A SHOULDER INJURY PREVENTION MANUAL FOR YOUTH BASEBALL ATHLETES

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PROJECT

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A SHOULDER INJURY PREVENTION MANUAL FOR YOUTH BASEBALL ATHLETES

A Project

by

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Department of Kinesiology
Abstract

of

A SHOULDER INJURY PREVENTION MANUAL FOR YOUTH BASEBALL ATHLETES

by

Joshua James Severin

Statement of Problem

The purpose of this project is to provide an injury prevention manual for youth baseball athletes and their coaches. The manual will provide knowledge about shoulder injuries, shoulder anatomy, injury prevention exercises and additional resources for further education.

Sources of Data

The sources of material for this project include journal articles, books, web sites and interviews with coaches.

Conclusions Reached

Many youth baseball athletes and coaches face several issues that stress the need to develop an injury prevention program. Playing year round has increased the demand on the youth athlete, which increases the demand for knowledge about injury prevention. A basic understanding of the shoulder is needed in order to build the foundation for developing a program to maintain a healthy shoulder.
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Chapter 1
INTRODUCTION

The shoulder is a complex joint offering the most freedom of movement of any other joint in the body. The three bones of the shoulder are the humerus, scapula, and clavicle. The shoulder contains four separate joints called the glenohumeral, acromioclavicular, sternoclavicular, and the scapulothoracic. The primary movers of the shoulder are the trapezius, pectoralis major, latissimus dorsi, and the anterior, lateral, and posterior deltoid. The stabilizer muscles consist of the levator scapula, rhomboids, serratus anterior, pectoralis minor, teres minor and major, supraspinatus, infraspinatus, and subscapularis. Downar and Sauers (2005) have shown that overhead athletes can produce in excess of 5000 degrees per second of velocity at the shoulder when participating in their sport. There are also predisposing factors that can potentially increase the risk of shoulder injury. Having a hooked acromion can decrease the space between itself and the humeral head potentially causing shoulder impingement problems. An athlete with abnormal shoulder laxity, whether it is excessive or insufficient, can cause the stabilizer muscles of the shoulder to have difficulty providing proper stability. Throwing is an unnatural act raising the hand above the shoulder causes the humeral head to elevate into the acromion compressing the rotator cuff muscles. Throwing causes the shoulder to reach maximal external and internal rotation while generating peak power of the shoulder stabilizers. Also, throwing causes the shoulder musculature to generate deceleration forces in order to control and keep stability at the glenohumeral joint. This
extreme measure of velocity combined with predisposing factors and the un-natural act of throwing can lead to acute and chronic injuries to the shoulder.

In order for the shoulder to function properly, a balance of mobility and stability must be achieved. Veeger and Van der Helm (2007) suggest that optimizing shoulder range of motion while maintaining control of the glenohumeral joint are key to an injury free shoulder. Precise control of the throwing arm allows for the shoulder to move from maximal external rotation to ball release in fewer than 50 milliseconds (Escamilla & Andrews, 2009). Previous research has shown that the scapula must elevate and rotate appropriately with humeral elevation in order to facilitate sufficient length tension relationships in the muscles responsible for proper shoulder stabilization and deceleration (Borsa, Timmons, & Sauers, 2003). Retaining the proper length tension relationship is important because if the muscle is over lengthened or to relaxed, the muscle cannot develop its maximum effort in order to stabilize the shoulder (Haffajee, Moritz, & Svantesson, 1972).

Myers, Pasquale, Laudner, Sell, Bradley, & Lephart (2005) discuss several strategies needed in order to prevent shoulder injuries. These strategies include: adherence to a safe pitch count, modification of faulty pitching mechanics, long-toss programs, maintenance of range of motion and flexibility, progressive resistance exercises to facilitate strength and endurance of the dynamic stabilizers, and proper warm-up. Finding ways to improve shoulder mobility while achieving maximum shoulder stability is necessary for the health of the athlete.
Baseball players are subject to an immense amount of overhead activity from the moment they play on their first team. Compounding this problem is the fact that most of these players are taught by coaches who may have a limited knowledge of current literature and strategies for injury prevention. In addition, there are no requirements for coaches to acquire continued education to keep updated with the latest research and developments for shoulder injury prevention. This limited knowledge can be detrimental to youth athletes immediately or at least set the stage for problems in the future. Youth athletes are defined as any athlete 18 years of age or younger. Moreover, in warmer weather, the creation of summer leagues, all-star squads and travel teams, some athletes are expected to play year around. Gone are the days where a baseball athlete would have the winter or summer off to give rest to their shoulder. Lyman, Fleisig, Andrews, & Osinski (2002) suggest that many of the pitching injuries that receive medical attention at higher competition levels result from cumulative microtrauma that began at the youth level. Also, 32% of youth athletes reported some form of shoulder pain during the season (Lyman, Fleisig, Waterbor, Funkhouser, Pulley, Andrews, Osinski, & Roseman, 2001). Lastly, the bones, joints and muscles of the youth athlete are continually growing and changing until full maturity is reached. Asking the youth baseball athlete to put the stresses of throwing on their shoulders while they are still developing could be another potential reason for such high incidences of shoulder pain. These observations call for an increase in knowledge and accessible information to strengthen the shoulder of the year round baseball athlete.
Purpose of the Study

The purpose of this study is to develop a shoulder injury prevention manual for youth baseball athletes and coaches. The manual is designed to increase youth baseball players and their coaches education about basic shoulder injuries, shoulder anatomy, shoulder exercises, shoulder stretches, example warm-up routines, throwing protocols, and provide additional resources.

Significance

Several other manuals have been developed in order to provide techniques for baseball athletes and coaches to use in order to gain some form of performance enhancement for the shoulder. This manual addresses the need for an increase in education, for youth baseball athletes and coaches, about the shoulder and the use of injury prevention techniques.
Chapter 2

REVIEW OF LITERATURE

McLeod & Andrews (1986) describe the glenoid fossa as shaped like a shallow dish having a greater radius of curvature than the humeral head. This unique design allows the humeral head to translate across the surface of the glenoid fossa in addition to rotational motion. This linear movement, not found at the hip ball and socket joint, allows for greater freedom of movement but comes at a price. Increased translation can allow the humeral head to shift superiorly causing impingement of the rotator cuff muscles. Excessive movement of the humeral head can cause improper length tension relationships with the rotator cuff muscles increasing the risk for a muscular strain. Also, greater translation of the humeral head across the labrum causes shearing forces and makes the labrum more susceptible to tears.

