



## The effectiveness of a Botulinum Toxin A infiltration in the management of bicipital cramps after arthroscopic biceps tenotomy

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A challenging complication of arthroscopic biceps surgery is the persistent painful cramping of the biceps. There is a paucity of data upon nonsurgical treatment of this debilitating complication. We propose an intramuscular injection of botulinum toxin A (BTX-A) for painful bicipital cramping after tenotomy of the long head of the biceps brachii tendon (LHBT). Ten patients with a painful Popeye sign after tenotomy of LHBT, were treated with intramuscular injection of 100 IU of BTX-A. Mean patient age was 56 years and mean time from surgery to infiltration was 317 days. The Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score was obtained. Pain was objectified by a visual analogue scale (VAS). Patient satisfaction was described as excellent, good, satisfactory, or poor, three and six months after injection. Mean VAS prior to infiltration was 6.8 and decreased significantly to 2.6 at follow-up. Mean QuickDash was 54.04 prior to infiltration and decreased to 19.84 at follow-up. Patient satisfaction was excellent in 9 and good in 1 patient. We report a significant pain reduction and functional improvement following BTX-A infiltration as treatment of painful bicipital cramping after tenotomy of LHBT.

**Keywords:** bicipital cramping; LHBT; BTX-A; botox; tenotomy; shoulder arthroscopy; rotator cuff.

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## INTRODUCTION

Lesions of the tendon of the long head of the biceps brachii (LHB) have been the subject of intense research for decades. They comprise a spectrum of pathologies, originating from inflammatory tenosynovitis to degenerative tendinopathy caused by overuse, trauma, or instability (1). Pain in the anterior part of the shoulder, at rest as well as on rotation of the shoulder, radiating pain down the arm, and paresthesia are frequent symptoms. Varying degrees of disability are observed (2,3,4). Treatment options are initially conservative, including nonsteroidal anti-inflammatory drugs, adjustment of activities, rest, physical therapy, and corticosteroid injections (4). If conservative management is unsuccessful, a range of surgical techniques has been suggested. Although the most appropriate management has

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been the subject of debate, arthroscopic removal of the diseased intra-articular portion of the LHB, by tenotomy or tenodesis, is increasingly accepted (3). Both techniques have similar outcomes (4-7). Despite the good functional results, reported complications of biceps surgery are the Popeye sign and loss of strength in elbow flexion and forearm supination (3-9). The Popeye deformity occurs due to a distal displacement of the long head of the biceps after spontaneous rupture or tenotomy, and the biceps muscle crops to a round ball as seen in the illustration (Fig. 1). Referring to the cartoon personage, this deformity is called a Popeye arm or Popeye sign. Most of the time, this deformity is pain free, but can cause extremely painful cramps in the muscle belly. The painful Popeye sign, which is more frequent in arthroscopic biceps tenotomy, significantly reduces the quality of life, and symptoms tend to be persistent (10-12).

Some authors suggest a surgical conversion to subpectoral tenodesis of the LHB to treat chronic bicipital pain and contracture after biceps tenotomy (13,14).

There is a paucity of data on outcomes of nonsurgical treatment measures of this debilitating complication (15).

In this manuscript, we evaluate the clinical effectiveness of intramuscular injection of botulinum toxin A (BTX-A), in the treatment of painful bicipital cramping after tenotomy of the LHB.

## MATERIAL AND METHODS

Between august 2017 and march 2019, ten patients with a painful Popeye sign, which resulted from tenotomy of the LHB tendon, were treated with intramuscular injection of BTX-A. Patient selection was based upon the presence of severe bicipital pain in the muscle belly of the biceps brachii at rest and during activity, that did not respond to conservative treatment and that persisted for more than three months. Patients with other causes of persistent shoulder pain after tenotomy were excluded. Conservative treatment included physical therapy and non-steroidal anti-inflammatory drugs. All patients underwent treatment by injection of 100 IU of BTX-A in the painful muscle belly of



**Figure 1.** — A patient with a Popeye deformity in the right arm due to a distal displacement of the long head of the biceps after tenotomy.

the biceps brachii. These 100 IU of BTX-A were dissolved in 2.5cc of a sterile saline (NaCl 0.9%) solution and were distributed over the contracted muscle belly through four separate puncture holes, and by injecting in a multidirectional fashion. Patient assessment occurred prior to injection and at a three months follow-up consultation. The Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score was obtained to determine overall function (16). Pain was objectified by a visual analogue scale (VAS): a score of 0 indicated no pain, and a score of ten the worst pain imaginable by the patient (17). Patient satisfaction was described as either excellent, good, satisfactory, or poor, three months after injection. A final clinical evaluation was performed at six months of follow-up.

VAS and QuickDASH scores were compared between baseline and three months after injection, with a paired samples t-test. The significance for all outcomes was defined as  $p < 0.05$ .

## RESULTS

Ten patients were treated with local intramuscular administration of BTX-A injection, for a symptomatic postoperative Popeye sign. The male to female ratio was one to nine. Mean age was 56 years old (range 41 to 69), and mean time lapse from surgery to infiltration was 317 days (range 151 to 700). Mean VAS prior to infiltration was 6.8 +/- 1.2 and this decreased to 2.7 +/- 1.9 at the three

months follow-up consultation. This difference was statistically significant ( $p < 0.0001$ ). Mean QuickDash was 54.05 +/- 12.0 prior to infiltration and decreased to 19.09 +/- 9.1 at follow-up. Once again significance was obtained ( $p < 0.0001$ ). No complications were reported in this study. Nevertheless, all patients mentioned minor and transient diminution of force when exerting elbow flexion and forearm supination. Patient satisfaction was excellent in nine and good in one patient. Pain reduction started two weeks after administration of BTX-A and lasted for four to six months. At a six months follow-up consultation, seven out of ten patients preferred a second intramuscular administration of BTX-A above referral for surgical treatment, when discussing the therapeutic options. The remaining three patients were comfortable and did not seek any further treatment.

