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Quad Rugby: A Strength and Conditioning Program for the Elite Athlete

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summary

Disabled sports are a recreational outreach for individuals who have experienced injuries or have physical limitations. Quad rugby is a sport for individuals with spinal cord injury, and it has grown exponentially in popularity. Disabled sports have recently expanded to the national and international levels. With increasing competition, the physical demands have been elevated to a new level. Athletes participating in disabled sports need comprehensive strength and conditioning programs to compete at high levels.

Introduction

Quad rugby, wheelchair rugby, or murderball (the original name) was the creation of three Canadians (5). The game came to the United States in 1981, and in 1988 the United States Quad Rugby Association was developed to promote and regulate the sport (5). Quad rugby (Figure 1) is an international event and is recognized as the fastest growing wheelchair sport (5). Players must have a combination of both upper- and lower-extremity impairments to participate. A significant amount of skill is needed to be successful in this sport. Players are formally classified into 1 of 7 categories from 0.5 (greatest impairment) to 3.5 (least impairment), and a maximum of 8 points are permitted on the court for each team of 4 players at any given time (5). Teams score by passing or carrying a rugby ball (volleyball) across the end line of a basketball court. Because the physical capabilities of each player's hands are very different, players use a variety of techniques to pass the ball. This may include 1-hand passes, 2-hand passes, or punching/batting the ball. Defensively, players use their wheelchair to block the opponent and collide into them in an attempt to jar the ball free.

Figure 1. Quad rugby.

The purpose of this manuscript is to enhance the reader's knowledge of the strength and conditioning needs of the

Table 1
Preseason Training Schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dynamic stretch Strengthen Cardiovascular Static stretch	Dynamic stretch Plyometrics Static stretch	Off	Dynamic stretch Strengthen Cardiovascular Static stretch	Dynamic stretch Plyometrics Static stretch	Off	Dynamic stretch Strengthen Static stretch

athlete with a physical disability. There is a paucity of literature on disabled sports and even less on training programs for these athletes. The exercises outlined in this program are not appropriate for all individuals with quadriplegia. This program has been designed to bring the competitive athlete to the level of an elite athlete competing in regional and national competition. This is a general program based on the specific needs of wheelchair users and the sport-specific needs of quad rugby. It is divided into sections of stretching, strengthening, plyometrics, and cardiovascular/endurance training. The program should be used as a template to be tailored to the needs of the individual athlete. Also, the authors have had success with the implementation of this program and hope to share the information with other quad rugby teams.

Safety

The majority of these exercises can be performed at home or in the gym with little equipment needed. When using weights, athletes should always have a spotter available for safety. This is especially important for the disabled athlete. Limited hand strength may make gripping a weight or piece of equipment challenging. Adaptations may need to be made to accommodate an athlete's grip strength. Elastic bands, mitts, and adapted handles may be a very simple solution to the problem. There are a few other circumstances that should be taken into consideration. Obviously, sensory deficits may be significant in a quadriplegic population. Care needs to be taken to protect areas of diminished sensation. Likewise, the possibility of autonomic dysreflexia needs to be addressed. Autonomic dysreflexia can occur suddenly and can be life threatening (1, 3). It occurs when an irritating stimulus occurs below the level of the spinal cord lesion. This can be an overfilled bladder, a full bowel, or a pressure wound (1, 3). Symptoms include:

- Pounding headache due to an elevation in blood pressure.
- Goose flesh.
- Sweating above the level of injury.
- Nasal congestion.
- Slow heart rate.
- Blotching of the skin.
- Restlessness.

Treatment involves removing the irritating stimulus as rapidly as possible. If the stimulus can not be identified, emergency medical treatment should be sought immediately.

Preseason and In-Season Training

Preseason training should primarily include flexibility, strengthening, plyometrics, and endurance training with an emphasis on improving overall strength and conditioning. As the competition season approaches, focus should shift toward the development of specific technical skills involved in the sport. This program outlines a schedule for both preseason and in-season training. The preseason training schedule is a 5-day training schedule with 2 days off for recovery. The schedule consists of 3 strength training sessions, 2 plyometric training sessions, and 2 cardiovascular/endurance training sessions per week. Stretching is to be performed before and after each workout session. The primary focus of preseason training is to condition the body for the demands of quad rugby competition. The majority of the focus during this time is on strengthening and fitness, with little emphasis on the technical skills of the game. An example of the preseason training schedule is shown in Table 1.

