Treatment of a shoulder luxation in a forelimb amputee dog

N. J. Burton, M. R. Owen
University of Bristol — Clinical Veterinary Science, Langford, Bristol, UK

Summary
An eight-year-old, male, thoracic limb amputee Whippet presented with a traumatic lateral luxation of the scapulohumeral joint. Surgical reduction and stabilisation of the shoulder joint by means of a modified Campbell scapulohumeral prosthesis and capsulorrhaphy was unsuccessful and relaxation of the shoulder joint occurred. Subsequent surgical stabilisation using bicipital tendon transposition and a modified Campbell scapulohumeral encircling prosthesis in combination with a novel body cast / Spica splint resulted in a return to satisfactory function of this limb.

Keywords
Shoulder luxation, forequarter amputee

Vet Comp Orthop Traumatol 2007; 20: 146–149
doi:10.1160/VCOT-06–05–0037

Introduction
Traumatic luxation of the scapulohumeral joint is a relatively uncommon injury in dogs (1) and is thought to occur most commonly during the swing phase of motion of the thoracic limb, when the joint is semi-flexed (2, 3). Traumatic scapulohumeral luxation usually results in lateral luxation of the humeral head, although cranial (4), caudal (5) and medial (6) luxations are also reported. Various techniques have been described for reduction and stabilisation of shoulder luxations, including closed reduction, which may be augmented by external splintage (7), non-weight-bearing sling, or modified Velpeau sling (4). Surgical reduction can be achieved with bicipital tendon transposition (3), supraspinatus tendon transfer (6), transarticular pinning (8) and suture stabilisation (9). Scapular glenoid excision (1), resection of the glenoid and humeral head (10) and scapulohumeral arthrodesis (11) have also been described for the salvage of irreparable shoulder luxations. These procedures are all documented in cases of unilateral, or less commonly, in bilateral scapulohumeral luxation, but to the authors’ knowledge the case described here is the first report of successful management of a traumatic scapulohumeral luxation in a thoracic limb amputee dog.

Case study
A 14 kg, eight-year-old, male, neutered thoracic limb amputee Whippet was presented to the University of Bristol with a six day history of thoracic limb lameness after having fallen down a staircase. Historical information indicated that a forequarter amputation of the contralateral limb had been performed two months previously following failed surgical management of traumatic shoulder luxation. Clinical examination and subsequent radiographic examination (performed with anaesthesia) identified a lateral scapulohumeral luxation of the remaining right thoracic limb (Fig. 1).

Surgical reduction and stabilisation of the luxation was performed. The dog was placed in left lateral recumbency and combined cranio-lateral and cranio-medial approaches to the shoulder joint were performed (12). The scapulohumeral joint was reduced and the joint capsule, which was torn on the lateral aspect of the joint, was repaired using simple interrupted 3 metric PDS II (Ethicon) sutures. A modified Campbell collateral ligament prosthesis was placed through bone tunnels in the scapular...
neck and the greater tubercle of the humerus (13) (Fig. 2), using 100 lb leader line secured with a stainless steel crimp (Veterinary Instrumentation, Sheffield, UK) to maintain scapulohumeral reduction. Postoperative radiography confirmed shoulder joint reduction and satisfactory implant placement and postoperatively within a few hours of surgery the dog was observed to be weight bearing on the limb.

Two days postoperatively the dog jumped from a height of 20 cm from its cage and was subsequently unable to stand on its thoracic limb. There was marked shoulder discomfort and radiography confirmed lateral relaxation of the humeral head. Revision surgery was performed. The scapulohumeral joint was reduced and a lateral bicipital tendon transposition was performed with osteotomy of the greater tubercle (3). The osteotomy was reduced with two 1.1 mm Kirschner wires and a 1 mm tension band wire. A 100 lb modified Campbell collateral ligament prosthesis was placed through bone tunnels in the scapular neck and the proximal humerus. Joint capsule reconstruction was not possible due to extensive tissue damage. Postoperative radiography confirmed reduction (Fig. 3). A Spica splint was placed to support and immobilise the shoulder for two weeks and the dog was strictly rested. At this stage the Spica splint was replaced by a body cast that extended distally only to the elbow joint (Fig. 4). The body cast was lined with a custom-made neoprene vest, which extended distally to the elbow joint. The dog was confined to the house for the following four weeks and the neoprene vest and body cast was changed at weekly intervals. Examination six weeks postoperatively revealed mild spinatus muscle group atrophy and there was some restriction of shoulder flexion and extension, though there was limited normal movement of the joint without any signs of discomfort. Radiographic examination confirmed maintenance of shoulder reduction. The dressings were removed and the dog’s activity level was restricted to lead exercise for a further eight weeks, after which time off leash exercise was permitted. Twelve months after surgery, the dog was active, the shoulder reduction was maintained and there was no discernible restriction in range of motion or pain on examination of the shoulder joint.