A review of McLeod and Andrews’ patients’ records indicated 297 athletes who were treated arthroscopically for shoulder problems and of these, 178 of the injuries were related to baseball. Throwing has been shown to produce the most consistent rotator cuff tears with and without other associated pathological conditions. With the baseball athlete’s ability to accelerate a baseball from 0 to 90 miles per hour in 50 to 80 milliseconds, any muscular imbalance between the stabilizers of the shoulder will allow articulation of the humeral head with the glenoid labrum rather than with the center of the glenoid fossa. If the humeral head makes contact with the labrum repeatedly, micro-tears within the labrum begin to develop and can lead to a full labral lesion which may need
surgery to repair. Rotator cuff muscles without proper length tension relationships and appropriate muscular balance can cause glenohumeral distraction, where the humeral head moves away from its proper seating in the glenoid fossa, because the stabilizing muscles are not working in sync in order to keep the humeral head centered. This off-centering of the humeral head during the throwing motion will cause it to be seated off-center, placing the labrum at a higher risk for injury.

Deceleration forces are generated by the posterior shoulder musculature during throwing after the ball is released from the hand. These deceleration forces are needed in order to slow down and stabilize the shoulder to prevent injury. McLeod and Andrews propose that these deceleration forces in baseball athletes are the mechanism underlying rotator cuff tears. The researchers justify their findings by comparing baseball players' injuries with athletes from a sport that does not involve the deceleration of the rotator cuff muscles. For example, swimming is almost devoid of deceleration forces, and the surgical records cited earlier show no rotator cuff tears in swimming athletes who were injured in their sport.

McLeod and Andrews noted a correlation between pitchers who had surgery and the length of time they competed throughout the year. Pitchers who had surgery averaged eight months of competitive pitching per year, compared to five and a half months in the control group. Also discussed were the negative effects that a showcase might have on a baseball pitcher. Showcases allow pitchers the opportunity to show their talent to college recruiters and professional scouts. However, these showcases can put unneeded physical stresses on athletes who often throw harder than they should in order
to impress the scouts. Furthermore, showcases are often held out of season when athletes are not physically prepared or do not have the endurance to give full effort.

Downar & Sauers (2005) studied the clinical measures of shoulder mobility in professional baseball players. The goals of the study were: to determine if differences exist in mobility between the throwing and non-throwing shoulder; and whether a strong correlation existed between selected measures of scapular mobility and measures of glenohumeral joint mobility. The specific measurements taken were scapular upward rotation, posterior shoulder tightness, and passive isolated glenohumeral joint internal/external rotation. The results showed a statistically significant increase in scapular upward rotation between the throwing and non-throwing shoulder at 90° of humeral elevation. No differences in posterior shoulder tightness were noted bilaterally. In addition, the throwing shoulder showed a decrease in passive internal range of motion with an increase in passive external range of motion. Reinold, Wilk, Macrina, Sheheane, Dun Fleisig, Crenshaw, & Andrews (2008) also demonstrated that range of motion at the shoulder continued to be reduced 24 hours after pitching while other researchers have documented changes in motion patterns of the upper extremities for up to four days which may be partially explained by eccentric contractions causing muscle damage leading to soft-tissue musculotendinous adaptations.

Lintner, Mayol, Uzodinma, Jones, & Labossiere (2007) collected data showing the efficacy of an internal rotation stretching program. Professional pitchers who have undergone three or more years of an internal rotation stretching program had a significantly greater average internal rotation and total range of motion for the dominant
arm compared with the group who did not perform an internal rotation stretching program. The authors concluded that internal rotation loss is neither permanent nor caused only by bony adaptations which have been previously proposed (Lintner et al., 2007). In fact, the dominant arm of a baseball player is expected to undergo soft tissue and bony adaptations making it asymmetric with the other side. However, with appropriate stretching techniques the effects of soft tissue and bony adaptations can be controlled.

The scapulothoracic joint is one of the least congruent joints in the body. Between the scapula and thorax, no actual bony articulation exists. This lack of articulation allows for tremendous mobility in retraction, protraction, depression, elevation, and rotation. Voight & Thomson (2000) suggest the lack of bony attachment predisposes this joint to pathologic movement and consequently makes the glenohumeral joint highly dependent on the musculature stabilizing the scapula for proper motion. The authors also propose that the main role of the scapula is maintenance of dynamic stability and controlled mobility at the glenohumeral joint. The scapula must perform several actions during the throwing motion. Escamilla and Andrews (2009) describe the throwing motion in three phases, arm cocking phase, arm acceleration phase, and arm deceleration phase. During the arm cocking phase, the arm is drawn posterior and superior to the shoulder and ends at maximum shoulder external rotation. The arm acceleration phase begins at maximum shoulder external rotation and ends at ball release. The arm deceleration phase begins at ball release and ends at maximum shoulder internal rotation. During the arm cocking phase, the scapula correctly positions and stabilizes itself in order to develop the proper
length tension relationships before the glenohumeral internal rotators develop their peak force. Through the acceleration phase, the scapula protracts around the thoracic wall in order to maintain proper length tension relationships with the glenohumeral internal and external musculature. At the same time, upward rotation and elevation of the scapula are required in order to tilt the acromion upward in order to decrease the chance of impingement. Finally, the scapula must resist over protraction, upward rotation, and elevation in order to assist with resisting shoulder distraction and anterior subluxation forces generated by the acceleration phase.

Cools, Witvrouw, Mahiew, & Danneels (2005) wanted to examine whether or not overhead athletes with impingement problems displayed different scapulothoracic muscle force output and balance when compared with a healthy control group active in overhead sports. Patients placed in the impingement group had to meet two of the following five criteria: positive Neer sign, positive Hawkins sign, positive Jobe sign, pain with apprehension, and positive relocation test. Protraction and retraction strength tests were performed bilaterally on all of the subjects using a Biodex isokinetic dynamometer. Five repetitions were performed at 60 degrees/second and ten repetitions at 180 degrees/second in the concentric-concentric mode. The impingement group demonstrated a statistically significant decrease in peak protraction force on the injured shoulder at both velocities. The authors questioned whether the peak power difference in the injured shoulder caused the impingement problem or if an adaptation of the shoulder to the repetitiveness of the overhead movements is to blame. Either way, the data concluded a serratus anterior muscular imbalance with the subjects who had impingement.
injuries. With a deficient serratus anterior muscle, the scapula cannot appropriately protract around the thoracic wall maintaining proper length tension relationships with the rotator cuff muscles. These findings support the hypothesis that shoulder impingement is related to scapulothoracic muscle dysfunction.