The in-season training differs from the preseason schedule in that there is a larger focus on technical skills. The in-season training schedule is a 5-day schedule with 2 days off for recovery. The schedule consists of 2 strength training sessions, 2 plyometric training sessions, 2 cardiovascular/endurance training sessions, and 3 skills sessions per week. Again, stretching is to be performed every day, before and after activity. An example of the in-season training routine is shown in Table 2.

Stretching

Stretching is an important part of a strength and conditioning program, not only in maintaining the integrity of the muscle tissue, but also in keeping the desirable length–tension ratio within the muscle (4, 7). Stretching should be performed before and after each training session or competition. This program utilizes 2 types of stretches: static and dynamic (4, 6, 8). These tasks should be performed at different times during the training.

Dynamic Stretches (Warm Up)

Dynamic stretches are slow, controlled movements through the full range of motion and are the most appropriate exercises to warm up prior to an athletic compe-

Table 2
In-season Training Schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dynamic stretch Strengthen Cardiovascular Static stretch	Dynamic stretch Skills Plyometrics Static stretch	Off	Dynamic stretch Strengthen Cardiovascular Static stretch	Dynamic Stretch Skills Plyometrics Static stretch	Off	Dynamic Stretch Skills Strengthen Static stretch

tition. Appropriate dynamic stretches are discussed in the following sections.

Neck Mobility. Sit in chair with the back supported. Move the neck in the following 3 directions:

- *Flexion/extension.* Tuck the chin into the chest, and then lift the chin upward. Perform 3–5 repetitions.
- *Side bending.* Lower the left ear toward the left shoulder and then the right ear to the right shoulder. Perform 3–5 repetitions.
- *Rotation.* Turn the chin toward the left shoulder and then rotate it toward the right shoulder. Perform 3–5 repetitions.

Shoulder Cirles. While sitting, raise the shoulders towards the ears, take them backward, down, forward, and then up again to the ears in a smooth action. Perform 8–10 repetitions.

Pendulum Swings. Lie on the stomach close to the edge of a weight bench. Let the arm hang over the edge of the bench. Relax the neck, scapula, shoulder, arm, and hand. Let the shoulder blade relax and drop down. Slowly and gently swing the arm forward and back. Repeat this task with the other arm.

Arm Swings (an Alternative to Pendulum Swings If Unable to Lie Down). While sitting, keep the back straight at all times. These can be performed in 2 directions:

- *Overhead/down and back.* With arms at the side, alternately swing the arms forward and up to an overhead position and then back down to the side. Perform 8–10 repetitions with each arm.
- *Side/front crossover.* With both arms out to the sides, swing the arms across in front of the chest so they cross over and then back to the side. This can be performed with both arms at once or with 1 arm at a time. Perform 8–10 repetitions.

Static Stretches (Cool Down)

Static stretches help elongate muscles to increase flexibility and are more appropriate at the end of practice when the muscles are warm (4, 8). All stretches should be held for 30 seconds (2). There are 8 static stretches recommended in this program. It is not essential that each stretch be done every session. The athlete is free to vary the stretches performed each session; however, it is strongly recommended that each stretch be addressed at least 2 times in the course of the weekly workouts. If any of these tasks result in pain or discomfort, the athlete should be advised to stop performing the task immediately and consult a medical professional. Appropriate static stretches are discussed in the following sections.

Upper Trapezius. While sitting, lower the right shoulder and bend the head toward the left shoulder. Place the left hand on top of the head and gently pull the head toward the left shoulder. Hold for 30 seconds and repeat 3 times to each side.

Side Torso Stretch. While sitting in a chair, raise the right arm over the head with the elbow by the ear and bend the trunk to the left side until a stretch is felt on the right side of the body. Hold for 30 seconds and repeat 3 times to each side.

Horizontal Shoulder Adduction. While sitting, pull one arm horizontally across the chest. The stretch should be felt in the back of the arm and shoulder. The opposite arm may be needed to assist the stretching arm. Hold for 30 seconds and repeat 3 times with each arm.

Shoulder Rotation. Lie on the back on a weight bench. Slide the arm out to the side to shoulder level, and bend the elbow to 90°. The fingers should be pointing toward the ceiling. If available, a partner could hold the shoulder down for stability. Relax and allow the arm to rotate forward, letting the palm of the hand and forearm fall forward toward the floor. Try not to let the shoulder come off of the bench. Hold for 30 seconds and repeat 3 times. Now rotate the shoulder 180° so the arm is dropping back by the head. Hold this position for 30 seconds and repeat 3 times. Perform the same tasks with the other arm.

