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Long-term follow-up after arthroscopic tenotomy for partial rupture of the biceps brachii tendon

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Summary

Objective: To report long-term clinical outcome and radiographic results in dogs diagnosed with partial bicipital rupture and treated by arthroscopic tenotomy.

Materials and methods: The medical records of dogs that had undergone arthroscopic tenotomy were retrospectively reviewed. Inclusion criteria for this study were: performance of an arthroscopic tenotomy between August 1999 and July 2007, availability of arthroscopic records data for review, and ability to obtain follow-up data for more than 1 year after arthroscopic tenotomy. In all cases, owners were interviewed at re-check appointments or via telephone to determine perceived outcome after surgery.

Results: Forty-seven arthroscopic tenotomies were performed on 40 dogs without any major surgical complications. Long-term follow-up examinations − ranging from 12 months to 48 months (mean 26 months) after the tenotomy − were obtained for 24 dogs (25 shoulders).

Clinical outcome was excellent in 22 shoulders (88%), with each dog showing a full return of limb function. A total of 10 dogs (11 joints) were evaluated radiographically and revealed no progression of pathology in 6 joints (55%). Five joints (45%) showed a limited progression of pathology radiographically.

Conclusion: Arthroscopic tenotomy in the treatment of bicipital partial rupture yields favourable long-term clinical results and a high degree of owner satisfaction. The feasibility of this technique and the long-term clinical and radiographic outcome from our study indicate that this technique can be considered a reliable and safe treatment for partial bicipital rupture.

Introduction

Tendon and ligament conditions are becoming more frequently recognised as a cause of shoulder lameness (1-5). According to Bardet (5), the most commonly reported conditions affecting the bicipital tendon are partial or complete tears at its origin. The aetiology of partial or complete ruptures and the associated tenosynovitis is complex (6-9).

The disease occurs primarily in large or medium-sized dogs of middle-age or older. Clinical signs are usually chronic and progressive (9-11).

Typical clinical findings are a positive biceps test and, when a complete bicipital rupture is present, hyperextension of the elbow along with flexion of the shoulder (1). Diagnostic imaging for a partially or completely ruptured biceps tendon includes radiography, arthrography, ultrasonography and arthroscopy. Primary radiographic signs are changes at the supraglenoid tubercle, such as osteophytosis, osteosclerosis, a radiolucent area and deformation of the tubercle and calcification and osteophytosis within the tendon sheath. Secondary arthrosis develops with chronicity of the lesion (11). Confirmation of the diagnosis can be made with ultrasound showing a changed structure of the proximal part of the biceps tendon as well as defects or a complete rupture. An increased amount of fluid within the tendon sheath is often seen as a secondary sign of synovitis within the joint (12-13). Arthrography can also be used to confirm the diagnosis by demonstrating a changed delineation of the biceps tendon and its sheath (14-16). Arthroscopy allows direct inspection of the biceps tendon, showing thickening of the tendon, ruptured fibres 54 and hyperplastic remnants (17-18). Recently, MRI has shown great potential as a diagnostic tool in the evaluation of canine shoulder disease, including partial bicipital rupture (19). A correct diagnosis is crucial for obtaining the desired treatment result.

The stabilising function of the biceps tendon in the shoulder remains controversial therefore treatment varies widely among surgeons, ranging from non-operative management to bicipital repair, tenotomy or tenodesis. Surgical treatment is recommended for dogs that do not
respond to medical treatment. According to the veterinary literature, good and excellent result have been obtained with both tenotomy and tenodesis (20-22). However, the ultimate outcome is based on preliminary results, and long-term clinical results are unavailable. The purpose of this study is to evaluate the long-term clinical outcome and radiographic results in dogs diagnosed with partial bicipital rupture treated by arthroscopic tenotomy.

