

Harnessing Science and Technology to Prevent Injuries in Sports: A Case Study of Gymnastics

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Abstract

Sports management is undergoing a transformation, with increasing dependence on principles of science and technology to enhance the effectiveness and efficiency of the sports players. Technology as an enabler has helped sports personnel achieve their optimal performances and ensure personal glorification. This paper highlights use of science and technology to reduce sports injuries and their management. Strategies for reducing injuries have been highlighted, using one of the most injury prone sports of Gymnastics as an illustration.

Keywords: Sports Injuries, Gymnastics, Sports Management.

I. INTRODUCTION

Learning rate and level of technical skills in sports are closely associated with maintaining balance. It is important to keep the whole body in balance and to maintain this balance when learning the movements and changing positions rapidly to prevent injuries. Sports science is the application of scientific principles to exercise and sport. Biomechanics, which explores the causes and effects of human movement and the way in which the body interacts with exercise equipment's, is an interdisciplinary field of physiology, engineering, psychology and other inter-dependent disciplines. Gymnastics is one of the hardest games, which has intertwined science and technology in order to improve the performance of its players. The scientific principles and concepts like "Therbligs" require not only innate amounts of strength, but also grace, flexibility, endurance, balance, speed, control, mental strength like focus. Gymnasts must train vigorously to develop the technical skill and refinement necessary for their sport. Older gymnasts who have been on the international scene for a while tend to incorporate more rest because they have already achieved the basic skills necessary to compete on the international level, and can get by with fewer hours, which is easier on their bodies especially as they get older. However, principles of bio-physical continue to govern training of the sports persons.

II. GYMNASTICS: AN INJURY PRONE SPORT

Gymnasts need to develop complex motor coordination that is associated with the technical accuracy, strength, endurance, speed, flexibility and persistence needed to withstand long hours of training. One of the most serious problems faced by contemporary gymnasts is the occurrence of injury (Sands, 2000). One of the aims of sports biomechanics is to prevent injury (Zatsiorsky, 2000). Gymnastics is rated among the highest in injury-related sports. Throughout the development of the game of Gymnastics, the moves and the demands of the competition have increased a great deal. With the increases of stress on the body, of course, comes an increased risk of injuries. So the precautions must be taken to try to avoid injuries.

One of these precautions is an extensive amount of stretching. The most important time to stretch is before practice. It is recommended that half an hour of intense stretching is completed during every practice session. Some of major muscles should be given a priority. They are legs which includes the hamstrings, ankle and the Achilles tendon. Other main muscles are the shoulders, hip, neck, back and abdominal muscles. The upper body is used as a weight bearing joint in gymnastics. Hence, injuries to the shoulder, elbow and wrist are common and may include wrist sprains, elbow dislocation, superior labrum, and anterior-posterior lesions in the shoulder.

It is equally important to stretch during the practice session. As you wait for a turn on the event, your muscles get cold and frightens up. Instead of doing nothing, you should stay warm and stretch your body parts randomly.

Besides to stretching before practice, stretching after practice is also very important as well. A good relaxed post-practice stretch is excellent for all the body parts and muscles 15 to 20 minutes is enough time to quickly run through your tired and tight muscles. Stretching the muscles after practice is important because they are tight, especially after an intense frowning session. Cardiovascular elements at the beginning of workout are good to get the blood flowing and prepare for workout.

Another important way to avoid injuries is to do a half hour of strength conditioning after practice. Strength in Gymnastics is a necessity because if your muscles and hear surrounding tissues are not well developed, it is easier for injuries to occur. During conditioning it is important that you push your muscles to their fullest, making them burn and hurt. When this happens, you

know that you are developing stronger muscle tissue. Goals should be set for every practice and conditioning session when goals are set, your strength increases further.

Body awareness also plays an important role in preventing injuries. If you feel pain in a certain body area during practice, relaxation assumes importance so as not to aggravate it further. The ultimate aim of scientific management of the training is to protect the players from injuries, not burden them with stress. If an injury is ignored, the long term cut come could result in a career threatening injury. Working with pain could lead to surgery or rehabilitation.

A proper diet also helps keep the body healthy and strong. Eating balanced diet properly, will lead to increase in energy level, which will remain constant throughout the practice session. A constant energy will be stored evenly throughout your body for practice while storing some for conditioning. Improper dieting may leave the gymnast full of energy at the beginning of practice, but by the end of practice there is nothing in storage, resulting in being burnt out. It is at this threshold stage that the chances of injuries greatly increase.

III. IMPORTANCE OF SCIENTIFIC TRAINING

One of the best ways of preventing injuries is to have continuous access to a physical therapist or sports trainer. A sports trainer can come in very helpful during practice as questions arise about your injuries. Sports trainer can monitor progress and way you workout. They can advise about conditioning or stretching moves to problem area. The emerging domain of using principles of fluid mechanics and laws of motion to rhythmic gymnastics has led to a significant drop in career threatening injuries.

Today, gymnasts put a tremendous amount of stress and demand on their bodies, but injuries have started to decline due to the research and knowledge of their causes. To do some meditation, exercise also very helpful to reduce the stress and make a gymnast emotionally strong which leads to help to reduce the chances of injuries. Increased popularity of Yoga as a tool of meditation and developing innate self has led to integration of ancient techniques being adapted to develop newer postures in gymnastics.

