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## **Buford Complex in a High School Softball Player with Glenohumeral Multidirectional Instability and Cubital Tunnel Syndrome with Ulnar Nerve Subluxation**

### **Cover Page Footnote**

I would like to thank Jacob Klein (ATC, Jackson High School in Jackson, Missouri) for providing information regarding the initial presentation of symptoms of the patient, diagnoses, treatment interventions, and progression of the patient throughout the post-operative recovery process; I would like to thank Dr. Anthony McPherron (DO, MBA, Southeast Health Hospital Orthopedics and Sports Medicine in Cape Girardeau, Missouri) for providing information regarding the diagnosis, and surgical interventions performed on the patient.

# ***Buford Complex in a High School Softball Player with Glenohumeral Multidirectional Instability and Cubital Tunnel Syndrome with Ulnar Nerve Subluxation***

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**Introduction:** The glenohumeral joint serves as the attachment for the upper extremity to the axial skeleton and is both the most mobile and one of the most commonly injured articulations of the human body. The glenoid labrum, glenohumeral ligaments, and posterior capsular ligaments comprise the main connective tissue supports to the joint. Trauma to this tissue is common in overhead athletics. **Case Report:** A 15-year-old female high school softball player with no prior history of either shoulder or elbow pathologies presented with pain in the elbow of her throwing arm that progressed to her shoulder during her high school softball team's fall season. The athlete received an MRI showing the presence of a Buford complex, a normal anatomical variation of the glenoid labrum in which the anterosuperior portion of the labrum is undeveloped in conjunction with an overdeveloped cord like middle glenohumeral ligament that originates upon the superior portion of the glenoid at the same location of the base of the biceps tendon. The athlete underwent a supervised rehabilitation program and continued athletic participation until she eventually developed glenohumeral multidirectional instability and secondary cubital tunnel syndrome with associated ulnar nerve subluxation. The athlete was managed through rehabilitation until the development of the secondary pathologies which were treated surgically. **Clinical Implications for Practice:** Athletic trainers and all allied health care professionals should be aware of the Buford complex, particularly if they deal with athletes in overhead sports. The Buford should be considered a predisposing factor to glenohumeral and glenoid labrum pathologies, and proper prophylactic practices may serve to reduce the incidence of injury or reinjury to the affected shoulder in these individuals. **Key Words:** *buford complex, glenohumeral instability, softball*

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## ***INTRODUCTION***

The glenohumeral joint serves as the attachment for the upper extremity to the axial skeleton and is both the most mobile and one of the most commonly injured articulations of the human body.<sup>1</sup> The glenoid labrum, glenohumeral ligaments, and posterior capsular ligaments comprise the main connective tissue supports to the joint. The glenoid labrum is the element that is responsible for creating stability throughout the entire range of motion by forming a ring that surrounds the border of the glenoid fossa, extending laterally and engulfing the humeral head, and deepening the concave surface of the glenoid.<sup>1</sup>

Trauma to this tissue is common in overhead athletics such as baseball, softball, and volleyball, or in contact sports such as American football, basketball, and rugby.

When looking at collegiate American football players after the NFL combine, 14.9% of athletes who participated in the combine over a six year period presented with a glenoid labrum tear with 53.8% of said athletes showing evidence of prior surgical intervention.<sup>2</sup> These results are relatively low in comparison to professional rugby players where 35% of players who were retrospectively reviewed over a three year period presented with a SLAP tear of the glenoid labrum secondary to an undisclosed shoulder injury that required arthroscopic surgical intervention.<sup>3</sup>

