Seasonal Shoulder Injury Prevention Program for Competitive Swimmers

Needs Statement:

Competitive swimming in the United States is increasing in popularity.[1] The average competitive swimmer practices 5-7 days a week, completes 6,000 – 10,000 meters a day and 60,000-80,000 meters a week. With the average swimmer taking about 8-10 strokes per lap, each shoulder undergoes 30,000 rotations each week.[1] It is reported that 47% of 10-18 year olds and 66% of senior development swimmers have a history of shoulder pain.[1] The literature refers to this as "swimmer's shoulder".[1,3]

Swimming's popularity is understandable. It is a low impact sport that is appropriate for all ages. Participation in competitive swimming can result in many health, social, and personal benefits. Swimming builds cardiovascular and respiratory health, increases aerobic fitness, promotes muscle development while maintaining flexibility, and helps to develop coordination in children.[7] In addition, swimming emphasizes the creation of team camaraderie, time management, self-discipline, relationship building and goal setting skills that transfers into all areas of life.[7] Lastly, swimming increases confidence, builds self-esteem, initiates lifelong friendships, and more! It is evident that swimming can have a significant impact on the lives of those who participate. Therefore, our goal is to prevent seasonal shoulder injuries so that participation is not limited and swimmers can continue to work towards their goals.

Despite these positive influences, swimming places a tremendous amount of stress on the glenohumeral joint and shoulder girdle.[1] It is no surprise then that the most common complaint from competitive swimmers is shoulder pain.[1] This can be due to the demands of the sport, muscle weakness, muscle imbalances, altered posture and stroke technique.[1,3,5,6] Like many swim clubs, the Winston-Salem Swim Team (TYDE) currently does not have a shoulder injury prevention program. In a discussion on September 25, 2013 with the TYDE head coach, Robin Jacobs voiced her desire to implement this type of program due to shoulder injuries that have impeded swimmer participation. She wants a program specifically for the National Prep Teams I and II whose ages range from 11-14 years old. These two groups are involved in higher intensity training and frequency that prepares them for advanced level competitions.

Additionally, swim coaches have access to multiple resources that pertain to shoulder health and injury prevention through the main swimming organization, USA Swimming.[18] However, this information is not always implemented due to the lack of training, knowledge, and experience of the coaches to execute and instruct swimmers through a shoulder injury prevention program. Thus, preventing shoulder injuries can be addressed through a shoulder strengthening program for the athletes and an educational program for the coaches addressing associated risk factors and technique. Both of these programs will be supported by the current literature, clinical experiences, and previous competitive swimming experience.

Background:

The current literature recommends a shoulder prevention program for competitive swimmers; however, there is little information regarding the prevention of overuse injuries in competitive swimmers.[2,3,5] Currently, there is no effective shoulder injury prevention program.[3,5] The available evidence takes multiple approaches toward developing a method to prevent shoulder injuries. These range from correcting muscle imbalances, strengthening weakened glenohumeral and scapular muscles, stretching tight musculature, and to correcting poor posture.[3,5]

The recommended key components of a prevention program are shoulder and scapular strengthening and stretching.[2,4] A training program that focused on the eccentric strengthening of the external rotators of the shoulder was performed 4 times a week for 5 weeks with outcomes including decreased shoulder rotator cuff muscle imbalances.[12] An 8 week scapular and periscapular strengthening and stretching program performed 3 times a week for collegiate swimmers improved forward head and forward shoulder posture, increased muscle strength, and decreased reports of shoulder pain.[13] Another study performed 3 times a week for 12 weeks with adolescent swimmers compared the effects of strength through strengthening or endurance programs. They found that both programs increased muscular strength, reduced muscular imbalances, and side to side differences in the swimmers.[8] Additionally, the ratio of external rotation to internal rotation can be altered by swim training alone.[14,15] Therefore, not only is strengthening recommend, but also the correction of muscular imbalances as these were more indicative of shoulder pain than limited range of motion.[14]