Materials and methods

Inclusion criteria

The medical records of dogs that underwent arthroscopic tenotomy as treatment for partial rupture of the biceps tendon (PRB) were retrospectively reviewed. Inclusion criteria for this study were: performance of an arthroscopic tenotomy between August 1999 and July 2007, availability of arthroscopic records data for review, and ability to obtain follow-up data for more than 1 year after the arthroscopic tenotomy. For this study, diagnosis of PRB was based on the presence of definitive forelimb lameness localised to the shoulder, filling defects of the biceps brachii tendon sheath, abnormal delineation of the tendon seen on a positive contrast arthrogram or an amorphous, inhomogeneous, hyperechoic biceps brachii tendon on ultrasonographic examination and confirmed by arthroscopy. Retrieved data included, age, gender, breed, activity status, orthopaedic examination findings, arthroscopic findings and follow-up examinations.

Arthroscopy

Shoulder arthroscopy was performed in a standardised manner for all dogs using craniolateral and caudolateral portals (Wolf 2.7 mm, 30° fore-oblique arthroscope) (18). The joint was explored using a standard compartmental approach. The presence of a partial bicipital rupture was assessed by visual examination and probing the tendon while extending and flexing the elbow. Transection of the tendon was achieved by an arthroscopic hook scissor (Richard Wolf Gmbh, Knittlingen, nr. 98487.04). At the time of arthroscopy, digital images of each structure were obtained for subsequent evaluation and data recording.

Post-operative care

The instructions for initial post-operative care that were given to owners included short leash walks, or restriction of the dog to a small room when unobserved, for 6 weeks after surgery. In addition, analgesics were administered for 3 weeks and physiotherapy was not performed. When there was no evidence of pain at the 6 week re-check, a progressive return to full activity and non-concussive activities were encouraged over the subsequent 6 weeks. Unrestricted activity was allowed after 12 weeks of convalescence.

Outcome

In order to evaluate the treatment outcome, the owners were asked to present their dogs for a clinical and radiological re-examination (Group 1). If the owners could not present the patient to the clinic again, the treatment was evaluated by means of functional results reported by the owner through a questionnaire (Group 2). The extent of the remaining complaints and complications were of special interest. All of the dogs presented were observed and video recorded walking and trotting on leash, in a straight line and in a circle (2 directions). Two investigators independently assigned an individual lameness score for each forelimb of each dog. The lameness score was based on a 5-point scale: 0 = no detectable lameness, 1 = mild weight-bearing lameness, 2 = moderate weight-bearing lameness, 3 = marked weight-bearing lameness, 4 = non-weight-bearing lameness. The evaluation of the treatment’s success was based on the findings of the clinical examination and on the owners’ reports (questionnaires). The outcome was rated ‘excellent’ when no lameness was observed or reported in all activities without the use of anti-inflammatory medication. The outcome was rated ‘good’ in dogs with occasional lameness or exercise intolerance sensitive to anti-inflammatory medication. All other outcomes were rated ‘poor’.
Radiographs from the initial examination and the follow-up examination were evaluated and compared with respect to subchondral bone sclerosis, remodelling, osteophytosis and enthesiophytosis. The joint was then subjectively graded based on the severity of the radiographic arthrosis (Fig. 1).

Results

Patients

47 arthroscopic tenotomies were performed in 40 dogs, but only 24 dogs met the inclusion criteria due to lack of follow-up. Nine dogs were no longer living at the time of owner contact, and so no interview was performed. Contact data were not available for 7 other dogs because of address change. All of the dogs were large breed and included: Bernese Mountain Dog (7), Newfoundlander (2), Golden Retriever (3), Border Collie (3), Crossbreed (2), Rottweiler (1), American Staffordshire Terrier (1), Labrador Retriever (1), German Shepard (1), Irish Wolf Hound (1), Beauceron (1), and Nova Scotia Duck Tolling Retriever (1). The dogs’ ages ranged from 6 months to 10 years (mean: 42 months). The group included 10 intact females, 1 spayed female, 9 intact males, and 4 castrated males.

Clinical and arthroscopic findings

The degree of lameness varied among the dogs (24), ranging from subtle, chronic intermittent lameness to permanent non-weight-bearing lameness. The duration of lameness ranged from 3 weeks to 3 years (mean: 3.5 months). Only in half of the cases, was there a history of trauma and acute onset of lameness. Orthopedic examination findings include, atrophied shoulder muscles (92%), a painful shoulder in extension (20%), a positive biceps test (88%) and hyperextension of the elbow (8%). Besides the ruptured aspect of the biceps tendon, the most consistent arthroscopic findings were synovial hypertrophy and hyperaemia (88%) and fibrillation of the medial glenohumeral ligament (32%). Other findings included fibrillation of articular cartilage of the humeral head (12%), fibrillation of the subscapularis muscle (8%) and a partial rupture of the medial glenohumeral ligament (4%).