Doorway Internal Rotation. Sit in a chair inside a doorframe. Lift the arm out to side of the body at shoulder height. Bend the elbow to 90° and place the palm on the doorframe. Hold the palm on the door and gently lean the body forward until a stretch is felt in the front of the shoulder. Hold for 30 seconds and repeat 3 times to each side.

Assisted Extension. Sit upright in chair with the back supported. Place both

hands behind the chair with the elbows straight. Have a partner gently pull both of the hands up toward the ceiling. Be careful not to bend the body forward. Hold for 30 seconds and repeat 3 times.

Rhomboids. Sit upright in a chair facing a partner with the back supported. Interlock the fingers and hold the arms toward a partner. Have the partner gently pull the athlete's arms forward without pulling the body forward. Hold for 30 seconds and repeat 3 times.

Pectoralis Stretch. Lie on the back on a weight bench. Drop the arms out to the sides and relax them over the edge of the bench. Keep the elbows straight. Hold for 30 seconds and repeat 3 times.

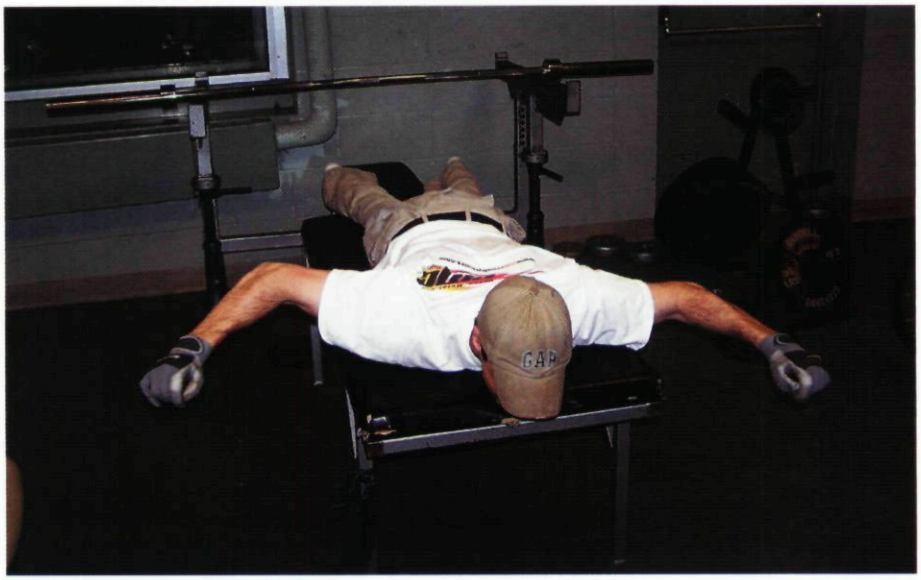

Figure 2. Prone scapular retractions.

Strength Training

When beginning any strengthening program, athletes should start with light weight until the movements have been mastered. The amount of weight to start with will vary for each athlete. It may take some time for the athlete to determine the amount of resistance that is challenging. When in doubt, err on the conservative side by using the lighter weight. Given the varying levels of disabled, all exercises may not be possible for all athletes. However, it is important that the exercises be performed with the correct form, and form should not be compromised to increase the weight. It is recommended that the athlete select a resistance/weight with which he or she is able to complete 6–8 repetitions per set (4). If the athlete is able to complete 10 repetitions with ease, then the resistance is too light and it should be increased on the next set. If the athlete is unable to complete 6 repetitions, then the resistance is too heavy and the athlete should decrease the resistance for the next set. Be sure to complete the full range of motion for each exercise. The goal is to perform 2 sets of each exercise with at least a 1-minute rest period between sets (7). This will provide adequate recovery time to achieve maximal strength benefits. It is not essential that the athlete perform every strengthening exercise every session. However, it is recommended that each exercise be completed once per week.

Chest Press

Sit at the machine with handles at chest level and forearms parallel to the floor. Push forward until arms are almost straight. Slowly return to the starting position.

Butterfly

Sit at the machine with arms bent on pads perpendicular to the floor. Squeeze arms, bringing forearms together. Slowly return to the starting position.

Chair Tug-of-War

Tie 2 wheelchairs together with players back to back. Each player attempts to push forward to overcome the force of his opponent. The result is a tug-of-war scenario where one athlete may be able to overcome the force of his opponent for a few pushes and then loses ground to his opponent when he repositions his hand for another push. Pushing contests should last about 1 minute.