Further insight is provided by Hibberd et al.[3] who conducted a 6 week program on collegiate swimmers to improve glenohumeral and scapular muscle strength and scapular kinematics. The specific intervention was not successful in improving these variables. They recommended that a yearlong program may result in greater strength gains and long term benefits to correct muscular imbalances, scapular kinematics, and movement patterns to prevent injury. They also recommended that implementing a program in youth swimmers may have a greater impact on the developing muscles to decrease shoulder pain and injuries now and later into their careers.[3] A similar study by Swanik et al.[4] assessed the effects of a 6 week functional training program on shoulder strength and the incidence of shoulder pain. They concluded that despite not having a significant increase in strength, there was less shoulder pain reported.[4]

The role of education is also important in preventing seasonal shoulder injuries. The literature recommends educating the coaches and swimmers on the importance of injury prevention and early injury detection while swimming.[2] Coaches are swimming experts. They should teach proper stroke technique and recognize any stroke deviations during practice.[2] In particular, dropping the elbow during the "catch" phase, crossing midline upon hand entry, and decreasing body rotation in the long axis strokes are concerning.[9,16] These improper stroke mechanics place extra stress on the shoulder joint and can cause shoulder pain and injury.[9] Coaches should also encourage breathing to both sides during freestyle. This will promote symmetrical side to side musculature as well as limit stress concentration to one shoulder during this stroke phase.[2,16] Next, swimmers should understand the importance of a shoulder injury prevention program to gain adherence. Swimmers need to recognize the various types of pain, understand what constitutes "bad pain", and report it to their coach and parents so that proper interventions can occur.[9]

There are multiple modes to effectively educate. Some useful methods for learning involve presentations, meetings, videos, handouts, demonstrations and participation. These methods utilize the different sensory systems to meet the various learning needs of the participants.[10] Therefore, a combination of these methods would be the most effective. This involves a PowerPoint presentation that contains text and videos, group discussion, time for the participants to practice the exercises, and handouts containing the key points for future use.

The evidence presents multiple approaches that attempt to produce a successful intervention. Despite the outcomes, these studies contain limitations and knowledge gaps. The consideration of two models can help to effectively utilize the existing evidence into clinical practice. First, the Translating Research into Injury Prevention Practice (TRIPP) model can guide scientifically proven evidence towards an implementation strategy and the assessment of injury prevention in the real world.[11] This model consists of six stages which carefully guides this process, ensures the application of prevention methods, and has been shown effective.[11] Next, a sports model, Determinants of Sport Behavior includes all the dynamics involved in sport and the avenues of intervention. The factors that influence sport behavior are the athlete's physical and psychological factors, load, personal equipment, and the environment of physical and human factors.[17] By outlining the specific and unique aspects of swimming, these theories can supplement the intervention and identify individual needs while maintaining scientific rigor.

Objectives:

The primary goal of this program is to prevent seasonal shoulder injuries in competitive swimmers on the TYDE Swim Team. The specific objectives are:

- To develop a shoulder strengthening program that addresses common impairments in competitive swimmers
- To integrate this program into TYDE's 2014 training schedule
- For coaches to recognize the risk factors that contribute to shoulder pain and injuries
- For all parties to understand that shoulder pain can occur during swim training and can be a precursor to shoulder injuries
- For swimmers to demonstrate improved strength, a lower incidence of shoulder pain and injuries

Methods:

The proposed shoulder injury prevention program will contain an exercise and educational component. The exercise portion involves a shoulder strengthening program for the athletes, consisting of three phases delivered over the 16 week intervention. The educational component will be geared towards the coaches and will occur prior to the start of the intervention.

Site Parameters: The program will be held at the Downtown YMCA in Winston-Salem, NC. This location is easily accessible and is the current site of the TYDE swim practices. Having the program at the same location as swim practice eliminates additional transportation, and allows for easier participation and transition. Additionally, the recommended time of day for the intervention can be accommodated as well. This site also meets the needs of the exercise and educational components of this program. It offers ample exercise equipment and available space for testing, training, and meetings.