Outcome and radiographic evaluation

Long-term follow-up examinations were obtained for 24 dogs (25 shoulders) and ranged from 12 months to 48 months (mean: 26 months). No complications related to the tenotomy were reported. The follow-up exam consisted of a second clinical and radiological examination of the affected dogs (Group 1; n= 10 dogs (11 shoulders)) or a questionnaire answered by the patient’s owner (Group 2; n=14 dogs (14 shoulders). In Group 1, 81% (9/11) showed an excellent result, with relief of symptoms at a mean time of 3 weeks. The dogs had no abnormalities on clinical examination, were without lameness at the time 164 of the long-term follow-up examination, and did not show any signs of lameness after exercise. The result for one dog was rated as ‘good’ (lameness score 1). The dog showed no signs of lameness most of the time. However, after hard exercise or when running in circles, a low degree lameness was noticed. One result was rated as ‘poor’, as the dog suffered from permanent low to moderate lameness. A second arthroscopic examination revealed fibrous tissue originating from the supraglenoidal tubercle running in the inter-tubercular groove. The lameness did not improve after the second arthroscopic transection of the fibrous tissue. Despite the latter case, none of the dogs developed an abnormal gait or an inability to flex the elbow. In Group 2, 92% (13/14) of the results obtained via the questionnaire were rated as ‘excellent’; one report was rated as ‘good’. No cosmetic deformities were noticed in Group 1 or in Group 2.

A total of 10 dogs (11 joints) were evaluated radiographically and revealed no progression of pathology in 6 joints (55%). Five joints (45%) showed a limited progression of pathology. The median progression was 0 (Table 1).

Discussion
The goal of surgical treatment in partial bicipital rupture is to eliminate movement of the tendon in the inflamed tendon sheath. This can be accomplished with either tenodesis or tenotomy. Initially, biceps tenotomy was criticized based on biomechanical data and a lack of long-term clinical results (22-24). The biceps muscle-tendon unit is one of many structures in the canine body to cross two joints. In the elbow, it serves as a flexor and supinator. Whilst its function at the elbow is clear, its role in the shoulder remains controversial. An in vitro study by Sidaway (24) has confirmed that the biceps tendon contributes to the passive shoulder stability, particularly in the neutral and flexed positions. However, scapulo-humeral stability after bicipital tenotomy should be comparable to that after a traditional bicipital tenodesis. If significant instability had been present after tenotomy, we would have expected clinical, and eventually radiographic, signs after a longer period of time, which did not occur in this study. It seems clear that the biceps tendon does not have a primary stabilizing function in the shoulder but has multiple secondary roles instead. Therefore, as no primary function can be isolated, it is not surprising that there is no single reliable clinical test or single treatment in biceps pathology.

In human medicine, tenodesis was initially advised to re-establish the resting muscle length and thereby maintain the length-tension relationship, prevent muscle atrophy, avoid cramping, pain, maintain elbow flexion and supination strength and avoid cosmetic deformity (Popeye sign) (25). Currently, tenotomy is becoming more popular than tenodesis (26-28). Mariani et al. (29) compared 30 patients with spontaneous rupture of the long head of the biceps treated non-operatively with 26 patients who underwent early biceps tenodesis. They found only a 13% difference in the biceps’ supination strength between the two groups and no difference at all in elbow flexion strength. However, in patients who are concerned about potential cosmetic deformity and associated dysfunction, tenodesis might be advantageous. It is important to note that none of the dogs in this study developed an abnormal gait, a cosmetic deformity or the inability to flex the elbow.