**Discussion**

Numerous surgical techniques have been described for the management of scapulohumeral luxation in the dog and of these, transposition of the bicipital tendon has been described for the correction of medial, lateral, and cranial scapulohumeral instabilities (3, 5, 14, 15). Lateral transposition of the biceps brachii tendon is an effective means of correcting lateral luxation of the shoulder and therefore of re-establishing normal joint function (16). However, concerns have been raised that this technique may result in incongruity of the articular surfaces during the initial postoperative period (17), inhibiting normal joint motion and predisposing to degenerative change and lameness (6). In contrast to these claims, in vivo studies of bicipital tendon transposition to repair shoulder luxation in dogs indicate that dogs became sound within eight weeks of surgery and that radiographic evidence of degenerative changes of the shoulder joint as a result of the luxation and subsequent surgical repair are mild (16).

In the revision surgery performed in this case report, a modified Campbell scapulohumeral encircling suture (13) was used in addition to the bicipital tendon transposition. Although bicipital tendon transposition provides robust support, relaxation of the shoulder joint following this procedure has been reported (16). The modified Campbell prosthesis was used in conjunc-
tion with a bicipital tendon transfer due to the severe trauma sustained to the joint capsule, prohibiting capsulorrhaphy, and because immediate postoperative loading of the single thoracic limb was anticipated in this dog. To further minimise the chance of relaxation occurring in association with immediate postoperative limb use, the scapulo-humeral joint was additionally supported using a body and proximal limb cast (18), combined with a Spica splint. A custom-made, neoprene dressing for the trunk and proximal limb enabled the application of the Spica splint and body cast for 28 days without any dressing related complications.

Kinetic studies indicate that in quadrupartite dogs, 60% of the body weight is distributed equally between the forelimbs with residual body weight carried by the pelvic limbs (19). In contrast, forelimb amputees carry 46% of their body weight on their single forelimb with the remaining 54% being distributed on their hind limbs (19). Furthermore, total stance time in forequarter amputees during locomotion is significantly decreased in all limbs and both the breaking force and the propulsion contact times are altered in the single remaining thoracic limb (19). Together, these factors may be responsible for greater forces and stresses applied to the joints of the single thoracic limb. Such high demand use of the shoulder can cause fatigue failure of the glenohumeral ligaments (20), predisposing to shoulder luxation. Muscular contraction imbalance, which creates a force vector that deviates from the glenoid centre, has also been implicated as a predisposing factor for scapulo-humeral luxation (21).

Previous in vitro (17) and in vivo studies (16) indicate that lateral scapulo-humeral luxation is associated with rupture of the lateral joint capsule and compromise to the infraspinatus tendon and the lateral glenohumeral ligament. The attachment of the fibrocartilagenous labrum of the glenoid cavity appears to be the weakest part of the lateral glenohumeral ligament (6), and tearing of this structure has been reported arthroscopically in three dogs with shoulder instability (21). It is possible that following thoracic limb amputation, the adaptive medialisation of the remaining forelimb required for balance and the increased loads transmitted through the single thoracic limb may result in cyclic weakening and subsequent rupture of the lateral joint capsular structures, resulting in lateral shoulder luxation. In a study of nine hind limb amputees that underwent total hip replacement, a high rate of hip luxation was reported compared to that observed in quadruped dogs (22). These authors speculate that hip luxation is predisposed due to the increased range of motion of the hip combined with adaptive medialisation of the hind paw during the stance phase of locomotion overloading the surrounding tissues (22). Similar abnormal stresses and tissue injuries associated with tripedal locomotion may have predisposed to luxation of the shoulder in the case described herein. Kinematic gait analysis would be necessary to quantify the degree of adaptive paw medialisation during locomotion to verify this hypothesis.

In a review of a series of canine amputees, of which 36 had forequarter amputations, no long-term complications were associated with, or occurred, as a consequence of the surgery performed (23). This is perhaps surprising since gait analysis of forequarter amputees indicates that following amputation, these dogs have difficulty maintaining balance and that they frequently fall over (24). In the dog described, the fact that luxation occurred in both shoulders suggests a predisposition to traumatic shoulder luxation in this dog.

In summary, surgical stabilisation of traumatic lateral shoulder luxation in a forequarter amputee was successfully performed using bicipital tendon transposition augmented by a modified Campbell scapulo-humeral suture. The repair was protected postoperatively, using a novel body cast/Spica splint combination. Treatment resulted in a return to satisfactory shoulder joint function.

References
9. Slocum B, Slocum TD. Suture stabilisation for luxations of the shoulder In: Bojrab MJ (ed) Current Techniques...
Corrigendum

In the manuscript, ‘Surgery plus chondroprotection for canine cruciate ligament (CCL) rupture: A proton-NMR study’, by Crovace et al., published in VCOT 2006; 19: 239-245, the authors belatedly find that the co-author F.P. Fanizzi from the Dipartimento di Scienze e Tecnologie Biologiche ed Ambientali, Università di Lecce, Lecce, and Consortium C.A.R.S.O. Cancer Research Center, Bari, Italy, was not listed. The Publisher apologises on behalf of the authors for this mistake.