Moseley, Jobe, Pink, Perry, & Tibone (1992) concluded that most abnormal biomechanics and physiology that occur in sports related shoulder injuries arise from dysfunction of the muscles that stabilize the scapula. Wilk, Meister & Andrews (2002) have shown that an anteriorly tilted scapula contributes to subacromial impingement. The authors have also noted scapular position abnormalities in overhead throwers correlate to pectoralis minor muscle tightness and lower trapezius weakness. These dysfunctions can lead to axillary artery occlusion and neurovascular symptoms such as arm fatigue, pain, and tenderness. An improperly stabilized and positioned scapula decreases the maximum force that can be transferred to the hand. This deficiency creates a situation in which the athlete tries to compensate for the loss of force by making the distal links work at higher velocities than normal. This increase in force production at the distal links can be detrimental to the shoulder musculature because they do not have the size, cross-sectional area, or time in which to efficiently develop the larger forces normally generated at and transferred from the trunk and lower extremities (Kibler 1998). The authors’ show that the kinetic energy delivered by the hip and trunk to the arm decreases by 20%, resulting in an 80% increase in shoulder mass or a 34% increase in rotational velocity at the shoulder in order to deliver the same amount of resultant force to the hand. The previous studies support McMullen & Uhl’s (2000) hypothesis that
scapular motion provides optimal muscle length-tension ratios while reducing energy requirements of the rotator cuff during throwing. Scapular mobility and stability mediates the demand on the rotator cuff, promotes conservation in the upper extremity, and aids in glenohumeral stability.

Fatigue also has been thought to play an important role in shoulder injury pathology. Myers, Guskiewicz, Schneider, & Prentice (1999) reported that fatigue decreased proprioception of the shoulder, as measured through joint position-sense assessment. Because fatigue may hinder proprioceptive feedback from the shoulder to the central nervous system, joint injury could result due to altered control of glenohumeral joint stability. Tripp, Yochem, & Uhl (2007) also observed decreased accuracy and increased variability in the shoulder during multiple planes of motion after fatigue of the shoulder. Both Tripp et al. (2007) and Myers et al. (1999) agree that clinicians should incorporate into their rehabilitative or preventative programs multiplanar endurance training exercises for the dynamic stabilizers of the glenohumeral joint which include the levator scapula, rhomboids, serratus anterior, pectoralis minor, teres minor and major, supraspinatus, infraspinatus and the subscapularis. Likewise, Wilk, Meister, & Andrews (2002) state that a proper balance between agonist and antagonist muscle groups are thought to provide dynamic stabilization to the shoulder joint. External rotator cuff muscles should be at least 65% as strong as the internal rotator cuff muscles.

Amateur baseball athletes demonstrate differential shoulder activation patterns while throwing a baseball when compared to their professionals. Gowan, Jobe, Tibone,
Perry, & Moynes (1987) conducted a comparative electromyographic analysis of the shoulder between professional and amateur pitchers. Subscapularis activity was nearly twice as great in professional pitchers. Inversely, the pectoralis major, supraspinatus, serratus anterior, and biceps brachii muscle activity was 50% greater in amateur pitchers. Also, rotator cuff and biceps brachii activity were two to three times higher in amateur pitchers during the deceleration phase. These data suggest that professional pitchers utilize better mechanics from the lower extremities to transfer more energy to the more distal appendage in order to reduce the amount of muscular activity needed to accelerate and decelerate the throwing arm. This may also explain why professional pitchers generate less rotator cuff and biceps brachii activity, muscles that help resist glenohumeral joint distraction and enhance stability. The increased activity of the biceps brachii in amateur pitchers is concerning because of its origin at the superior aspect of the glenoid labrum. Repeated excessive stress from the biceps brachii to its origin in the labrum may result in superior labral pathologies.

Today, many baseball athletes are told to “warm up” their shoulder prior to throwing in order to help prevent injuries. This can leave these athletes with several questions about what exactly does a “warm up” consist of. To help answer these questions Myers, Pasquale, Laudner, Sell, Bradley, & Lephart (2005) studied 12 different tubing exercises through electromyographic analysis. Wires were intramuscularly inserted into the subscapularis, supraspinatus, teres minor, and rhomboid muscles. Surface electrodes were placed over the pectoralis major, anterior deltoid, middle deltoid, latissimus dorsi, serratus anterior, biceps brachii, triceps brachii, lower
trapezius, and infraspinatus. Electromyographical (EMG) analysis indicated that a minimum of seven specific exercise were required to produce at least moderate activation of all muscles needed for proper shoulder function in the overhead athlete. These seven exercises included: shoulder extension, shoulder flexion, throwing acceleration, throwing deceleration, external rotation at $90^\circ$ of abduction, scapular punches, and either high or low scapular rows.

Hintermeister, Lange, Schultheis, Bey, & Hawkins (1998) used EMG to show which elastic resistance exercises produced the greatest muscle activation in certain shoulder muscles. Their findings concluded that the shrug was the most effective exercise because it elicited the highest activity from the subscapularis, trapezius, and latissimus dorsi muscles. Also, the supraspinatus, infraspinatus, and serratus anterior muscles were stimulated during the shrug exercises. Scapular retraction caused peak muscle activity in the subscapularis. External rotation elicited the most muscle activation from the infraspinatus; narrow and middle-grip seated rowing exercises actually elicited greater peak activity from the subscapularis muscle than a solitary internal rotation exercise; and the forward punch elicited the greatest activity from the supraspinatus, serratus anterior, and anterior deltoid muscles, in addition to stimulating the pectoralis major and infraspinatus muscles as well.

Niederbracht, Shim, Sloniger, Paternostro-Bayles, & Short (2008) noted that previous strength training studies have not shown a reduction in the muscular imbalance of the glenohumeral joint between internal and external rotational forces. Furthermore, current shoulder strength training programs that do not address the issue of muscular
imbalances of the shoulder may not effectively reduce the risk for shoulder injury. Niederbracht et. al. showed increased eccentric external total work with the use of a resistance training program versus the control group. The resistance training program helped reduce the muscular imbalance between the rotator cuffs concentric internal total work and eccentric external total work. The reduction in shoulder rotator cuff muscle imbalances may potentially reduce the risk for shoulder injuries.

Richards & Dawson (2009) examined the effect of using multidirectional movement arcs instead of traditional linear movements with elastic band resistance. The subjects’ shoulder strength with flexion and abduction were tested prior to the six week resistance training program in order to compare gains, if any, between multidirectional and conventional resistance exercises. Although the trend of improvement of shoulder strength with multidirectional resistance was not found to be statistically significant, the study warrants further research to investigate whether or not resistive multidirectional movement arcs exercises can be more effective than conventional strength training programs.