Intervention:

The coaches will attend an educational session prior to the initiation of the shoulder strengthening program. This session will include how swimming influences the shoulder, the signs/symptoms, and risk factors associated with shoulder pain. By its conclusion, the coaches should have an enhanced awareness of "swimmer's shoulder", be able to identify risk factors, and assist with the prevention of seasonal shoulder injuries. Additionally, the proposed shoulder injury prevention program will be explained in detail to gain their compliance and support.

The shoulder injury prevention program will be conducted prior to normal swim training 3 days a week for 16 weeks. The intervention group will contain the National Prep Teams I and II. The remaining swim groups, who are similar in age and swim ability, will act as the control groups. The program will involve stretching and strengthening exercises. The time requirement is about 30 minutes. The intervention is comprised of three phases that will coincide with the goals in swim training and racing schedule. Each phase will present with more progressive strengthening exercises and a different variation of a stretch. However, necessary adjustments will be made if exercise progression is not indicated. Within each phase, the number of repetitions for the strengthening exercises will increase steadily from 3 sets of 10 repetitions to 3 sets of 15 repetitions. The stretching exercises will remain at 3 sets of a 30 second hold for the entire intervention. The exercise progression is further displayed in Table 1 of the Appendix.

Outcome Measures: Prior to the start of the program, baseline measurements will be taken of each participating swimmer. The swimmers will report current shoulder pain using the VAS pain scale (0-10) whenever present throughout the season. The swim coaches will track attendance at each practice to determine program adherence. The swimmers will also report any acquired

shoulder injuries during the 16 week swim season. Strength will only be measured twice-- at the beginning and end of the swim season. The program director will examine shoulder strength of the shoulder internal and external rotators, serratus anterior, middle and lower trapezius using a hand-held dynamometer. In addition, the coaches will complete a survey before and after the educational session to demonstrate their understanding of the competitive swimmer's risk for shoulder injuries and the role of a preventative shoulder strengthening program.

Phase I: (1-5 weeks) The goal of this first phase is to introduce the exercises to the athletes and ensure that they are performing them with proper technique and muscle activation patterns. The stretches will include the corner and sleeper stretch. The strengthening exercises will include internal and external rotation in side lying with dumbbells for resistance, push up plus, and W, T, Is in prone (on stomach).

Phase II: (6-11 weeks) The second phase will be the most challenging. Its goal is to make significant strength gains. The stretches will include horizontal adduction or the cross body stretch and the partner chest stretch. The strengthening exercises will include standing internal and external rotation with theraband tubing, standing rows with theraband tubing, and W, T, Ys in prone on a therapy ball.

Phase III: (12-16 weeks) The goal of this final phase is to continue progressing the exercises to maintain strength gains while preparing for upcoming swim meets. The stretches will be transitioned to an anterior chest stretch in supine (lying face up) on a foam roller, chin tucks in supine, and the sleeper stretch. The strengthening exercises will contain external rotation in the 90-90 position in standing with theraband tubing. The prone ball exercises will now involve transitions between Y to W, T to W, and T to Y.

Anticipated Outcomes: The anticipated outcomes involved in implementing a season long shoulder prevention program include the following:

1. All participating swimmers will have a program adherence rate of at least 80% for the entire swim season.
2. 90% of the coaching staff will demonstrate an increased understanding of the risk factors and signs/symptoms associated with shoulder pain and injuries indicated at survey completion.

3. 90% of the participating swimmers will demonstrate increased strength of the select musculature via a hand-held dynamometer at the end of the season.
4. Participating swimmers will report at least 20% fewer complaints of shoulder pain and seasonal shoulder injuries via the VAS pain scale.