Many of the skills can be adapted to become exercises themselves for the very young. For instance, simply rocking back and forth on your back helps to strengthen the abdominals. Push ups against the wall by standing one foot away and leaning onto the wall is a good progression for strength development. Just hanging from a bar in tuck position works hip flexors and abdominals. It requires immense strength in every single muscle strand in the entire body, and if one is slightly weak in one area, could tear the whole ligament or muscle.

IV. COMMON SPORTS INJURIES AND THEIR TREATMENTS

More conditioning and strength training is usually done in the 'off-season' during which there are few or no competitions, and more routines are performed during the competitive season to ensure the ability to safely execute the routines and earn a high score. Thus, a pattern of injuries can be expected with the progression of the training regime.

- Labral tears may occur during any gymnastic exercise, but ring and bar specialists seem particularly vulnerable. It is characterized by pain that initially resolves but tends to recur with return to sport. Inspection of equipment to ensure that it is in good condition, including padded floors, secured can significantly reduce the chances of injury. To prevent them, practices should be designed to do tumbling, bars, vault and beam tumbling early and beam and floor dance and conditioning at the end of practices.
- In gymnastics, the wrist is subjected to forces that can exceed twice the body weight. The first step in treating wrist pain is to reduce the training volume of the athlete, relieve symptoms, and to participate in only pain-free activities. If the gymnast is experiencing pain with non-gymnastic activities of daily living, a brace or cast to immobilize the wrist is recommended. Wearing safety gear whenever competing or training special equipment may include wrist guards, hand grips, footwear, ankle or elbow braces, and pads
- Anterior Cruciate Ligament (ACL) injuries can result when a gymnast lands short or is over-rotated while tumbling, dismounting, or vaulting. A pop may be heard or felt followed by knee swelling with hours. The muscles adapt to the demands of the sport and develop the ability to withstand the high volume and frequency of training. Gymnasts should not typically go all out to fatigue themselves like a weightlifter would, at least not on a regular basis. Most do not do hard conditioning consecutive days in a row. They should ensure 'harder' training days interspersed with 'easier' days in the week. They should taper conditioning work before major competitions so their muscles are fresh, doing something like half the usual volume (otherwise they would not maintain enough conditioning to get through the routines).
- Gymnasts can suffer from a variety of injuries to the Achilles tendon located just above the back of the heel, as a result of the repetitive stress of jumping and landing. Achilles tendinitis results in calf soreness that is aggravated with jumping and landing. Treatment should initially consist of ultrasound, stretching, activity modification, and calf exercises. There are ways to ameliorate the negative factors in a longer practice – breaks, a wide variety in practices

from day to day to avoid boredom and loss of concentration and scheduling the practice to go from the most active and dangerous activities to activities that require less energy and concentration. For example, starting with tumbling on the competition floor in the beginning of practice and progressing through practice to the rod floor (softer and easier), tumble tramp and then tumbling into the pit and trampoline near the end of practice. This type of practice plan allows more margin of error later in the practice than in the beginning when the gymnast was fresher and more energetic.

- Injuries to the foot and ankle are common in gymnastics. Acute injuries are usually sprains, which can be minor or more serious. Swelling, bruising and tenderness directly over the bones are signs of a more serious injury. Minor injuries typically have tenderness limited to one side of the joint without significant swelling. Protection with taping or abrace can aid recovery and reduce the risk for reinjury. Chronic ankle pain or repeated injuries are worrisome and require evaluation before continuing with participation.
- The cause of low-back pain can include muscle strain, ligament sprain, fracture, and/or disc disorders. Frequently, low-back pain will worsen with activity, especially with extension movements, such as arching the shoulders backwards. Low-back pain in gymnasts related to muscular strain or ligament sprain usually responds to withstand physical therapy exercises. Gymnasts need to adapt to the needs of their sport. Because upper body strength and control is more challenging and less natural for most athletes to develop, more time is generally spent on it during physical preparation. Gymnasts are expected to have a certain strength-to-weight ratio in order to safely be able to perform the skills and remain aesthetically pleasing. Their body fat percentage is much more important than their weight. The upper body is usually the more challenging aspect to develop as the human body was not designed to walk around and 'jump' off its hands like gymnasts do. The shoulders are asked to function almost like hips do when you stand. That is why gymnasts are famous for their enormous shoulders. The study by Sands and McNeal (2006) have shown that by turning the hands inward during back handspring the gymnasts, particularly females, can reduce the problem of injuring an elbow (due to the carrying angle) and reduce the risk of damage to the wrist (by reducing wrist hyperextension). Warm up muscles with light aerobic exercise, such as jumping jacks or running in place, before beginning training or new activities can significantly reduce the risk. Has proposed a model to integrate social-cognitive, motivational, bio-psychological and learning theories to demonstrate its utility in developing effective interventions to promote physical activity.

V. CONCLUSIONS

It is hypothesized that targeted injury prevention strategies, based on biomechanical analyses, have the potential to help reduce the incidence and severity of gymnastics injuries (Bradshaw & Hume, 2012). A scientific training regime will mandate spending efforts at developing the strength, flexibility, body control, coordination and skills needed to compete. Application of principles of science and appropriate use of technology to monitor the progress can lead to gaining sustainable competitiveness in sports. Strains and sprains involving the back, particularly the lumbar region, appeared to occur more frequently than in most other interscholastic athletic activities. Preventive efforts need to incorporate more neuromuscular training and core stability programs in the off-season and preseason conditioning to enhance proper landing and skill mechanics. Equipment manufacturers should be encouraged to reevaluate the design of the landing mats to allow for better absorption of forces.

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