Treiber, Lott, Duncan, Slavens, & Davis (1998) combined lightweight dumbbell training exercises with elastic tubing exercises in order to determine if an isotonic resistance training program could increase rotator cuff strength. The data indicated significant increases in internal and external peak torque of the rotator cuff musculature with the experimental group versus the control. Prokopy, Ingersoll, Nordenschild, Katch, Gaesser, & Weltman (2008) described how throwing is an open kinetic chain movement, but some upper extremity resistance exercises are done in a closed kinetic chain fashion.
The purpose of the Prokopy et. al. study was to determine the efficacy of closed kinetic chain resistance training (CKCRT) versus open kinetic chain resistance training (OKCRT). Both groups showed equal increases in strength, while CKCRT showed significant increases in shoulder torque and power compared to the subjects who were in the OKCRT program.

The aforementioned literature describes the complexity and uniqueness of the shoulder, establishing what it takes for the shoulder to function properly in order to reduce the chances of injury. Research has shown that youth baseball shoulder injuries are still prevalent even with determinants in place such as per game pitch counts and limiting the types of pitches thrown. The recent literature has started to establish the importance of the scapula and discern why shoulder injuries occur and what can be done to help prevent them. Several studies show the benefits of developing tubing or weight exercises in order to gain strength and improve endurance of shoulder musculature. This research has shown the need to move away from the overload of performance enhancing manuals and an increase in educational and injury preventative manuals.
Chapter 3

METHODOLOGY

This manual will provide a comprehensive look at the shoulder in regards to the throwing activities of the baseball athlete and has been developed for use by youth athletes as well as those who work closely with their education, training, and coaching. Because baseball players are being asked to play year round to refine their skill at such young ages, coaches now carry a greater responsibility to produce healthy athletes. This project was designed to increase knowledge on shoulder anatomy, shoulder injuries, shoulder exercises, shoulder stretches, proper warm-up, throwing protocols, and to provide additional sources of information for youth baseball players and their coaches. The manual will also include pictures depicting shoulder anatomy, shoulder exercises and stretches.

The following is an outline of major sections included within this shoulder manual.

I. Introduction
   a. What separates this manual from previous manuals
   b. Material not covered within manual
      i. Endurance training
      ii. Lower or upper body plyometrics
      iii. Lower or upper body strength training
      iv. Pitching/throwing mechanics
   c. Disclaimer
II. Shoulder Injuries
   a. Acute
      i. Rotator cuff tear/strain
      ii. Other muscle strains
      iii. Joint sprains
   b. Chronic
      i. Labral tears
      ii. Instability/Subluxation
      iii. Tendonitis

III. Shoulder Anatomy
   a. Bones of the shoulder
      i. Humerus
      ii. Scapula
      iii. Clavicle
   b. Shoulder joints
      i. Gleno-humeral
      ii. Acromio-clavicular
      iii. Scapulo-thoracic
   c. Shoulder musculature
      i. Primary movers
         1. Latissimus dorsi
         2. Trapezius
3. Pectoralis major
4. Anterior, lateral, posterior deltoid

ii. Stabilizers
   1. Pectoralis minor
   2. Supraspinatus
   3. Infraspinatus
   4. Subscapularis
   5. Teres minor
   6. Teres major
   7. Levator scapula
   8. Rhomboids
   9. Serratus anterior

IV. Preventative Exercises

   a. Shoulder exercises with resistance tubing
      
      i. Flexion
      ii. Extension
      iii. Abduction
      iv. Adduction
      v. Flys
      vi. Reverse flys with scapular retraction
      vii. Internal rotation
      viii. External rotation
ix. 90° of abduction internal rotation
x. 90° of abduction external rotation
xi. Shoulder shrugs
xii. Empty can
xiii. Full can
xiv. Drawing the sword
xv. Pitching motion
xvi. Reverse pitching motion
xvii. High pulls
xviii. High row pulls
xix. Low row pulls
xx. Scapular punches
xxi. Scapular retraction
xxii. Reverse fencing

b. Shoulder exercises with hand weights
   i. Flexion
   ii. Extension
   iii. Abduction
   iv. Flys
   v. Reverse flys with scapular retraction
   vi. Internal rotation
   vii. External rotation
viii. 90° of abduction internal rotation
ix. 90° of abduction external rotation
x. Shoulder shrugs
xi. Empty can
xii. Full can
xiii. Drawing the sword
xiv. High pulls
xv. Bent over high row pulls
xvi. Bent over low row pulls
xvii. Scapular punches
xviii. Scapular retraction

c. Shoulder stretching techniques
   i. Vertical with assistance
   ii. 135° with assistance
   iii. 90° with assistance
   iv. Follow through with assistance
   v. External rotation with assistance
   vi. Internal rotation
   vii. Cross-arm
   viii. Overhead bent arm
   ix. Shoulder twists
   x. Bent over shoulder twists
d. Example warm-up routines
   i. Kyle Yamashiro’s Two Out Drill
   ii. Myers et. al. (2005)

V. Additional Resources
   a. Shoulder injuries
   b. Shoulder anatomy
   c. Shoulder exercises
   d. Additional information not included within this manual
Chapter 4

SHOULDER INJURY PREVENTION MANUAL

Chapter 4.1. Introduction

Previous shoulder manuals have focused primarily on developmental outcomes such as power and velocity of the shoulder while other manuals focus on throwing or pitching mechanics in order to develop greater ball velocity and movement. This manual will focus on educating youth baseball athletes and coaches about the shoulder and injury prevention through the use of shoulder exercises, stretches, warm-up routines, and throwing protocols. This manual will not cover endurance training, lower/upper body plyometrics, lower/upper body strength and power training, and pitching mechanics. Although these exercises can be beneficial for injury prevention, the author thought the message of injury prevention would be lost if they were included because of an overload of information and having the reader become more focused on performance enhancement.

Even though the exercises, throwing protocols, and warm-up routines are of light to moderate activity, if any pain is felt in the shoulder or discomfort stop immediately and consult a physician. Also, following these exercises, throwing protocols, and warm-up routines do not guarantee to eliminate the risk of shoulder injury, but instead these exercises were meant to help build a solid foundation and decrease the likelihood of sustaining a shoulder injury.
Chapter 4.2. Shoulder Injuries

*Acute*

A strain is a tearing of the muscle or tendon that can range from very small, which is considered first degree, to complete tears of the muscle or tendon which are considered third degree strains. Rotator cuff muscles (supraspinatus, infraspinatus, subscapularis, teres minor) are the most consistently diagnosed muscular strain injuries among baseball athletes (McLeod & Andrews 1986). There are two main reasons why rotator cuffs strains are so frequent. One, the rotator cuff muscles are very small in actual size, yet they try to generate and slow down the tremendous force throwing applies to the shoulder. Secondly, rotator cuff strains occur as a secondary injury (Prentice, 2004). Meaning, another structure involved in throwing is injured which causes the shoulder to overcompensate and in turn will cause repeated stresses to the rotator cuff eventually giving way to a rotator cuff strain.