## DISCUSSION

The intramuscular administration of BTX-A injection for a symptomatic postoperative Popeye sign, caused a significant improvement in terms of VAS and QuickDash score. BTX-A is widely used for treating orthopaedic disorders that involve muscular spasm, as

it reduces muscle activity by inhibiting the release of acetylcholine at the neuromuscular junction level (11,18-20). Since 1989, BTX-A infiltration has been approved for therapeutic and esthetical treatment purposes (21). Although it is known as a toxic biologic agent (21), the administration of small doses for medical use, is considered safe (22-24).

BTX -A has a proven efficiency in the treatment of a variety of neurological and non- neurological disorders (22-24), such as blepharospasm (25), cervical dystonia (25), headache (26), tremors (27), spasticity (post-stroke spasticity, spasticity in Cerebral palsy), and even plantar fasciitis (28). Most orthopaedic disorders that benefit from the administration of BTX-A, involve spasticity and pain (11,18-20), which is no different in our patient series. Following arthroscopic biceps tenotomy, the majority of the patients are pain free (2-10). However, a minor group of patients develop persistent and painful cramping of the biceps muscle that is resistant to conventional

conservative management. The incidence of a symptomatic Popeye sign after arthroscopic biceps tenotomy ranges from three to 38% (5,7,8,10). These muscular spasms have a negative impact on the quality of life (12).

Our case series demonstrates the value of BTX-A in the conservative management of bicipital pain and contracture after biceps tenotomy. The administration is simple, straightforward, and little invasive. No activity restriction or specific rehabilitation protocol is required following the treatment. None of the patients developed any drug-related adverse events (11,18-20).

Pain relief after BTX-A administration lasted for four to six months, which is comparable to the duration of the effect of BTX-A when administered for other indications, such as spastic muscles in cerebral palsy (19,20). Seven out of ten patients in our series preferred BTX-A administration above referral for subpectoral tenodesis, when

experiencing recurrency of the symptoms at a 6 months follow-up consultation. Repeating BTX-A administration is safe, efficient, and might even induce an ever- increasing degree of muscular atrophy at each infiltrative cycle. This reduction in bicipital muscular mass, might explain the lower demand for treatment at the six months follow-up consultation.

Surgical tenotomy of the long head of the biceps brachii elicits a decrease of the strength of elbow flexion and forearm supination from respectively eight to 16% and from eleven to 21% (29,30). BTX-A infiltration reduces strength as it causes muscle atrophy (20,31-33). Since an avulsed and contracted muscle belly has little to no effect on the mobility nor on the strength of motion, paralyzing this muscle belly will not affect either of them. The subjective sensation of a minor and transient diminution of force when exerting elbow flexion and supination, might be explained by diffusion of the injected BTX-A to the intact muscle belly of the biceps brachii and even to the brachialis muscle. When reviewing literature upon the surgical treatment options of painful bicipital cramping after tenotomy, revisionary surgery and conversion to subpectoral tenodesis of the avulsed tendon is considered a successful approach. Gregory et

al. (13) reviewed in 2012 a series of 21 patients (mean age, 46.5 years) who underwent a mini-open subpectoral biceps tenodesis for persistent bicipital pain after biceps tenotomy (one out of 21 patients) or failed tenodesis (20 out of 21 patients). Tenodesis was performed into the bicipital groove with an interference screw. The mean time from the initial biceps intervention to revisionary surgery was 19.6 months. With an average follow-up of 33.4 months, eleven out of 21 patients reported significant pain relief and functional improvement. Six patients were lost to follow-up and only one patient was not satisfied with the result. Anthony et al. (14) reported their results in 2015; eleven patients (mean age, 43.3 years) with symptomatic bicipital cramping after biceps tenotomy (six out of eleven patients) or biceps rupture (five out of eleven patients), underwent a mini-open subpectoral biceps tenodesis with interference screw. Ten patients reported an improvement of cosmetic deformity and pain was resolved in eight patients. One patient was lost to follow-up. These results are consistent with those of other studies on the clinical outcome of revision biceps tenodesis for persistent cramping pain in the biceps (34,35,36). In our study ten patients (mean age of 56 years) were treated with local intramuscular administration of BTX-A injection, for a symptomatic postoperative Popeye sign. Mean time lapse from surgery to infiltration was 317 days. We noted a patient satisfaction that was excellent in nine and good in one patient.

In contrast to BTX-A infiltration, revision biceps tenodesis is an invasive procedure and implies the necessity of a rehabilitation protocol with restriction of resisted elbow flexion for a period of six weeks after surgery (13,14,34-36).

Nevertheless, there are several limitations to our study that are worth mentioning. First, our patient group is limited and there is no control group for comparison. Data were collected in a retrospective fashion. We did not set out to do a prospective randomized controlled trial (RCT), since this would require a larger study effort and cost than available. However, it would be interesting to perform a RCT, comparing the intramuscular administration of BTX-A to an alternative placebo treatment, such as the infiltration of a similar volume of NaCl

0,9%. Second, our study did not include objective measurements of strength, only patient-reported outcomes of improvement in pain and function, which require an objectification of subjective patients (37). Third, the potential benefit of repeated BTX-A infiltrations for persisting cramping in the biceps muscle still has to be confirmed.

In conclusion, our study demonstrates a significant and promising pain reduction and functional improvement following BTX-A infiltration as treatment of painful bicipital cramping after tenotomy of the long head of the biceps muscle.

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