Prone Scapular Retraction (Figure 2)

Lie on the stomach with the arms at shoulder level. The elbows should be straight and palms facing the floor. Lift the arms toward the ceiling while pinching the shoulder blades together (Figure 2). Hold for 6 seconds. If able, a cuff weight can be placed on the wrist for resistance.

Scapular Depression

Sit in a chair with forearms on the armrests or on the floor with forearms up on a seat that is behind. Elbows should be bent. Push the elbows down against the surface, lowering the shoulder blades and lifting the bottom slightly off of the chair. Hold for 2 seconds each.

Elastic Band Rows

Sit with elbow straight at the side. Grip one end of elastic band with the other end fixed to an object at or below the height of the hand. Bend the arm as shown in Figure 3. Hold for 2 seconds and return slowly to the straight position. Repeat this task with the other arm.

Machine Rows

Sit at machine with arms straight in front and handles just below shoulder level. Pull arms back toward chest, keeping elbows close to the side and forearm parallel to the floor. Slowly return to the starting position.

Figure 3. Elastic band rows.

Figure 4. Lateral raises.

Serratus Anterior Punches

Lying on the back on a bench, raise the arm up to the ceiling. Keep the elbow straight and punch the hand towards the ceiling until the shoulder blade is slightly off the bench. Repeat this task with the other arm. For more resistance, use cuff weights on the wrists.

Sitting Serratus Anterior Punches (Using a Chest Press Machine)

Sit at chest press machine with handles at chest level and press weight out until elbows are straight. Keeping elbows straight, push the weight out as far as possible, lifting shoulder blades off of the back rest while maintaining the back on the back rest. Slowly lower the weight until shoulder blades touch the back rest and repeat.

External Rotation with Elastic Band

Sit with right elbow fixed at side and bent to 90° with a towel roll between the arm and ribs. Wrap one end of the elastic band around the right wrist. Secure the other end to an object to the left that is the same height as the hand. Begin with the forearm and hand across the belly, and by rotating the shoulder, move the hand as far to the right as possible. Slowly return to start position. Repeat with opposite arm.

Internal Rotation with Elastic Band

Sit with right elbow fixed at side (towel roll under arm). Bend the elbow to 90°. Wrap one end of the elastic band to the right wrist with the other end secured to an object to the right. Begin with the arm rotated out to the side and bring the hand to the belly while keeping your elbow fixed at the side. Repeat with opposite arm.

Lateral Raises

Sit with arms at the sides. Raise arm out to side to shoulder level with palm facing down and slowly lower. Repeat with opposite arm. This can also be performed with cuff weights or straps holding dumbbells as shown in Figure 4.

Front Raises

Sit with arms straight in front and alternate raising arms out in front to shoulder level (lead with the thumb pointing upward). Slowly lower back to the original position. Repeat on opposite arm. This can also be performed with cuff weights or straps holding dumbbells.

Bicep Curls

Sit with elbow resting on bench and arm straight. With palm up, curl forearm to shoulder and slowly return. This can be performed with cuff weights or cables as shown in Figure 5.

Shoulder and Elbow Extension for Triceps

Sitting in the wheelchair, secure an elastic band to the left leg rest. Secure the elastic band around the right wrist and extend the shoulder and elbow as far back as possible. Repeat with the other arm.

Plyometrics

Plyometric training is a combination of strength and speed training designed to enhance power (4). Plyometric exercises are higher intensity tasks than regular strength training (4). Thus, to avoid overworking the muscles, plyometrics are incorporated into the training program only 2 days per week. All of the following exercises should be performed as quickly as possible. Because of physical limitations of the athlete with quadriplegia, the plyometric tasks included in this exercise routine have been altered to accommodate these limitations. Even then, some athletes may not be able to perform all of the exercises. Nonetheless, it is the quality of the exercise that is more important than the quantity. The athlete needs to know that progressive resistance will increase strength but the exercises should not be painful. If discomfort lasts more than a couple of hours after an exercise program, this may be a sign of an excessive workout. The exception to this rule is the presence of delayed onset muscle soreness (8) that is experienced 24–48 hours after exercise, particularly if it involves eccentric or "negatives" (the lowering of weights for example). This type of soreness will subside with repeated exposures to "negative" type training. The goal is to perform 2 sets of 6–8 repetitions each. Again, allow a 1-minute rest between sets to provide adequate muscle recovery (7).