Strains of the primary movers (trapezius, anterior/lateral/posterior deltoid, pectoralis major, latissimus dorsi) and other stabilizers (levator scapula, rhomboids, serratus anterior, pectoralis minor, teres major) are less common because the stresses of throwing do not affect these muscles as greatly as the rotator cuff muscles and do not succumb to secondary injury as easily as the rotator cuff muscles.

A sprain is the tearing of a ligament that can range from very small, which is considered first degree, to complete tears of the ligament which are considered third degree sprains. The most commonly sprained ligament is the acromioclavicular (AC) ligament which compromises the AC joint (Prentice, 2004). This is a sprain of the
ligament that connects the acromion of the scapula to the clavicle or commonly known as a separated shoulder.

*Chronic*

The shoulder labrum contributes to shoulder stability by increasing the joint surface and providing attachments for various ligaments and tendons (Richards 1999). These factors make the shoulder labrum susceptible to tears because of the movement of the humeral head during the throwing motion and the constant pull on the labrum from the attached ligaments and tendons. In order for a labral tear to heal, surgery is required, but appropriate physical therapy and rehabilitation instead of surgery can eliminate associated shoulder pain and return the athlete to play (Richards 1999). Accordingly, any decision on labral treatment should be discussed with the appropriate physician.

Instability of the shoulder is an inherent risk because of having the greatest range of motion of any joint in the body. Throwing generates forces that can exceed the restraints of the shoulder (Prentice 2004). When throwing, through constant repetitive motion, causes repeated trauma to the structures that hold the shoulder in place. These repetitive traumas eventually will cause instability of the shoulder. Subluxation occurs when the humeral head excessively translates from the joint without complete separation of the joint surfaces and returns quickly to its normal position (Arnheim & Prentice 1997).

Tendonitis is inflammation or swelling of a particular tendon. Rotator cuff tendonitis, is the most common form of tendonitis in the shoulder (Prentice 2004). Tendonitis can occur because of overuse of the shoulder, compression from another
structure causing repeated micro-trauma, and as a secondary issue from overcompensating for another injured structure in the shoulder.

Chapter 4.3. Shoulder Anatomy

Bones of the shoulder

The bones of youth athletes differ from their adult counterparts. Bone mineral content, size and density are constantly changing through adolescents, especially during puberty. Epiphyseal plates, or growth plates, are located at the ends of a bone. This is where the bone elongates during growth. This is important with youth athletes because a growth palate is located on the humerus where several ligaments and tendons attach. The high incidence of shoulder pain with youth athletes may be related to the stresses throwing causes on the shoulder combined with their constantly changing shoulder anatomy.

The bones that make up the shoulder complex are the clavicle, humerus, and scapula. The clavicle is an S shaped bone that supports the anterior portion of the shoulder. The clavicle extends from the sternum to the acromion process of the scapula. The humerus is the bone in the upper arm that articulates with the glenoid fossa of the scapula. The humerus connects the distal link of the hand to the shoulder complex. The scapula is a flat, triangle shaped bone located on the posterior side of the thoracic wall. Figure 1 depicts all three bones of the shoulder. It must be noted that the following depictures of shoulder anatomy are of adult structures. Youth bones, joints, and musculature may vary slightly.
Shoulder joints

The shoulder consists of four articulations: the sternoclavicular, acromioclavicular, glenohumeral, and the scapulothoracic joints. This manual will only cover the latter three joints. The AC joint, the point on the shoulder, is where the distal end of the clavicle articulates with the acromion process of the scapula. The glenohumeral, or ball-and-socket, joint is where the round head of the humerus articulates with the glenoid fossa of the scapula. The scapulothoracic joint consists of the scapula and the thoracic wall. This is not considered a true joint because there are no bony attachments from the thoracic wall to the scapula, only muscle holds the scapula in place. Refer to Figure 2 for the AC and glenohumeral joints, while Figure 3 shows a picture of the scapulothoracic joint.
http://www.eorthopod.com/content/shoulder-anatomy

Figure 2. The glenohumeral and acromioclavicular joints.
Figure 3. The scapulothoracic joint.

Shoulder musculature

i) primary movers

The primary movers of the shoulder consist of six muscles, the trapezius and latissimus dorsi (Figure 4), the pectoralis major (Figure 5), and the anterior, lateral, and posterior deltoid (Figure 6). The trapezius helps with scapular rotation, retraction, elevation and depression. The latissimus dorsi and pectoralis major adduct and internally rotate the humerus. The anterior deltoid performs shoulder flexion, the lateral deltoid abducts the shoulder, and the posterior deltoid performs extension of the shoulder.
Figure 4. The latissimus dorsi and trapezius muscles.
Figure 5. The pectoralis major muscle.

Figure 6. The anterior, lateral, and posterior deltoid muscles.
**ii). stabilizers**

The shoulder stabilizers consist of nine muscles the pectoralis minor (Figure 7) supraspinatus, infraspinatus, subscapularis, teres minor (Figure 8), and the teres major, levator scapula, rhomboids, and serratus anterior (Figure 9). The pectoralis minor stabilizers the scapula by drawing the scapula inferior and anteriorly against the thoracic wall. The supraspinatus assists with shoulder abduction and stabilizes the humerus. The infraspinatus and teres minor both help with shoulder adduction, external rotation, and shoulder stability. The subscapularis and teres major assist with shoulder adduction and internal rotation. The levator scapula elevates and stabilizers the scapula while the rhomboids provide scapular retraction and stabilization. The serratus anterior provides scapular stabilization and protraction.

http://www.betterlifefitnesssolutions.com/NewFolder/Pectoralis%20Minor.png

Figure 7. The pectoralis minor muscle.
Figure 8. The rotator cuff muscles.
4.4. Preventative Exercises

*Shoulder exercises with resistance tubing*

The following pages (35 - 56) describe and depict 22 shoulder exercises using resistance tubing. Athletes should begin with 2 sets of 10 repetitions and light resistance when attempting an exercise for the first time. After the athlete develops proper technique and becomes accustomed to the exercise, intensity, resistance, and repetitions can gradually be increased.
The following exercises were selected in order to create activity in multiple planes of shoulder motion while activating all shoulder musculature using resistance tubing. The exercises cover all aspects of shoulder injury prevention, developing muscular strength in all ranges of motion and during the arm cocking, acceleration, and cocking phase, while developing glenohumeral and scapulothoracic stability and improving muscular function that controls arm deceleration.