There are several confirmed variations to the glenoid labrum with many of them affecting the anterosuperior labrum such as the anterosuperior portion of the labrum inserting directly to the glenoid rim, sublabral recesses, a detached glenoid labrum, or

an entirely undeveloped glenoid labrum as noted by Tirman et al.<sup>4</sup> Depending on the condition, the athlete may be predisposed to certain trauma to the labral tissue both acutely through the loss of stability provided by the labrum or chronically through improper arthrokinematics leading to joint stresses being amplified on the connective tissues. This may be the case in patients diagnosed with a Buford complex. The Buford complex was first introduced in the literature by Williams et al in 1994 and is characterized by an undeveloped anterosuperior glenoid labrum with a concurrent overly thickened middle glenohumeral ligament that has a cord-like appearance and inserts directly on the anterosuperior portion of the glenoid cavity at the base of the biceps tendon.<sup>5</sup> This variation is present in 1.5% of the population according to both Williams et al and Bennett et al.<sup>5-6</sup>

The odd presentations of the Buford complex would theoretically lead to a dramatic increase in pathologies developing in patients with a Buford complex. Pathologies such as luxations or subluxations, lesions to the labral tissue, and glenohumeral instability could all be conditions that those with a Buford complex are predisposed to. Without the anterosuperior portion of the labrum, improper arthrokinematics and possibly deleterious compensatory mechanisms are likely to be developed. This would lead to surrounding tissues taking on added stresses from movement. This creates several possibilities: (1) inefficiency of movement and detrimental movement patterns being engrained leading to deteriorating athletic performance, (2) acute injury most likely to the labrum resulting from both excessive loading of the joint and simultaneously less available labral tissue to handle stress, or (3) the development of chronic conditions such as multidirectional instability, chondromalacia, the development of arthritic tissue in the articulation or other general inflammatory conditions. Pathologies affecting the rotator

cuff musculature, specifically the supraspinatus tendon, may also develop such as tendonitis, or glenohumeral impingement syndrome. This could result due to its position along the anterosuperior portion of the joint which could predispose it to increased micro trauma without the presence of the anterosuperior labrum to manage stress from movement of the humeral head.

### **REVIEW OF THE LITERATURE**

One thing to note is the presence of the thickened cord-like middle glenohumeral ligament that may serve to protect the anterior shoulder capsule to a degree in place of the absent labral tissue as discussed by Ozer et al who upon their review of the literature found separate incidences of the Buford complex being negatively correlated to glenohumeral instability.<sup>7</sup> These results are echoed in further findings by the authors who analyzed 3129 patients who underwent glenohumeral arthroscopy and found that 83 patients with a Buford complex. Of these 83, only 11 presented with some form of glenohumeral instability (anterior, posterior, or multidirectional). Further, these 11 patients came from a sample size of 687 of the original 3129 patients who had instability. This means only 13.8% of those with a Buford complex had instability and 1.6% of those with instability presented with a Buford. However, there were findings of concern by the authors when they analyzed the relationships between the Buford complex and SLAP lesions as well as general labral pathologies. In respect to the Buford complex and SLAP lesions, there were 68 confirmed SLAP lesions out of the 83 patients with a Buford (81.9% of Buford's patients) while 1007 total patients out of the entire sample of 3129 had SLAP lesions (33.1% of total patients). While these two sample sizes are remarkably different, it is nonetheless a staggering increase in the percentage of patients who presented with a SLAP lesion when they also had a Buford variation. The results when comparing the relationship

between the Buford complex and general labral pathologies are similarly alarming. Out of the 83 patients with a Buford, 78 presented with a labral pathology meaning 93.9% of those with a Buford developed a labral pathology while only 1590 out of 3046 (52.2%) of those without a Buford complex were positive for a labral pathology. Both metrics comparing the Buford to SLAP lesions and labral pathologies were reported to have p-values of  $<.001$ .<sup>7</sup> These findings by Ozer et al show a dichotomy between specific labral pathologies and those that are more generalized to the entire articulation.