Pre-operative clinical findings in this study are similar to literature however, in 2 patients (8%) hyperextension of the elbow was possible, despite the fact that the biceps tendon was not completely ruptured. Clinical outcome was excellent in 22 shoulders (88%), with each dog showing a full return of limb function. Symptoms disappeared rapidly in the majority of the dogs, at a mean time of 3 weeks. Since most dogs showed an immediate pain relief, it is likely that tenotomy eliminates the painful traction forces that are exerted on the non-ruptured part of the affected biceps tendon and its attachment onto the supraglenoid tubercle. In one case, the dog had recurrence of symptoms six weeks after operation and suffered from low to moderate permanent lameness for 24 months. After other joint problems were ruled out, the dog underwent a second arthroscopic exam, which revealed the presence of fibrous tissue at the normal location of the bicipital tendon. The authors believed that this was 219 the result of an incomplete tenotomy of the biceps tendon in the initial arthroscopy. During arthroscopic tenotomy, the tendon does not always retract clearly in its groove, which can make it difficult to judge whether or not the tendon is completely transected, particularly in chronic cases.

Despite fibration of the humeral head, no lesions were detected. However, even after the second tenotomy, the owner could still see no improvement 10 months post-operatively. Another explanation could be that the initial diagnosis was incorrect. This stresses the importance of a complete diagnostic work-up, that carefully rules out other pathologies. Fibrillation of the MGHL present in 32% (8/25) and a partial rupture of the MGHL present in 4% (1/25), were regarded as secondary findings. Post-operative exercise restriction could have contributed to the recovery of these structures. None were surgically treated and the outcome was rated ‘excellent’ in all affected dogs. Therefore, we recommend caution in interpreting such findings as a primary clinical problem, because, in our opinion, some could be coincidental findings of no clinical significance. Although it was limited, degenerative joint disease was present pre-operatively in all dogs from Group 1. We could not demonstrate a correlation between presence of increase in grade and the clinical outcome. However, all dogs with post-operative grade I (5/11) had excellent clinical outcomes. Dogs showing clinical signs for more than 5 weeks were associated with higher post-operative grades, which suggests that early recognition and treatment could produce better clinical outcomes. The number of radiographic cases is not large enough for statistical analysis.

A major limitation of our study is that tenodesis (open or arthroscopically) was not evaluated as an alternative treatment. Because no comparison was made, tenotomy cannot be considered...
superior to tenodesis based on the available data. However, data from the present study
designed to evaluate a more complex treatment (tenodesis) have not yet been made.

Another limitation is that dogs from Group 2 were evaluated only by a subjective
questionnaire. However, the results achieved in both groups were consistent, and the overall
clinical outcome for both groups was rated ‘excellent’ in 88% of the cases. Force plate
analysis, computed tomography and arthroscopy would have contributed important data to
this study, but they were beyond the scope of this work for financial reasons and the desire
to not tax the goodwill of the owners. Indeed, owners are not inclined to come for an
additional examination if no problems are present. This could have affected our results – even
positively – because, for the majority of the dogs, the short-term results (which are not
included in this study) were rewarding.

Variables in our study were epidemiologic aspects and the different functions, environments
and pre-surgical management. Only one dog from Group 1 was a working dog – nevertheless,
outcome was excellent after bilateral arthroscopic tenotomy.

We conclude that arthroscopic tenotomy in the treatment of bicipital partial rupture yields
favourable long-term clinical results and a high degree of owner satisfaction. Although it
cannot be considered superior to tenodesis, the feasibility of applying this technique and the
long-term clinical and radiographic outcomes from our study suggest that this technique can
be considered a safe, reliable treatment for partial bicipital rupture.

5. Bardet JF. Lesions of the biceps tendon: Diagnosis and classification. VetComp Orthop
7. Davidson EB, Griffey SM, Vasseur PB et al. Histopathological, radiographic, and
arthrographic comparison of the biceps tendon in normal dogs and dogs with biceps
8. Gilley RS, Wallace LJ, Hayden DW. Clinical and pathologic analyses of bicipital
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Table 1: Clinical, radiographic and follow-up findings of the dogs that were represented for clinical and radiographic re-evaluation (Group 1).

Figure 1. Joints with PBR with different degree of arthrosis

Grade 0: No radiographic abnormality
Grade 1: Sclerosis at the glenoid rim and medial trochlea of the bicipital sulcus

Grade 2: Osteophytosis less than 3mm at the caudal rim of the humeral head

Grade 3: Osteophytosis more than 3 mm at the caudal rim of the humeral head