McLeod and Andrews (1986) discuss the importance of stability of the humeral head. If the head of the humerus moves excessively within the joint, it could cause trauma to the labrum and eventual tearing. Glenohumeral stability is controlled by the deltoid and rotator cuff musculature. Several exercises within this manual address movement of the humeral head by increasing endurance and strengthening the musculature that controls deceleration forces and glenohumeral stability.

Cools et al. (2005), Moseley et al. (1992), and Wilk et al. (2002) have all described how scapular function can be detrimental to the structures of the shoulder. Scapular dysfunction has been linked to impingement problems and creating improper length tension relationships with the rotator cuff muscles. Muscles that control the scapula are the levator scapula, trapezius, rhomboids and serratus anterior. The tubing exercises build strength and endurance for the muscles that control scapular stability and provide deceleration forces for the shoulder.

Resistance tubing has a few advantages over standard hand weights. Resistance tubing is not affected by gravity. The tubing can be fixed in any position and still provide resistance. Also, the further the tubing is stretched the greater the resistance. This allows
for one band to provide different amounts of resistance instead of having to have several
different hand weights. Conversely, resistance tubing can be expensive and they wear
out over time, needing to be replaced far more often than standard hand weights.

Figure 10. Start/End positions for flexion with tubing.

Shoulder flexion with resistance tubing begins with the band placed beneath the foot and
the hand by the athlete’s side. The athlete raises their shoulder smoothly into 90° of
flexion.
Shoulder extension with resistance tubing begins with the band attached in front of the athlete. With the shoulder in slight flexion, the athlete pulls their shoulder backward smoothly into extension.
Figure 12. Start/End positions for abduction with tubing.

Shoulder abduction with resistance tubing begins with the band placed beneath the feet and the hand by the athlete’s side. The athlete raises their shoulder smoothly into 90° of abduction.
Figure 13. Start/End positions for adduction with tubing.

Shoulder adduction with resistance tubing begins with the band attached to the side of the athlete. With the shoulder in abduction, the athlete pulls their hand toward the body smoothly into adduction.
Shoulder flys with resistance tubing begins with the band attached behind the athlete and the shoulders in abduction. The athlete pulls their hands together smoothly into horizontal adduction.
Shoulder reverse flys with resistance tubing begins with the band attached in front of the athlete and the hands together in shoulder flexion. The athlete pulls their hands backward smoothly into horizontal abduction.
Shoulder internal rotation with resistance tubing begins with the band attached to the side of the athlete. The arm is placed at the side with the elbow flexed to 90° and the shoulder in external rotation. The athlete then internally rotates their shoulder.
Shoulder external rotation with resistance tubing begins with the band attached to the side of the athlete. The arm is placed at the side with the elbow flexed to 90° and the shoulder in internal rotation. The athlete then externally rotates their shoulder.
Figure 18. Start/End positions for 90° of abduction internal rotation with tubing.

Shoulder internal rotation at 90° of abduction with resistance tubing begins with the band attached behind the athlete. The arm is placed at 90° of abduction with the elbow flexed to 90°. The athlete then internally rotates their shoulder.
Figure 19. Start/End positions for 90° of abduction external rotation with tubing.

Shoulder external rotation at 90° of abduction with resistance tubing begins with the band attached in front of the athlete. The arm is placed at 90° of abduction with the elbow flexed to 90°. The athlete then externally rotates their shoulder.
Figure 20. Start/End positions for shoulder shrugs with tubing.

Shoulder shrugs with resistance tubing begins with the band placed beneath the feet and the hands by the athlete’s side. The athlete then raises their shoulders smoothly into scapular elevation.
Empty can with resistance tubing begins with the band placed beneath the feet and the shoulder internally rotated, slightly flexed, and horizontally abducted to 45°. The athlete then raises their shoulder smoothly into 90° of abduction.
Full can with resistance tubing begins with the band placed beneath the feet and the shoulder externally rotated, slightly flexed, and horizontally abducted to 45°. The athlete then raises their shoulder smoothly into 90° of abduction.
Figure 23. Start/End positions for drawing the sword with tubing.

Drawing the sword with resistance tubing begins with the band placed beneath the feet and the shoulder internally rotated with the hand touching the opposite hip. The athlete then raises their shoulder smoothly into 135° of abduction and external rotation.
Pitching motion with resistance tubing begins with the band attached behind the athlete. The athlete starts in the cocked phase of their throwing style and finishes smoothly in their follow through position.
Reverse pitching motion with resistance tubing begins with the band attached in front of the athlete. The athlete starts in their follow through position and finishes smoothly in the cocked phase of their throwing style.
Figure 26. Start/End positions for high pulls with tubing.

High pulls with resistance tubing begins with the band placed beneath the feet and the athlete’s hands by their sides. The athlete then pulls their hands straight up smoothly keeping their elbows as high as possible.
High row pulls with resistance tubing begins with the band attached in front of the athlete. The shoulders are flexed to 90° with the palms facing down. The athlete pulls their elbows backward smoothly finishing in 90° of abduction with elbows flexed to 90°.
Low row pulls with resistance tubing begins with the band attached in front of the athlete. The shoulders are flexed to about 45° with the palms facing down. The athlete pulls their elbows backward smoothly finishing in 90° of elbow flexion.
Scapular punches with resistance tubing begins with the band attached behind the athlete. The shoulder is flexed to 90° with the scapula retracted. The athlete then smoothly protracts their scapula.
Figure 30. Start/End positions for scapular retraction with tubing.

Scapular retraction with resistance tubing begins with the band attached in front of the athlete. The shoulder is flexed to 90° with the scapula protracted. The athlete then smoothly retracts their scapula.
Reverse fencing with resistance tubing begins with the band to the side of the athlete. The shoulder is abducted to 60° with the thumb facing up. The athlete then pulls their elbow smoothly behind their back.

**Shoulder exercises with hand weights**

The following pages (57 - 74) describe and depict 18 shoulder exercises using hand weights. Athletes should begin with 2 sets of 10 repetitions and light weights when attempting an exercise for the first time. After the athlete develops proper technique and becomes accustomed to the exercise, weight and repetitions can gradually be increased.