However, conflicting information in this respect comes from a case report by Nishinaka et al that followed a 34-year-old male company worker who had a history of recurrent posterior dislocation of the shoulder (RPDS) and a Buford complex.<sup>8</sup> The authors concluded that in their case the RPDS was due to in part to the exaggerated motion both in anterior and posterior translation likely in relation to the Buford complex and its impact on the patient's articular integrity. Even with this conclusion the authors noted that during their review of the literature there was no existing evidence found showing a relationship between the Buford complex and either glenohumeral instability or RPDS.<sup>8</sup> A case report by del Rey et al aimed to provide some insight into this relationship with a 29-year-old male recreational athlete who initially presented with reoccurring glenohumeral instability.<sup>9</sup> The authors stated that the patient had presented with a Hill-Sach lesion under MRI associated with the instability and during the arthroscopic surgery received an intraoperative diagnosis of a Buford complex. This evidence shows a relationship between the Buford complex and glenohumeral instability as no noted prior pathology was connected to the articular instability in this patient.<sup>9</sup> However, further research is required to determine whether there is a true relationship, and the lack of current evidence is resultant from the rarity of

the Buford complex in general, or if there is no meaningful relationship between the anatomical variation and glenohumeral instability.

There is further existing evidence to the relationship between the Buford complex and SLAP lesions. A retrospective review designed by Bents et al analyzed 250 shoulder arthroscopies that were performed at a single institution over a two-year period on patients who were primarily active-duty service members or academy cadets with this number being reduced to 235 cases which met the authors' inclusion criteria.<sup>10</sup> The review showed 6 cases of a Buford complex with 5 of the patients having confirmed SLAP lesions (1 Type I lesions, 3 Type II lesions, and 1 Type III lesion). Of those patients in this study that did not present with a Buford complex in their affected shoulder (229 cases) only 40 presented with a SLAP lesion. When comparing the percentages, 83% of those with a Buford had an associated SLAP lesion whereas only 17.5% of those without a Buford suffered from a SLAP lesion.<sup>10</sup> From this review of the literature, it can safely be hypothesized that a Buford complex is a condition that predisposes athletes to the SLAP lesion. However, regarding glenohumeral instability the literature is less conclusive and further evidence could help clarify what the relationship between the Buford and instability is. Therefore, the intent behind this case report was threefold: (1) to increase awareness of the Buford complex in the clinical field (2) to explore if there is a relationship between the Buford complex and glenohumeral instability and (3) greater inform the athletic training and other allied health care professions of intervention and management practices for athletes with a Buford complex, specifically those in overhead throwing sports.

### **CASE REPORT**

A 15-year-old high school female softball player with no history of shoulder or elbow pathologies began experiencing elbow pain in

her dominant arm during her high school team's fall season that progressed to shoulder pain. The progression of the pain from the elbow to the shoulder gave reason for the athlete's parents to take her to an orthopedic physician. The athlete received an MRI with a gadolinium injection a couple of weeks after her initial presentation of symptoms. This imaging showed rotator cuff tendonitis and a suspected Buford complex. The physician advised the athlete to begin a rehabilitation program focused on improving range of motion and strengthening of the shoulder musculature. The athlete was withheld from throwing for two weeks but was allowed to continue to perform batting and outfielder drills until the rehabilitation program was completed. The athlete remained pain free until she began participation for her travel team the summer following her initial presentation of symptoms. Her athletic trainer referred her to a separate orthopedic physician who ordered an EMG study. The test was unremarkable, and she was withheld from activity to avoid aggravation of symptoms and to resume her previous supervised rehabilitation program. Upon completion of the rehabilitation a few weeks later the athlete was allowed to resume full participation.