Assessment

An evaluation of this proposal will be performed to identify the strengths and weaknesses of the educational and strengthening programs. The design, contents, and organization of both components will be considered and modified as needed to enhance its effectiveness. Progression towards the proposed goals will be monitored throughout this evaluation process. The first goal commands an adherence rate of at least 80% which will be progressively assessed with the coach's attendance records. The second goal warrants the coaching staff to develop an increased understanding of "swimmer's shoulder" that will be evaluated by comparing survey results before and after the educational session. The third goal involves strength gains of select musculature in the swimmers determined by comparing pre- and post-intervention hand-held dynamometer readings. The final goal entails 20% less reports of shoulder pain and injuries by the athletes which will be evaluated through daily self-reports using the VAS pain scale.

These outcome measures will provide important information about the athletes and coaches as individuals and as groups. These measures have the potential to show trends, areas for improvement, and correlations between variables throughout the 16 weeks. This data will also provide insight into the suitability of the current outcomes, identify additional measures and logistical aspects to improve the program for future implementation.

For further evaluation, the athletes and coaches will provide feedback and recommendations at the conclusion of the program via a survey. Information will encompass the program's site, setup, schedule, content, areas of strength and improvement. Thus, the success of the program depends upon achieving these goals and obtaining the desired feedback from all participants. The feedback will be considered in the future use of these programs.

Limitations

A potential barrier to this program is participant adherence. Reaching the desired attendance rate could be a challenge for this age group. The timing of the program may conflict

with school activities, other extracurricular activities, and family commitments, which may result in missing this or all components of practice. A make-up protocol has not yet been devised. Transportation could be an additional issue as this age group is dependent on others for this service.

Additionally, there is little evidence from the literature to support the selected shoulder strengthening program. The program design, chosen strengthening and stretching exercises, and exercise progression may or may not be successful in preventing shoulder injuries in the targeted group of competitive swimmers. Regardless of the outcome, this program has the potential to contribute additional information to the current evidence in an effort to devise a way to prevent seasonal shoulder injuries in competitive swimmers.

Relevance

This proposal aims to address the relatively high incidence of shoulder pain and injuries in competitive swimmers by implementing a shoulder strengthening program as prevention. It also educates the coaches on these shoulder issues and encourages them to play a role in the prevention process as well. This injury prevention program has the potential to make a significant impact by allowing swimmers to maintain their yearlong participation and gain the multiple benefits swimming has to offer. Additionally, this program has the capability for substantial growth where it can be applied to other swim groups on the TYDE Swim Team as well as act as a template for other swim teams in the North Carolina area. The current evidence supports the use of this program for other age groups and swim levels not included in this proposal. The results from this program will be used to enhance and determine more effective ways to prevent seasonal shoulder injuries in competitive swimmers.

Appendix

Table 1: Strength Exercise Progression throughout the 16 weeks

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Phase I Strengthening Exercises: - Side lying ER & IR - Push Up Plus - Prone W, T, I Start at 3x10 and progress to 3x15 based on: - Proper technique - No pain or discomfort - Level of perceived effort Phase I Stretching Exercises: - Doorway/corner stretch - Sleeper stretch Perform 3 sets with 30 sec hold					Phase II Strengthening Exercises: - Standing ER & IR - Standing Rows - Prone W, T, Y on ball Start at 3x10 and progress to 3x15 based on: - Proper scapular rhythm - No pain or discomfort - Level of perceived effort Phase II Stretching Exercises: - Cross body stretch Perform 3 sets with 30 sec hold - Chin tucks Perform 10 sets with 10 sec. hold						Phase III Strengthening Exercises: - Standing ER in 90-90 - Prone Y to W on ball - Prone I to W on ball - Prone T to Y on ball Start at 3x10 and progress to 3x15 based on: - Proper scapular rhythm - No pain or discomfort - Level of perceived effort Phase III Stretching Exercise: - Towel or foam roller stretch - Sleeper stretch Perform 3 sets with 30 sec hold				

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