These shoulder exercises mimic the previous 22 exercises to provide an alternative to the more expensive and less durable resistance tubing. All exercises except for, pitching motion, reverse pitching motion, reverse fencing, and adduction can be performed with standard hand weights. Although standard hand weights are gravity
dependent, they provide a cheaper alternative to resistance tubing that is very durable and can last for many years.

Figure 32. Start/End positions for flexion with hand weights.

Shoulder flexion with hand weights begin with the hand by the athlete’s side. The athlete raises their shoulder smoothly into 90° of flexion.
Shoulder extension with hand weights begin with the athlete bent over and the arm hanging straight down. The athlete raises their shoulder smoothly into extension.
Figure 34. Start/End positions for abduction with hand weights.

Shoulder abduction with hand weights begin with the hand by the athlete’s side. The athlete raises their shoulder smoothly into $90^\circ$ of abduction.
Figure 35. Start/End positions for flys with hand weights.

Shoulder flys with hand weights begin with the athlete on their back and hands out to their sides. The athlete smoothly horizontally adducts their shoulders.
Shoulder reverse flys with hand weights begin with the athlete on their stomach and their hands straight down. The athlete smoothly horizontally abducts their shoulders.
Shoulder internal rotation with hand weights begin with the athlete on their side and elbow tucked in with 90° of flexion at the elbow. The athlete smoothly internally rotates their shoulder.
Figure 38. Start/End positions for external rotation with hand weights.

Shoulder external rotation with hand weights begin with the athlete on their side and elbow resting on their side with 90° of flexion at the elbow. The athlete smoothly externally rotates their shoulder.
Shoulder internal rotation at 90° of abduction with hand weights begin with the athlete on their back. The arm is placed at 90° of abduction with the elbow flexed to 90°. The athlete then internally rotates their shoulder.
Shoulder external rotation at 90° of abduction with hand weights begin with the athlete on their stomach. The arm is placed at 90° of abduction with the elbow flexed to 90°. The athlete then externally rotates their shoulder.
Figure 41. Start/End positions for shoulder shrugs with hand weights.

Shoulder shrugs with hand weights begin with the hands by the athlete’s sides. The athlete smoothly elevates the scapulas.
Figure 42. Start/End positions for empty can with hand weights.

Empty can with hand weights begin with the shoulder internally rotated, slightly flexed, and horizontally abducted to 45°. The athlete then raises their shoulder smoothly into 90° of abduction.
Full can with hand weights begin with the shoulder externally rotated, slightly flexed, and horizontally abduced to 45°. The athlete then raises their shoulder smoothly into 90° of abduction.
Figure 44. Start/End positions for drawing the sword with hand weights.

Drawing the sword with hand weights begin with the shoulder internally rotated with the hand touching the opposite hip. The athlete then raises their shoulder smoothly into 135° of abduction and external rotation.
High pulls with hand weights begin with the athlete’s hands by their sides. The athlete then pulls their hands straight up smoothly keeping their elbows as high as possible.
Figure 46. Start/End positions for bent over high row pulls with hand weights.

High row pulls with hand weights begin with the shoulders flexed to 90° with the. The athlete pulls their elbows smoothly upward finishing in 90° of abduction with elbows flexed to 90°.
Low row pulls with hand weights begin with the shoulders flexed to 90°. The athlete pulls their elbows backward smoothly finishing in 90° of elbow flexion and 0° of shoulder abduction.
Figure 48. Start/End positions for scapular punches with hand weights.

Scapular punches with hand weights begin with the athlete on their back. The shoulder is flexed to 90° with the scapula retracted. The athlete then smoothly protracts their scapula.
Scapular retraction with hand weights begin with the athlete on their stomach. The shoulder is flexed to 90° with the scapula protracted. The athlete then smoothly retracts their scapula.

**Shoulder stretching techniques**

The following pages (75 - 84) describe and depict 10 shoulder stretches. Athletes should begin these stretches lightly and while holding each stretch for ten seconds, progressively increase the stretch.
Figure 50. Vertical stretch with assistance.

The athlete starts at 180° of flexion and uses the opposite hand to provide pressure vertically for the stretch.
The athlete starts at 135° of abduction and uses the opposite hand to provide pressure at an angle for the stretch.
Figure 52. 90° stretch with assistance.

The athlete starts at 90° of abduction and uses the opposite hand to provide pressure horizontally for the stretch.
Figure 53. Follow through stretch with assistance.

The athlete starts in their follow through position and uses the opposite hand to provide pressure for the stretch.
Figure 54. External rotation stretch with assistance.

The athlete starts at 90° of abduction and external rotation and uses the opposite hand to provide pressure for the stretch.
Figure 55. Internal rotation stretch.

The athlete starts at 90° of flexion and internal rotation and uses the opposite arm to provide pressure for the stretch.
Figure 56. Cross-arm stretch.

The athlete starts at 90° of flexion and 90° of horizontal adduction and uses the opposite arm to provide pressure for the stretch.
Figure 57. Overhead bent arm stretch.

The athlete starts at 180° of flexion with the elbow bent and uses the opposite hand to provide pressure for the stretch.
The athlete starts with both shoulders at 90° of abduction and then proceeds to twist back and forth while trying to keep the shoulders loose.
The athlete starts bent over with both shoulders at 90° of abduction and then proceeds to twist back and forth while trying to keep the shoulders loose.

*Example warm-up routines*

Presented on the following pages (85 – 96) is Kyle Yamashiro’s Two-Out Drill. This drill was designed for use in-between innings of a baseball game to regain range of motion and activate shoulder musculature. This also can be used prior to the beginning of a throwing program.
Figure 60. Kyle Yamashiro’s Two-Out Drill

Figure 60 A. Vertical stretch with assistance.

The athlete starts at 180° of flexion and uses the opposite hand to provide pressure vertically for the stretch.
Figure 60 B. 135° stretch with assistance.

The athlete starts at 135° of abduction and uses the opposite hand to provide pressure at an angle for the stretch.
Figure 60 C. 90° stretch with assistance.

The athlete starts at 90° of abduction and uses the opposite hand to provide pressure horizontally for the stretch.
Figure 60D. Follow through stretch with assistance.

The athlete starts in their follow through position and uses the opposite hand to provide pressure for the stretch.
The athlete starts at 90° of abduction and external rotation and uses the opposite hand to provide pressure for the stretch.
Figure 60 F. Small arm circles.

The athlete holds their arms at $90^\circ$ and performs small arm circles forwards and backwards.

Figure 60 G. Large arm circles.