During a tournament, the athlete dove into second base and upon getting up reported intense pain in her dominant shoulder, presented with cyanotic skin and paresthesia in the ipsilateral hand and struggled to perform in the weeks following this incident. The athlete returned to her physician and a possible labral tear was found. The physician recommended a conservative treatment protocol, and the athlete was allowed to continue participation given she successfully completed a throwing program prior to her high school fall competitive season. The athlete reported no improvement in symptoms and developed paresthesia along her right extremity and upon returning to her physician received an ultrasound guided

corticosteroid injection to her shoulder. The athlete reported the injection exasperated the pain in her shoulder and received an MRI over the cervical neck, shoulder girdle, and nerve conduction study testing. The MRI showed the Buford complex that was originally seen the previous year. The nerve conduction study showed a slowing of the ulnar nerve suggesting mild ulnar neuropathy distally. The physician concluded the possible underlying neuropathology to be more severe than the trauma to the shoulder labrum. The neuropathology was identified as cubital tunnel syndrome with secondary ulnar nerve subluxation, and upon further examination it was concluded that the patient was positive for multidirectional instability rather than a labrum tear and that the multidirectional instability influenced the development of the cubital tunnel syndrome. Two procedures were scheduled: a shoulder capsular plication surgery for the glenohumeral multidirectional instability, and an ultrasound guided nerve hydro-dissection for the cubital tunnel syndrome. During the preparation for the hydro-dissection, the ulnar nerve was found to be perched on the ulna with the elbow placed in flexion and the physician decided against the procedure; the shoulder capsular plication was scheduled a few weeks later. The capsular plication surgery was performed with ulnar transposition being performed on the patient's ulnar nerve to treat the cubital tunnel syndrome and its associated ulnar nerve subluxation.

The athlete was placed in an immobilization sling for 6 weeks and began the first phase of a 4-phase rehabilitation plan as shown in Table 1. The athlete progressed through the first two phases with few issues. During the third phase of the supervised rehabilitation program the athlete was cleared to begin a throwing program. Shortly after beginning the throwing program the athlete began experiencing novel pain in external rotation in her affected shoulder. The athlete reported the pain to her physician during a check-up

and was ordered by the physician to stop the throwing program and continue her rehabilitation until she was pain free. After a few more weeks the athlete saw her physician and reported no progress with the rehab, continued pain, and additional symptoms of mental fatigue, burnout, and frustration with the rehabilitation and lack of improvement in her condition. The physician recommended a change in who the athlete was seeing for her rehabilitation and wrote a script for the athlete to begin seeing a new allied health care provider. The new rehabilitation program was focused heavily on strengthening the posterior shoulder and immediately the athlete began to see her pain in external rotation begin to diminish. Due to this reduction in pain the athlete's physician ordered her to start a throwing program. The athlete completed her rehabilitation with the new allied health care provider in 4 weeks and continued to progress through her throwing

program for another 3 weeks after rehabilitation was completed. The throwing program was structured to progress the athlete to throwing at either 135 or 150 feet based on their capabilities when healthy. However, once the athlete reached 105 feet, she began to experience soreness in her shoulder that their athletic trainer noted was nothing abnormal or excessive. Yet, the athlete decided to discontinue her throwing program once she reached this point as she had decided against any athletic participation. At this point, the athlete had been dealing with the initial symptoms and issues from her injuries, surgery, and post-operative recovery for almost 2 years which caused her to lose multiple competitive seasons. The athlete concluded that she was too far behind her peers to be able to contribute in games and decided to not continue playing softball, the athlete's only form of sports participation. Overall, the athlete had completed all their

