing to determine if proper placement has been achieved.

Femoral Head/Neck Preparation

Internally rotate the femur until you can visualize the caudal femoral head. Using a #11 blade, carefully remove any remnants of the RL attached to the fovea capitis, being careful not to damage the surrounding articular

cartilage. Using a 0.062" k-wire, drill a small 'starter' hole in the femoral head directly centered on the fovea (previous attachment of the RL). Drill only 2-3mm deep. This starter hole allows precise tip placement of the femoral head aiming device and avoids drill bit slippage during subsequent drilling. Place the tip of the aiming device into the starter hole just drilled into the femoral head and externally rotate the femur back to a relatively neutral position while maintaining tension on the tip of the aiming device to prevent it from dislodging. The location on the lateral femoral cortex at which the bone tunnel should begin is at a point several mm cranial to the crest of the third trochanter, and at a distal level from the proximal femur approximately even with the lesser trochanter (medially). A common mistake is starting this bone tunnel too far proximal. It is helpful to have identified the point on the lateral cortex before positioning the aiming device. Elevate sufficient vastus lateralis muscle cranially from the crest of the third trochanter to provide a clear view of the target point to be drilled.

Predrilling a small starter hole with a 0.062" k-wire or small Steinmann pin will help prevent the subsequent drill bit from 'walking' while drilling the femoral neck bone tunnel. Position the drill sleeve of the aiming device on the target point (starter hole on the lateral femoral cortex) and tighten the sleeve. In larger dogs, drill the femoral head/neck tunnel using a 3.2mm drill bit. In medium/ small dogs or cats, use an appropriately sized drill sleeve and smaller drill bit (2.5mm or 2.0mm), but sufficiently large to accommodate passage of your suture size. Note that Securos offers a long, 2.4mm diameter drill bit and drill sleeve that is compatible with the current aiming device. After drilling the femoral neck tunnel, remove the aiming device, and rotate the femur to expose the fovea capitis. Pass the suture ends through the bone tunnel at the fovea and out the lateral cortex.

Suture passage can be accomplished in several ways. If using nylon, the suture is stiff enough to allow passage by simply pushing each end of the suture back thru the tunnel. If using soft braided polyester, pass the strands using the Securos suture passer. This is possible only if you have drilled a 3.2mm tunnel. If using braided polyester with a narrow bone tunnel, suture can be passed using a wire loop (22ga): the wire loop being passed from lateral to medial in a similar fashion to the Securos suture passer. With the suture residing in the femoral neck tunnel, reduce the hip while pulling firmly on the suture to keep it taught.

Securing the Suture Prosthesis to the Femur

Suture strands exiting the femoral neck tunnel on the lateral femur can be secured in several ways: 1) because it is difficult to knot hard nylon, crimp clamps work well. Drill a transverse bone tunnel from cranial to caudal at a point approximately 1.5-2.0cm proximal to the suture tunnel. Tunnel the end of one suture strand under the vastus lateralis muscle cranially and proximally, between the femoral neck tunnel and the cranial end of the transverse bone tunnel. Pass this suture end through the transverse tunnel from cranial to caudal. Then pass this and the other end of the suture in opposite directions through an appropriately sized crimp cramp. This places the crimp clamp on the caudal aspect of the greater trochanter, where it is easily accessible to crimp and will not impinge on muscle. Apply tension on the suture with the Securos tensioning device and assess the joint range of motion. When satisfied with appropriate toggle suture tension, crimp the clamp with the Securos Power X crimping device. This precisely engineered instrument ensures optimal holding strength without risk of severing the suture and provides a 5x mechanical advantage over previous models. 2) if using braided polyester (stronger, but more reactive than nylon), simply pass one end of the suture through the eye of a second toggle and tie a knot with the toggle secured against the lateral femoral cortex. A polypropylene button can be substituted for this toggle, but may present a more soft tissue irritating profile than the toggle. 3) if using braided polyester (also

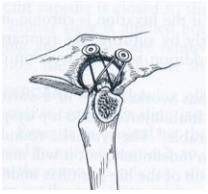
more reactive than nylon), the suture can be passed through the transverse bone tunnel as above, with the ends thereafter tied.

Determining How Tightly to Tie the Suture

IT IS EXTREMELY IMPORTANT NOT TO OVER-TIGHTEN THE SUTURE. This is the most common error made. The suture should only be tightened enough to maintain hip reduction while preserving relatively normal hip range of motion. In a normal hip, there will be several mm of mediolateral translation of the femoral head in and out of the acetabulum when the capsular 'vacuum effect' is released. This should be preserved.

Before the suture is crimped or tied, assess tightness of joint reduction as follows: 1) test for presence of Ortolani sign/ laxity. There should be little or no subluxation. If there is no Ortolani, make sure the suture is not too tight. If a positive Ortolani is elicited, tighten further before proceeding. 2) test again for mediolateral translation by grasping the greater trochanter and lifting upward, or simply grasping the thigh and lifting upward while keeping the femur parallel to the table. There should be only a few mm of laxity present. 3) manipulate the hip thru a range of motion: flexion/ extension, adduction/abduction, and internal/external rotation, assessing for normalcy. Do not crimp or tie the suture until you are satisfied with the degree of suture tension allowing normal range of motion. Too tight a reduction risks either premature failure of the suture prosthesis or contact pressure induced chondromalacia of the articular cartilage.

Following adequate joint reduction, perform whatever capsular repair is possible with the tissues available, and close. Insertion of the external rotator tendon will require reattachment if tenotomized or compromised by rupture or avulsion. Document proper positioning of the toggle with postoperative radiographs.



If a surgical revision is required or if there is insufficient joint capsule remaining to provide joint coverage, a synthetic capsule technique may be required to maintain reduction. Herein, after joint reduction, two bone screws of suitable diameter are inserted in the dorsal rim of the acetabulum, taking care that they do not penetrate the articular surface. Metal or plastic washers are placed on the screws to prevent the suture from slipping off the head of the screws. Two lengths of suture are threaded through a hole drilled in the bony bridge between the trochanter and femoral head. The sutures are separated and each is placed around a screw, under the washer. A few degrees of internal rotation and slight abduction is applied to the femur before the sutures are tied tightly. Finally, if a greater trochanteric osteotomy was used in the surgical approach, additional stability may be gained by moving the trochanter slightly distal and caudal to its original site when reattaching with a tension band technique. This results in increased abduction and internal rotation of the femur.

Aftercare

If the patient will not be required to ambulate on the operated leg immediately postop, consider enhancing security of the repair by placing the limb in an Ehmer sling or tibial sling for 10-14 days. The patient should be absolutely confined to a small room or large cage or crate for 6 weeks, with activity restricted to brief leash walks only long enough to toilet. At the 6 week recheck, if the hip is still reduced, the patient can be allowed a gradual return to activity by progressively lengthening leash walks over one month thereafter.

Ultimately, long-term success of the procedure depends on there being a normal hip conformation to begin with, one that is conducive to maintaining reduction had there not been trauma. A toggle pin repair performed in a patient with a shallow/subluxating hip conformation is doomed to failure. Take-home message: pick your patients wisely; considering femoral head and neck ostectomy (FHO) as a salvage procedure.