The athlete holds their arms at $90^\circ$ and performs small arm circles forwards and backwards.
Figure 60 H. Shoulder twists stretch.

The athlete starts with both shoulders at 90° of abduction and then proceeds to twist back and forth while trying to keep the shoulders loose.
Figure 60 I. Bent over shoulder twists stretch.

The athlete starts bent over with both shoulders at 90° of abduction and then proceeds to twist back and forth while trying to keep the shoulders loose.
Figure 60 J. Continuous external and internal rotation at 90° abduction.

The athlete starts with their shoulders at 90° abduction, elbow flexion and maximal external rotation, then continuously moves back and forth from maximal external rotation to maximal internal rotation.
Figure 60 K. Continuous horizontal abduction and adduction at 90° abduction.

The athlete starts with their shoulders at 90° abduction, elbow flexion and external rotation, then continuously moves back and forth from maximal horizontal abduction to maximal horizontal adduction.
The athlete starts at 90° of flexion and internal rotation and uses the opposite arm to provide pressure for the stretch.
The athlete places their arm in slight flexion and uses the opposite hand to grab the arm being stretched and pulls back on the hand providing pressure for the stretch.

On the following pages (97 – 103) Myers et al. (2005) describes the seven basic tubing exercises that can be completed in order to activate all primary movers and stabilizers of the shoulder.
Shoulder flexion with resistance tubing begins with the band placed beneath the foot and the hand by the athlete’s side. The athlete raises their shoulder smoothly into 90° of flexion.
Shoulder extension with resistance tubing begins with the band attached in front of the athlete. With the shoulder in slight flexion, the athlete pulls their shoulder backward smoothly into extension.
Shoulder external rotation at $90^\circ$ of abduction with resistance tubing begins with the band attached in front of the athlete. The arm is placed at $90^\circ$ of abduction with the elbow flexed to $90^\circ$. The athlete then externally rotates their shoulder.

Figure 61 C. Start/End positions for $90^\circ$ of abduction external rotation with tubing.
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Figure 61 D. Start/End positions for pitching motion with tubing.

Pitching motion with resistance tubing begins with the band attached behind the athlete. The athlete starts in the cocked phase of their throwing style and finishes smoothly in their follow through position.
Reverse pitching motion with resistance tubing begins with the band attached in front of the athlete. The athlete starts in their follow through position and finishes smoothly in the cocked phase of their throwing style.
Low row pulls with resistance tubing begins with the band attached in front of the athlete. The shoulders are flexed to about 45° with the palms facing down. The athlete pulls their elbows backward smoothly finishing in 90° of elbow flexion.
Figure 61 G. Start/End positions for scapular punches with tubing.

Scapular punches with resistance tubing begins with the band attached behind the athlete. The shoulder is flexed to 90° with the scapula retracted. The athlete then smoothly protracts their scapula.

Chapter 4.5. Additional Resources

The material covered within this manual is only a small portion of the literature and science available for the public about shoulder education and injury prevention. This manual was designed to be a building block for youth baseball athletes and coaches in order to better understand the shoulder and use shoulder exercises, stretches, and warm-up routines in order to help maintain a healthy shoulder. Thousands of web pages, books, and journal articles exist that give a more comprehensive look at subjects that were covered in this manual as well as those that were not. Below is a mixed list of books, web pages, and credited journals to give youth baseball athletes and coaches a more in-depth and comprehensive education about several topics.
• *The Athlete’s Shoulder*, authored by James Andrews, Kevin Wilk, and Michael Reinold.

• *Limbs and Back (Anatomy Workbook)*, authored by Peter Lisowski and Colin Hinrichsen.

• *Jumping into Plyometrics: 100 Exercises for Power and Strength*, authored by Donald Chu.


• *The Art & Science of Pitching*, authored by Tom House, Gary Heil, and Steve Johnson.


• http://scholar.google.com/ Online journal search engine.
Chapter 5

DISCUSSION

Playing youth baseball only in the summer has become a thing of the past. Adolescents now participate on all-star teams, travel squads, club teams, and showcases year round. The focus on these young athletes is how they can become better, striving to develop stronger arms, greater velocity, and better breaking pitches. This can cause tunnel vision and lose sight of what allows a baseball player to achieve all of this, a healthy shoulder.

A healthy shoulder can be difficult to maintain and is not easily understood. The complexity of the shoulder serves as a positive in order to develop maximal range of motion while developing excessive amounts of velocity. The complexity of the shoulder also serves as a negative by predisposing itself to injury due to its innate qualities that allow it such freedoms. Most of the power that is developed at ball release is generated by the lower body and trunk. The shoulder acts as a whip transferring the energy developed from the lower body and trunk to the baseball. The ability of the shoulder to appropriately stabilize and decelerate this energy makes the shoulder a complex and unique joint.

Youth baseball athletes put their trust in the hands of their coaches. Whether or not youth coaches have the proper training, they are asked to teach their athletes how to throw a baseball as effectively and safely as possible. To this author’s knowledge, most if not all youth leagues do not require a coach to obtain credentials or pursue continuing
education in order to stay current with the latest research on injury prevention. The problem is that it would be inappropriate to ask a coach to stay current with the latest research in shoulder function and injury prevention. Without a previous history of understanding and comprehension of the shoulder, such literature would be difficult to understand and extrapolate the important data in order to transfer the author’s findings to a real world setting.

Youth leagues are setting game, weekly, and yearly pitch limits while limiting the use of breaking balls until a certain age. Even with these limits in place, shoulder pain still occurs amongst 32% of youth athletes studied (Lyman et al. 2001). When year around baseball, out of season showcases, increasing focus of performance driven goals, and the limited knowledge some coaches may possess all add up to an increase of risk for shoulder injury for the youth baseball athlete.

This injury prevention manual is designed to increase general knowledge of the shoulder and develop an awareness of preventative exercises. This manual provides a collection of current scientific research on shoulder injuries, shoulder mobility, scapular function and dysfunction, shoulder fatigue, differences between professionals and amateurs, and resistance tubing efficacy, to present reasoning behind developing a shoulder injury prevention exercise program.

Further recommendations for this manual would be to focus on injury preventative exercises for the collegiate athlete and coach. Allowing future authors to add material not covered within this manual that would be more appropriate for the adult baseball athlete. Also, implementation of this manual into a summer youth baseball league would
provide data on the efficacy of reducing the incidence of shoulder pain and, because
shoulder injuries are multiplicative, could give insight into whether or not decreasing
shoulder pain would also reduce the frequency of elbow injuries. Further research would
add valuable data needed in the area of shoulder injury prevention for youth athletes.
REFERENCES