	Begin Date	End Date	Focus of Treatment	Exercise Catalogue	Exercise Volume
Phase 1	Immediately post-op	6 weeks post-op	Increase Grip Strength Swelling Reduction Increase ROM	Putty Squeezes Normatec Gravity Assisted Shoulder Dangles	Done as Tolerated
Phase 2	6 weeks post-op	20 weeks post-op	Increase ROM Shoulder Strengthening Elbow Strengthening Wrist Strengthening Increase Grip Strength	Wand Press Shoulder Flexion Serratus Punches Supine Triceps Extension Prone Rows Prone Shoulder Extension Prone Shoulder Horizontal Abduction Bicep Curls Wrist Curls Wrist Extension Curls <u>Supination and Pronation</u>	3x10 with 1 sec Iso
				Isometric Shoulder Flexion Isometric Shoulder Extension Isometric Shoulder Abduction Isometric Shoulder IR Isometric Shoulder ER Putty Pinch and Pull Putty Grip	1x10 with 10 second Iso 1x2 with 3-minute Hold
Phase 3	20 weeks post-op	28 weeks post-op	Passive ROM Stabilization Shoulder Strengthening Dynamic Scapular Stabilization Upper Body Plyometrics	PROM-Shoulder Rhythmic Stabilization	10 min
				Upper Body Ergometer Bench Press with Stick Flexion with Stick SC Pull Downs SC Pullovers SC Rows SC Adduction SC Flexion SC Extension SC D1 Flexion SC D2 Extension SC Pull Aparts Ball on Wall Flexion	6 min 3x10 30x
Phase 4*	28 weeks post-op	32 weeks post-op	Posterior Shoulder Strengthening Upper Body Plyometrics	Ball on Wall Circles for Stabilization	3 min
				Banded ER & Scapular Retraction Side Lying ER with towel Wall Serratus Push Up Plus Standing Horizontal Abduction and ER Weighted Ball Drop Perturbations AROM Shoulder Abduction Side-Lying Side Throws Opposite Shoulder Taps Self-Toss with Weighted Ball	2 sets until muscular failure 2x20 3x10 2x15 1x1 w/ 1 sec Iso 10x3 2x10-15
*Indicates change to new allied health care professional for rehabilitative services					
ROM = Range of Motion; Iso = Isometric Contraction; IR = Internal Rotation; ER = External Rotation; PROM = Passive Range of Motion; AROM = Active Range of Motion; SC = Straight Cane					

rehabilitation, completed approximately 75% of their throwing program, and outside of soreness related to the throwing program had no signs, symptoms, or issues with daily activities.

### **DISCUSSION**

There is no known existing evidence of treatment of a Buford complex in athletes of this age group or about an athlete dealing with several pathologies and presenting with a Buford complex in the ipsilateral shoulder. Of the available literature, there appears to be a rather strong relationship between the presence of a Buford complex and pathologies affecting the glenohumeral articulation and in particular the glenoid labrum. Pathologies such as the SLAP lesion have a remarkable correlation to individuals with a Buford complex and the presence of a Buford variation should be considered a predisposing factor specifically for the SLAP lesion and possibly other types of labral lesions as further evidence emerges. One pathology of note is glenohumeral instability due to the conflicting nature of its relationship to the Buford in the literature. However, based on the available case reports demonstrating a relationship between the Buford and glenohumeral instability and the details in this case report, it is the opinion of this author that the Buford complex may predispose athletes in overhead athletics to developing glenohumeral instability and should be considered as such. The athlete faced almost 2 years worth of rehabilitation, imaging, surgery, and post-operative rehabilitation. This prolonged period of treatment led to the loss of 2 seasons for the athlete with their high school team and they were faced with the prospect of having to play down in competition if they were to continue playing. This combined with the mental fatigue and exhaustion they dealt with from the recovery process caused the athlete to lose their desire for sports participation entirely. More appropriate or timely measures of treatment may have kept the athlete from their lengthy

recovery timeline and consequently being robbed of their desire for sports participation and their competitive career.

### **CLINICAL IMPLICATIONS FOR PRACTICE**

In summary, the Buford complex is a variation of the glenoid labrum that should be considered a factor that predisposes athletes to developing SLAP lesions, other general labral pathologies, and possibly glenohumeral instability. Appropriate treatment of the Buford should include thorough prophylactic treatment protocols to ensure athletes with a Buford complex have a heightened degree of strength and dynamic stability of the affected shoulder. Should an athletic trainer have an athlete with a Buford develop a pathology in that shoulder, they should not solely focus on the pathology during the rehabilitation of their athlete but include proper protocols to address the lack of stability of the articulation because of their Buford variation to reduce the risk of subsequent or recurring pathologies developing in the affected articulation.

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