Vertical Toss (for Shoulders and Biceps; a Partner Is Required)

Sit with the back up against the box, legs spread apart and straight (this can also be performed while sitting in a wheelchair positioned in front of a box). The partner stands on the box, holding a rugby ball over the athlete. The partner drops the ball into the athlete's hands. The athlete catches the ball with elbows bent and tosses it back up to the partner on the box. Keep the catch time (the time the ball is in the hands) to the shortest time possible. If able, the athlete can progress to using a weighted ball (plyoball or medicine ball).

Figure 5. Biceps curls.

Chest Pass (for Pectoralis and Triceps; a Partner Is Required)

Sit facing your partner. Begin by holding the rugby ball with both hands at chest level. Pass the ball to the partner, pushing it off the chest and ending with the arms straight. The partner catches the ball and passes it back. Try to anticipate the catch and return the ball as quickly as possible. Keep the catch time (the time the ball is in the hands) to the shortest time possible. Increase the distance between the athlete and the partner to increase the intensity.

Side Passes (for Pectoralis, Shoulders, and Triceps; a Partner Is Required)

Sit next to your partner. Begin by holding the rugby ball with both hands at chest level. Pass the ball sideways to the partner. The partner catches the ball and passes it back. Try to anticipate the catch and return the ball as quickly as possible. Keep the catch time (the time the ball is in the hands) to the shortest time possible. Increase the distance between the athlete and the partner to increase the intensity. Be sure to execute this task to both sides.

Power Development

Wheelchair Explosion

This drill is an explosive, short-distance sprint. Emphasize the start to build speed as quickly as possible. Sprint for 10 feet and stop immediately. Emphasize the stop. To increase the amount of resistance, this drill can also be performed with a weight attached to the chair's frame as shown in Figure 6. It is recommended that a cloth/towel be placed under the weight to avoid damaging the gym floor.

Figure 6. Wheelchair explosions.

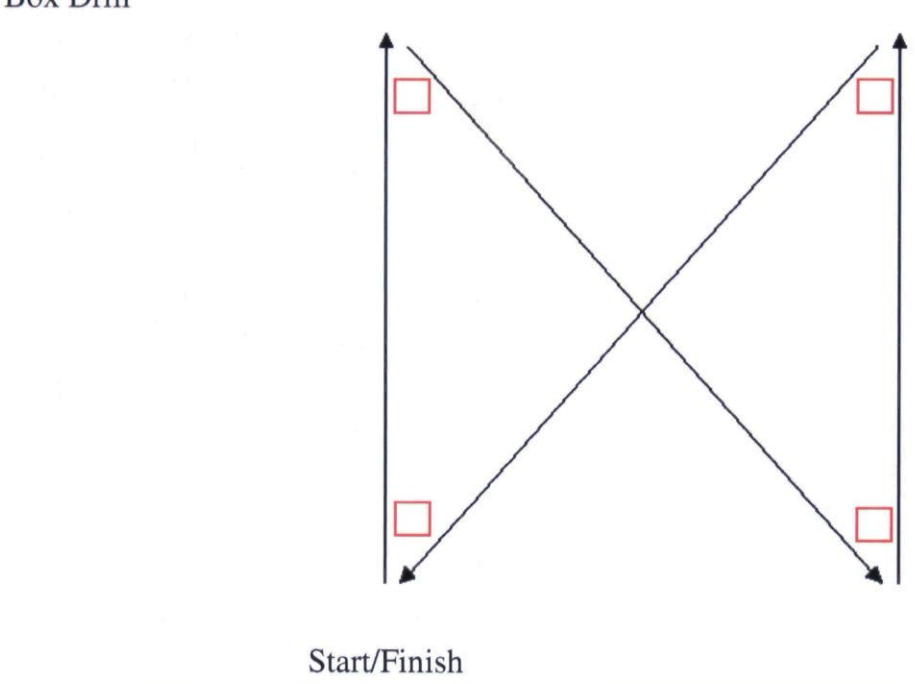

Figure 7. Box drill.

Wheelchair Turns

This drill is an explosive, short distance sprint with a 180° turn. Emphasize the start to build speed as quickly as possible. Sprint for 10 feet and quickly turn 180° to sprint back to the start. At the starting line, stop immediately and emphasize the stop.

Box Drill (Recommended Distance between Cones Is 10 Feet)

This drill is an explosive, short-distance sprint with 3 sharp turns (follow the arrows in Figure 7). Start in the bottom right corner and follow the arrows around the cones. Emphasize the start to build speed as quickly as possible. At the finish line, stop immediately, emphasizing the stop.

Cardiovascular/Endurance Training

Cardiovascular fitness and training are important in any sport, especially sports involving high-demand nonstop action (4, 7). A large emphasis of preseason training should be dedicated to increasing one's cardiovascular fitness. For the wheelchair athlete, this includes many nonstop wheelchair pushing drills. This can also be achieved through circuit training. Circuit training is the combination of many anaerobic exercises performed consecutively, with very minimal to no rest in between, to achieve a cardiovascular training effect (4, 7). The athlete should strive to complete 2 of the following tasks at each cardiovascular workout. By varying the combinations of activities, the athlete can minimize the onset of boredom associated with long-term training.

Laps/Coopers

Place cones on the corners of the court. Propel as fast as possible around all 4 cones. Start at 5 to 10 minutes and progress to 20 continuous minutes. Change directions every 5 minutes.

Hand Cycle

Sit in front of the machine grasping the handles. The handles should be at or below shoulder level to reduce the risk of injury. Set the resistance at a level in which the athlete can propel continuously. Start at 5 to 10 minutes and progress to 20 minutes. Change directions (forward versus backward) every 5 minutes.

Figure Eights

This drill is a combination of sprinting and easy propulsion. Place 4 cones in the corners of the court as shown in the Fig-

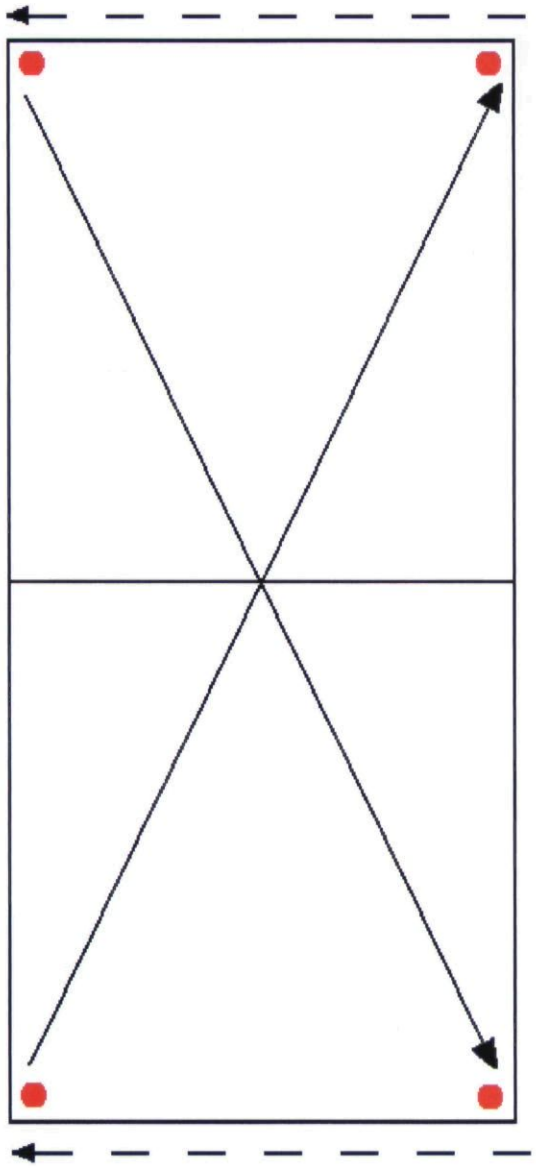

Figure 8. Figure eights.

ure 8. Start at the bottom left corner of the court and sprint as fast as possible to the top right corner of the court (solid line). Go around the cone and easily propel to the cone in the top left (dashed line). Then, sprint to the cone at the bottom right of the court (solid line) and easily return to the original cone (dashed line). Repeat for about 10 to 15 minutes.

Suicides

Starting at the baseline, sprint one-fourth the length of the court, turn 180° and return to the baseline. Without stopping, sprint to one-half court, turn 180°, and return to the baseline. Without stopping, sprint three-fourths the length of the court, turn 180° and return to the baseline. Finally without stopping, sprint the full length of the court, turn 180°, and return to the baseline.

Summary

This exercise program is designed to enhance the disabled athlete's flexibility, strength, and endurance. The needs of the physically challenged athlete can be met with implementation of the same basic concepts used by able-bodied athletes. This exercise program is by no means the only program that can be successful for the rugby athlete. There are many other exercises and activities that could be helpful. However, the athlete is strongly advised to seek qualified medical advice prior to implementing any exercise program. ♦

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